AMERICAN LITTORAL SOCIETY – ANIMAL LEGAL DEFENSE FUND – ANIMAL WELFARE INSTITUTE – CAPE FEAR RIVER WATCH – CENTER FOR A SUSTAINABLE COAST – CENTER FOR BIOLOGICAL DIVERSITY CET LAW – CLEAN OCEAN ACTION – COASTAL CONSERVATION LEAGUE – CONSERVATION LAW FOUNDATION – COOK INLETKEEPER – DEFENDERS OF WILDLIFE – THE DOLPHIN PROJECT – EARTH LAW CENTER – EARTHJUSTICE – ENVIRONMENT GEORGIA – THE HUMANE SOCIETY OF THE U.S. – INITIATIVE TO PROTECT JEKYLL ISLAND – INTERNATIONAL FUND FOR ANIMAL WELFARE – MATANZAS RIVERKEEPER – MIAMI WATERKEEPER – NATURAL RESOURCES DEFENSE COUNCIL – NORTH CAROLINA COASTAL FEDERATION – NORTH CAROLINA WILDLIFE FEDERATION – OCEAN CONSERVATION RESEARCH – ONE HUNDRED MILES – ST. JOHNS RIVERKEEPER – SATILLA RIVERKEEPER – SIERRA CLUB – SIERRA CLUB ATLANTIC CHAPTER – SIERRA CLUB CHAPTERS OF FLORIDA, GEORGIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NORTH CAROLINA, SOUTH CAROLINA, AND VIRGINIA – SOUND RIVERS – SOUTH CAROLINA WILDLIFE FEDERATION – SOUTHERN ENVIRONMENTAL LAW CENTER – STOP OFFSHORE DRILLING IN THE ATLANTIC (SODA) – SURFRIDER FOUNDATION – WHALE AND DOLPHIN CONSERVATION – WORLD WILDLIFE FUND

PUBLIC HEARINGS REQUESTED

By Electronic Mail

July 21, 2017

Ms. Jolie Harrison
Chief, Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
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Re: *Proposed incidental harassment authorizations for seismic surveys in the Atlantic Ocean*

Dear Ms. Harrison:

On behalf of the Natural Resources Defense Council ("NRDC"), Center for Biological Diversity, Earthjustice, Southern Environmental Law Center, American Littoral Society, Animal Legal Defense Fund, Animal Welfare Institute, Cape Fear River Watch, Center for a Sustainable Coast, Cet Law, Clean Ocean Action, Coastal Conservation League, Conservation Law Foundation, Cook Inletkeeper, Defenders of Wildlife, The Dolphin Project, Earth Law Center, Environment Georgia, The Humane Society of the U.S., Ocean Conservation Research, Initiative to Protect Jekyll Island, International Fund for Animal Welfare, Matanzas Riverkeeper, Miami Waterkeeper, North Carolina Coastal Federation, North Carolina Wildlife Federation, Ocean Conservation Research, One Hundred Miles, St. Johns Riverkeeper, Satilla Riverkeeper, Sierra Club, Sierra Club Atlantic Chapter, Sierra Club Florida Chapter, Sierra Club Georgia Chapter, Sierra Club Maine Chapter, Sierra Club Maryland Chapter, Sierra Club Massachusetts Chapter, Sierra Club New Jersey Chapter, Sierra Club North Carolina Chapter, Sierra Club South Carolina Chapter, Sierra Club Virginia Chapter, Sound Rivers, South Carolina Wildlife Federation, Stop Offshore Drilling in the Atlantic ("SODA"), Surfrider Foundation, Whale and Dolphin Conservation, and World Wildlife Fund, and our millions of members, many thousands of whom reside along the Atlantic coast, I write to express our serious concern over NMFS' proposal to authorize five industrial seismic surveys off the east coast of the United States. 82 Fed. Reg. 26,244 (June 6, 2017) [hereinafter "Proposed IHAs"].

The proposed authorizations fail to meet the standards prescribed by the Marine Mammal Protection Act ("MMPA"). Further, they fail in ways and to an extent that cannot be remedied through the issuance of final Incidental Harassment Authorizations ("IHAs"). Accordingly, we urge NMFS to withdraw the proposed authorizations and revise its analysis consistent with the agency's statutory obligations.

Our organizations are profoundly concerned about the harm to marine mammals from the proposed high-energy seismic surveys in the Atlantic Ocean. 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 injure, devastate, and undermine fundamental behaviors in marine mammal prey species. Given the scales involved, a survey taking place off the coast of Virginia may well harm endangered species from southern New England down through the Carolinas, affecting, for example, the entire migratory range of the endangered North Atlantic right whale.

And the degree of activity proposed by the pending applications is enormous. Collectively, the five private applicants have proposed to run very high-powered seismic airgun arrays over more than 92,500 miles of trackline over the next year alone, with as many as six seismic vessels operating at any one time. The Bureau of Ocean Energy Management ("BOEM") anticipates that applicants will shoot hundreds of thousands of additional miles of survey line over the next several years. It is no exaggeration to say that the proposed activity, beginning with the five applications pending here, will significantly degrade the acoustic environment of the Atlantic Outer Continental Shelf ("OCS") region.

Numerous commentators, including the National Oceanic and Atmospheric Administration ("NOAA"), have observed that such impacts, when experienced repeatedly and at the geographic scale of populations, can readily accumulate to population-level harm.[1] In the case of the North Atlantic right whale, these risks are particularly acute. The best available science indicates that the North Atlantic right whale is now declining in number,[2] leading twenty-eight right whale experts—among them some of the world's leading authorities on this endangered species—to warn that "[t]he additional stress of widespread seismic airgun surveys may well represent a tipping point for the survival of this endangered whale, contributing significantly to a decline towards extinction."[3] Populations that are resident or seasonally resident to the survey area, such as beaked whales off North Carolina, are also intensely vulnerable to population-level effects as a result of the cumulative nature of the noise exposure and the additional harm that may be caused by habitat displacement.[4]

The MMPA is a conservative statute. It requires that NMFS, in authorizing harm, first meet a number of basic, protective standards: that only "small numbers" of marine mammals will be taken, that the impacts on those species and populations will be "negligible," and that, through mitigation, the "least practicable adverse impact" on marine mammals and their habitat is achieved. 16 U.S.C. § 1371(a)(5)(D). At every step, the agency must use the "best scientific evidence available." *See, e.g.*, 16 U.S.C. § 1373(a). The Proposed IHAs fall short of these standards. NMFS hews to outdated positions that are no longer scientifically valid; and it makes summary findings that tend to understate impacts and, consequently, to rationalize the proposed actions. It applies a definition of "small numbers" that runs counter to the plain meaning and purpose of the MMPA; determines that impacts will be "negligible" by treating each proposed airgun survey as though it were the only activity taking place in the region; fails to prescribe mitigation sufficient to ensure that the surveys have the "least practicable adverse impact" on marine mammals and their habitat, or that they meet any other standard; and inappropriately proposes using the incidental harassment authorization process for an activity that has the potential to kill.

For all these reasons, and for those provided below, we urge NMFS to withdraw the proposed authorizations.

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[1] *E.g.*, Convention on Biological Diversity, Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats (2012) (UN Doc. UNEP/CBD/SBSTTA/16/INF/12); Gedamke, J., Harrison, J., Hatch, L., Angliss, R., Barlow, J., Berchok, C., Caldow, C., Castellote, M., Cholewiak, D., De Angelis, M.L., Dziak, R., Garland, E., Guan, S., Hastings, S., Holt, M., Laws, B., Mellinger, D., Moore, S., Moore, T.J., Oleson, E., Pearson-Meyer, J., Piniak, W., Redfern, J., Rowles, T., Scholik-Schlomer, A., Smith, A., Soldevilla, M., Stadler, J., Van Parijs, S., and Wahle, C., Ocean Noise Strategy Roadmap (2016).

[2] Pettis, H.M., and Hamilton, P.K., North Atlantic Whale Consortium annual report card: Report to the North Atlantic Right Whale Consortium, November 2016 (2016).

[3] Statement from C. Clark, S. Kraus, D. Nowacek, A. J. Read, A. Rice, H. C. Rosenbaum, M. Baumgartner, I. Biedron, M. Brown, E.A. Burgess, T. Frasier, C. Good, P. Hamilton, M. Johnson, R. D. Kenney, A. Knowlton, N. S. Lysiak, C. Mayo, W. A. McLellan, B. MacLeod, C. A. Miller, M. J. Moore, D. A. Pabst, S. Parks, R. Payne, D. E. Pendleton, D. Risch, and R. Rolland to the President of the United States (Apr. 14, 2016).

[4] Forney, K.A., Southall, B.L., Slooten, E., Dawson, S., Read, A. J., Baird, R. W., and Brownell, Jr., R. L., Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity, *Endangered Species Research* 32: 391-413 (2017).

We also urge NMFS to hold public hearings on its proposed actions. Seismic activities harm a wide range of species, from the great whales to the small zooplankton on which those whales depend. High-powered airgun blasts drive marine mammals from their habitat and impede their communication and foraging, among other critical life functions, over large areas of ocean. And the proposed surveys may well be the tipping point for critically endangered species like the North Atlantic right whale. The harm to wildlife is one reason for the broad and intense public engagement in the region over seismic surveys. More than 100 municipalities from New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida have debated, held hearings on, and adopted resolutions opposing seismic exploration off their coasts.[5] Numerous recreational and commercial fishing associations, from the Southern Shrimp Alliance to the International Game Fish Association, have issued statements expressing their concerns.[6] These concerns are mirrored by the Mid-Atlantic and South Atlantic Fisheries Management Councils, which are also opposed to the introduction of industrial seismic activities off the east coast.[7] Tens of thousands of small businesses and numerous chambers of commerce and tourism boards along the coast are now organized in opposition.[8]

The scientific community, too, has expressed serious concerns about the proposed actions. For example, seventy-five marine scientists submitted a statement in March 2015 to President Obama on the activity's impacts, and, as noted above, twenty-eight specialists on the North Atlantic right whale produced a statement in April 2016 concerning that species.[9] And this is to say nothing of the committed engagement of the local, regional, and national environmental communities.

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[5] Copies of the resolutions are included in the attachments to these comments. A hyperlinked list of all the resolutions is available at http://usa.oceana.org/climate-and-energy/grassroots-opposition-atlantic-drilling-and-seismic-airgun-blasting.

[6] *See*, *e.g.*, Letter from John Williams, Executive Director, Southern Shrimp Alliance, to Abigail Ross Hopper, BOEM (June 24, 2016); Letter from Jason Schratwieser, Conservation Director, International Game Fish Association (May 1, 2014).

[7] Letter from Christopher M. Moore, Executive Director, Mid-Atlantic Fisheries Management Council, to Gary D. Goeke, BOEM (May 2, 2014); Letter from Ben Hartig, Chairman, South Atlantic Fisheries Management Council, to Gary D. Goeke, BOEM (Apr. 30, 2015).

[8] See, e.g., Letter from Frank Knapp, Jr., President, Business Alliance for Protecting the Atlantic Coast , to Ryan Zinke, Secretary of the Interior (Apr. 28, 2017) (representing more than 41,000 businesses and 500,000 commercial fishing families); Letter from Melanie Pursel, Executive Director, Greater Ocean City, MD Chamber of Commerce, to President Barack Obama (Dec. 13, 2016); Resolution of Carteret County [North Carolina] Chamber of Commerce (adopted Sept. 5, 2015) (opposition to seismic blasting reaffirmed Apr. 25, 2016).

[9] Statement from C. Clark and 74 other marine scientists to the President of the United States (Mar. 5, 2015) (concerning the impacts of proposed seismic surveys on the mid-Atlantic and South Atlantic region); Statement from C. Clark, S. Kraus, D. Nowacek, A. J. Read, A. Rice, H. C. Rosenbaum, M. Baumgartner, I. Biedron, M. Brown, E.A. Burgess, T. Frasier, C. Good, P. Hamilton, M. Johnson, R. D. Kenney, A. Knowlton, N. S. Lysiak, C. Mayo, W. A. McLellan, B. MacLeod, C. A. Miller, M. J. Moore, D. A. Pabst, S. Parks, R. Payne, D. E. Pendleton, D. Risch, and R. Rolland to the President of the United States (Apr. 14, 2016) (providing new scientific information regarding the decline of North Atlantic right whales and describing the significant risk that seismic surveys pose to this declining population).

The broad public engagement on this issue is reflected in strong, bipartisan congressional opposition to seismic surveys in the Atlantic, including from states whose coasts and coastal environments would be most directly affected.[10] NMFS has held hearings in the past on incidental take authorizations of substantial public interest, and the seismic surveys proposed in this case have generated as much public concern and attention as any activity the agency has had to address. We therefore call on the agency to hold hearings in coastal communities in the mid- and southeast Atlantic.

I. BACKGROUND

A. The Marine Mammal Protection Act

Congress enacted the Marine Mammal Protection Act ("MMPA") because "certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities." 16 U.S.C. § 1361(1). The statute seeks to ensure that species and population stocks are not "permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part," and do not "diminish below their optimum sustainable population." *Id.* § 1361(2); *see also Conservation Council for Hawaii v. Nat'l Marine Fisheries Serv.*, 97 F. Supp. 3d 1210, 1216 (D. Haw. 2015). Congress intended for NMFS to act conservatively in the face of uncertainty when authorizing activities harmful to marine species. H.R. Rep. No. 92-707 (Dec. 4, 1971), *as reprinted in* 1972 U.S.C.C.A.N. 4144, 4148. This careful approach to management was necessary because of the vulnerable status of many species and because it is difficult to measure the impacts of human activities on marine mammals in the wild. 16 U.S.C. § 1361(l), (3).

At the heart of the MMPA is its "take" prohibition, which establishes a moratorium on the capture, harassing, hunting, or killing of marine mammals, and generally prohibits any person or vessel subject to the jurisdiction of the United States from taking a marine mammal on the high seas or in waters or on land under the jurisdiction of the United States. 16 U.S.C. §§ 1362(13), 1371(a). Harassment is any act that "has the potential to injure a marine mammal or marine mammal stock in the wild" or to "disturb a marine mammal . . . by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." *Id.* § 1362(18)(A).

NMFS may grant exceptions to the take prohibition. As relevant here, the agency may authorize, for up to a one-year period, the incidental, but not intentional, "taking by harassment of small numbers of marine mammals of a species or population stock" if the agency determines that such take would have only "a negligible impact on such species or stock." *Id.* § 1371(a)(5)(D)(i). The agency must prescribe regulations to ensure the activity has "the least practicable impact on

[10] *See, e.g.*, Letter from 103 Members of the U.S. House of Representatives to Ryan Zinke, Secretary of the Interior (June 28, 2017) (opposing Secretary Zinke's Secretarial Order to move forward with offshore oil and gas exploration in the Atlantic and to the subsequent issuance of the proposed IHAs); Letter from 55 Members of the U.S. House of Representatives to President Barack Obama (June 8, 2016) (opposing issuance of permits for seismic exploration in the Atlantic); Letter from 18 Members of the U.S. Senate to President Barack Obama (Apr. 28, 2016) (same).

such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance." *Id.* § 1371(a)(5)(D)(ii)(I). NMFS must also establish monitoring and reporting requirements. *Id.* § 1371(a)(5)(D)(ii)(III).

B. Impacts of seismic airgun testing

The ocean is an acoustic world. Unlike light, sound travels extremely efficiently in seawater; and marine mammals and many fish depend on sound for finding mates, foraging, avoiding predators, navigating, communicating, and raising their young—in short, for virtually every vital life function. When loud sounds are introduced into the ocean, it degrades this essential part of the environment. Some biologists have analogized the increasing levels of noise from human activities to a rising tide of "smog" that has industrialized major portions of the marine environment off our coasts. This acoustic smog is already shrinking the sensory range of marine animals by orders of magnitude from pre-industrial levels.[11]

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.[12] A large seismic airgun array can produce effective peak pressures of sound higher than those of virtually any other man-made source save explosives;[13] 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.[14] 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.[15]

The impacts of airgun surveys are felt on an extraordinarily wide geographic scale, including by baleen and sperm whales, whose vocalizations and acoustic sensitivities overlap most extensively with the enormous low-frequency energy that airguns put in the water. In baleen whales, for example, seismic airguns have repeatedly been shown to disrupt behaviors essential to foraging and mating over vast areas of the ocean, on the order in some cases of 100,000 square

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[11] Statement from 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., 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).

[12] It should be noted that deep-penetration seismic surveys are not used for renewable energy projects.

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

[14] 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).

[15] *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).

kilometers and greater, and across a wide range of behavioral contexts (foraging, breeding, and migrating).[16] Notably, recent work on western North Pacific gray whales has linked seismic exploration, together with shore-based piling, to significant reductions in the probability of calf survival—by about two standard deviations—in that endangered baleen whale population.[17] In sperm whales, airguns have been demonstrated to compromise foraging success at moderate levels of exposure on important feeding grounds; in some areas, it has been found to silence the species over great distances.[18] As numerous commentators have observed, such impacts experienced repeatedly and at the geographic scale of populations can accumulate to population-level harm.[19]

Similarly, seismic surveys are known to elevate background levels of noise, masking conspecific calls and other biologically important signals, compromising the ability of marine wildlife to communicate, feed, find mates, and engage in other vital behavior.[20] 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.[21] Indeed, the enormous scale of this acoustic footprint in some locations has been confirmed by studies in many regions of the globe, including the Arctic, the northeast Atlantic, Greenland, and Australia, where it has been shown to

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[16] *E.g.*, Castellote, M., Clark, C.W., and Lammers, M.O., Acoustic and behavioural changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise, *Biological Conservation* 147: 115-122 (2012); 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 (2014); Blackwell, S.B., Nations, C.S., McDonald, T.L., Thode, A.M., Mathias, D., Kim, K.H., Greene, C.R., Jr., and Macrander, M., Effects of airgun sounds on bowhead whale calling rates: Evidence for two behavioral thresholds, *PLoS ONE* 10(6): e0125720 (2015).

[17] Cooke, J.G., Weller, D.W., Bradford, A.L., Sychenko, O., Burdin, A.M., Lang, A.R., and Brownell, R.L., Jr., Updated population assessment of the Sakhalin gray whale aggregation based on the Russia-US photoidentification study at Piltun, Sakhalin, 1994-2014 (Nov. 2015) (Western Gray Whale Advisory Panel Doc. WGWAP/16/17).

[18] *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); Bowles, A.E., Smultea, M., Wursig, B., DeMaster, D.P., and Palka, D., Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test, *Journal of the Acoustical Society of America* 96: 2469-2484 (1994).

[19] *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); 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); Nowacek, D.P., Clark, C.W., Mann, D., Miller, P.J., Rosenbaum, H.C., Golden, J.S., Jasny, M., Kraska, J., Southall, B.L., Marine seismic surveys and ocean noise: Time for coordinated and prudent planning, *Frontiers in Ecology and the Environment* 13(7): 378-386 (2015).

[20] Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., and 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).

[21] *Id.*; Guerra, M., Thode, A.M., Blackwell, S.B., Macrander, A.M., Quantifying seismic survey reverberation off the Alaskan North Slope, *Journal of the Acoustical Society of America* 130: 3046-3058 (2011).

raise ambient noise levels and mask whale calls from distances of thousands of kilometers.[22] Even in the Gulf of Mexico, where the bathymetry is generally more complex than in the Atlantic, cumulative ambient noise metrics are elevated in some areas from surveys taking place as far as 500 kilometers away, according to a recent NMFS-directed modeling effort.[23] Notably, while the agency has not conducted a similar analysis for the Atlantic, its modeling effort for the Gulf found that seismic surveys have substantially reduced the sensory range available to virtually all marine mammal species there.[24]

In short, the biological impacts of seismic surveys include, but are not limited to:[25]

- *Disruption of essential vocalizations*. Seismic airgun noise can cause whales to stop producing vocalizations essential to breeding success, individual and cooperative foraging, predator avoidance, and mother-calf interactions.[26]
- *Direct disruption of foraging*. Seismic airgun noise can disrupt feeding behavior and significantly reduces foraging success even in whales that are frequently exposed to airgun noise.[27]
- *Masking and loss of communication space.* Seismic airgun noise can shrink the space whales need to communicate with their conspecifics, interfering over a vast scale with foraging, breeding, mother-calf contact, and other essential behavior. The noise also interferes with the animals' ability to hear other biologically important sounds.[28]

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[22] 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., et al., Sounds from airguns and fin whales, *supra*; Nieukirk, S.L., et al. Low-frequency whale and seismic airgun sounds, *supra*; 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).

[23] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, at K-19 (2016) (NMFS-directed study of cumulative and chronic efforts of geophysical surveys in the Gulf of Mexico).

[24] *Id.* at K-28 to K-31.

[25] For a general review of seismic impacts on marine mammals, see Weilgart, L., A review of the impacts of seismic airgun surveys on marine life (2013) (submitted to the Convention on Biological Diversity Expert Workshop on Underwater Noise and Its Impacts on Marine and Coastal Biodiversity, 25-27 Feb. 2014, London, UK); *see also* Weilgart, L.S., The impacts of anthropogenic ocean noise on cetaceans, *supra*.

[26] *E.g.*, McDonald, M.A., Hildebrand, J.A. and Webb, S.C., Blue and fin whales observed on a seafloor array in the Northeast Pacific, *J. Acoustical Soc'y of America* 98: 712-21 (1995); Di Iorio, L., and Clark, C.W., Exposure to seismic survey alters blue whale acoustic communication, *Biology Letter* 6: 51–54 (2010); Castellote, M., et al., Acoustic and behavioral changes by fin whales, *supra*; Blackwell, S.B., et al., Effects of airgun sounds on bowhead whale calling rates, *supra*; Cerchio S., et al. Seismic surveys negatively affect humpback whale singing activity, *supra*.

[27] *E.g.*, Miller, P.J.O., Using at-sea experiments to study the effects of airguns, *supra*. *See also* Pirotta, E., Brookes, K.L., Graham, I.M. and Thompson, P.M., Variation in harbour porpoise activity in response to seismic survey noise, *Biology Letters* 10(5): 20131090 (2014); Isojunno, S., Curé, C., Kvadsheim, P.H., Lam, F.-P.A., Tyack, P.L., Wensveen, P.J., and Miller, P.J.O., Sperm whales reduce foraging effort during exposure to 1-2 kHz sonar and killer whale sounds, *Ecological Applications* 26(1): 77-93 (2016).

[28] *E.g.*, 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:

- *Large-scale habitat avoidance or abandonment.* Seismic airgun noise can displace marine mammals from preferred feeding, breeding, and migratory habitat, over both the short- and long-term, with potentially serious energetic consequences.[29]
- *Startle response and sensitization.* Seismic airgun blasts, with their extremely rapid onset time, can induce a startle response, sensitizing animals to sound and causing longer-term avoidance.[30]
- *Impacts on prey species.* Seismic airgun noise can kill, injure, and disrupt the behavior of marine mammal prey species, from zooplankton to fish.[31]
- *Temporary and permanent hearing loss.* Seismic airgun noise can induce temporary or permanent hearing loss, impairing the animals' ability to feed, breed, and communicate.[32]
- *Increased injury and mortality risk.* Seismic airgun noise can exacerbate the risk of marine mammal stranding and vessel collision, of mother-calf separation, and of other mechanisms of injury and mortality.[33]
- *Physiological stress.* Seismic airgun noise can induce acute and, over time, chronic physiological stress, which may compromise the health of individual marine mammals and reduce reproductive success.[34]

201-222 (2009); Hatch, L.T., Wahle, C.M., Gedamke, J., Harrison, J., Laws, B., Moore, S.E., Stadler, J.H., and van Parijs, S.M., Can you hear me here? Managing acoustic habitat in U.S. waters, *Endangered Species Research* 30: 171-186 (2016).

[29] *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); Clark C.W., and Gagnon, G.C., Considering the temporal and spatial scales of noise exposures, *supra*; Rosel, P.E., and Wilcox, L.A., Genetic evidence reveals a unique lineage of Bryde's whales in the northern Gulf of Mexico, *Endangered Species Research* 25: 19-34 (2014).

[30] *E.g.*, 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 Neuroscience* 12: 30 (2011).

[31] *E.g.*, McCauley, R.D., Day, R.D., Swadling, K.M., Fitzgibbon, Q.P., Watson, R.A., and Semmens, J.A., Widely used marine seismic survey air gun operations negatively impact zooplankton, *Nature Ecology & Evolution* 1: art. 0195 (2017); Aguilar de Soto, N., Delorme, N., Atkins, J., Howard, S., Williams, J., and Johnson, M., Anthropogenic noise causes body malformations and delays development in marine larvae, *Scientific Reports* 3: art. 2831 (2013).

[32] *E.g.*, 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); NMFS, Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater acoustic thresholds for onset of permanent and temporary threshold shifts (2016) (NOAA Tech. Memo. NMFS-OPR-55).

[33] *E.g.*, Hildebrand, J.A., Impacts of anthropogenic sound, *supra*; Nowacek, D.P., Johnson, M.P., and Tyack, P.L., Right whales ignore ships but respond to alarm stimuli, *Proceedings of the Royal Society of London, Pt. B: Biological Sciences* 271: 227-231 (2004); Cooke, J.G., et al., Updated population assessment of the Sakhalin gray whale aggregation, *supra*; Gray, H., and Van Waerebeek, K., Postural instability and akinesia in a pantropical spotted dolphin, *Stenella attenuate*, in proximity to operating airguns of a geophysical seismic vessel, *Journal for Nature Conservation* 19: 363-67 (2011).

- *Loss in cetacean biodiversity.* Seismic airgun noise is associated over the long term with a loss in the biodiversity of cetacean species.[35]

The same high-intensity pulses can also affect non-marine mammal taxa and the communities that depend on them. For example, airguns have been shown to dramatically decrease catch rates of various commercial and recreational fish species (such as cod, haddock, pollock, and tuna), by 40–80% in some conditions, over thousands of square kilometers around a single array, indicative of substantial horizontal and/or vertical displacement.[36] One study found higher fish populations outside a seismic shooting area, indicating what is described as a "long-term" effect of seismic activity displacing fish away from these sound sources.[37] Decreased catch rates have led fishers in British Columbia, Norway, Namibia, and other jurisdictions to seek compensation for their losses from the industry.[38] Other effects on fish, derived from tests involving both seismic airguns and other low-frequency noise sources, include habitat abandonment, chronic stress, reduced reproductive performance, and hearing loss.[39] Even brief playbacks of predominantly low-frequency noise from speedboats have been shown to significantly impair the

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[34] *E.g.*, 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 Soc'y. B* 279(1737): 2363-2368 (2012).

[35] Parente, C.L., Araújo, J.P., and Araújo, M.E., Diversity of cetaceans as tool in monitoring environmental impacts of seismic surveys, *Biota Neotropica* 7(1): 49-55 (2007). *See also* Shannon, G., McKenna, M.F., Angeloni, L.M., Crooks, K.R., Fristrup, K.M., Brown, E., Warner, K.A., Nelson, M.D., White, C., Briggs, J., McFarland, S., and Wittemyer, G., A synthesis of two decades of research documenting the effects of noise on wildlife, *Biological Reviews* 91: 982-1005 (2016).

[36] 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., Effekter av seismiske undersøkelser på fiskefordeling og fangstrater for garn og line i Vesterålen sommeren 2009 [Effects of seismic surveys on fish distribution and catch rates of gillnets and longlines in Vesterålen in summer 2009], *Fisken og Havet*: 2-2010 (2010) (Institute of Marine Research Report for Norwegian Petroleum Directorate); 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).

[37] 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).

[38] *See, e.g.,* British Columbia Seafood Alliance, Fisheries and offshore seismic operations: Interaction, liaison, and mitigation: The east coast experience (2004), *available at* bcseafoodalliance.com/documents/ Canpitt.pdf (accessed July 2017); Anonymous, Presentation given at the Benguela Current Commission 5th Annual Science Forum: Key issues and possible impacts of seismic activities on tunas, for the Large Pelagic and Hake Longlining Association in Namibia (Sept. 24, 2013) (provided to NRDC by the Namibian Ministry of Fisheries and Marine Resources).

[39] *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, Australian Petroleum Production Exploration Association CMST 163: Report R99-15 (2000); 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).

ability of some fish species to forage.[40] Most recently, a study showed that most zooplankton species—which serve a vital function as prey species in the ocean ecosystem—[41] were decimated within a 1.5-mile swath around a single 150 in^3 airgun.[42] Contextually, the past few years have seen expansive research on the impacts of anthropogenic noise on fish and invertebrates—summarized at section II.B.4 of the present letter—and a concomitant increase in management concern in both the United States and Europe.

For these reasons and others, a group of seventy-five marine scientists—including leading experts in marine bioacoustics from Cornell, Duke, and other major research institutions—concluded that the introduction of extensive seismic prospecting off the mid-Atlantic and southeast coasts "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."[43] Their expert assessment was that a "negligible impact" finding, *i.e.*, a finding that these activities would have "only a negligible impact on marine species and populations," is "not supported by the best available scientific evidence."

C. The proposed authorizations

In this single notice, NMFS has proposed issuing incidental take authorizations to five independent seismic surveys, per the applications of seismic companies Spectrum Geo ("Spectrum"), TGS-NOPEC ("TGS"), ION GeoVentures ("ION"), WesternGeco ("Western"), and CGG. Three of the applications, from Spectrum, TGS, and ION, were opened for public comment in 2015; the two others, from WesternGeco and CGG, were added in the interim (*see* Proposed IHAs at 26245); and BOEM reports that an additional airgun survey application and an another proposing a high-resolution bottom mapping survey—using a unusually powerful multibeam echosounder that is the most probable cause of a mass mortality of melonheaded whales—[44] are pending before that agency under the Outer Continental Shelf Lands Act.[45]

As noted in the introduction, the five proposed surveys represent a breathtakingly vast survey effort: in aggregate, over 92,000 linear miles of trackline running from the New Jersey/ Delaware border in the north to central Florida, just south of Orlando, in the south. Proposed IHAs at 26250. These overlapping surveys, add up to the equivalent of more than 900 full days and

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[40] Purser, J., and Radford, A.N., Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (Gasterosteus aculeatus), *PLoS One* 6(2): e17478 (2011).

[41] Landry, M.R., A review of important concepts in the trophic organization of pelagic ecosystems, *Helgoländer Wissenschaftliche Meeresuntersuchungen* 30(1): 8-17 (1977).

[42] McCauley, R.D., et al., Widely used marine seismic survey air gun operations negatively impact zooplankton, *supra*.

[43] Statement from C. Clark et al. and 74 other marine scientists (Mar. 5, 2015), *supra*.

[44] Southall, B.L., Rowles, T., Gulland, F., Baird, R. W., and Jepson, P.D., 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) (BOEM-sponsored investigation).

[45] BOEM, Currently submitted Atlantic OCS Region permits, available at https://www.boem.gov/Currently-submitted-Atlantic-OCS-Region-Permits/ (accessed July 2017).

nights of seismic activity over the next year, with multiple surveys taking place at the same time. *Id.* at 26246. All would use large arrays ranging from 4808 in^3 to 6420 in^3, consisting of some 24 to 40 guns. BOEM expects this initial spate of authorizations to kick off many more years of geophysical prospecting, with another 290,000 track miles of 2D surveying anticipated over the next six years, in addition to higher-density 3D surveys across some 3400 lease blocks.[46]

NMFS's authorization process was suspended in January, after BOEM denied the companies' survey permit applications. BOEM had found that "deep-penetration seismic airgun surveys come with an environmental burden" and that "the potential disadvantage to this small, critically endangered, and declining population [of right whales] is not worth the risk."[47] But the process was soon revived by a new administration committed to expanding offshore oil and gas development. On April 28, 2017, President Trump issued an Executive Order directing the Interior and Commerce Departments to "expedite all stages of consideration of Incidental Take Authorization requests, including Incidental Harassment Authorizations and Letters of Authorization, and Seismic Survey permit applications under the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 et seq., and the Marine Mammal Protection Act, 16 U.S.C. 1361 et seq."[48] That directive was shortly followed by a secretarial order from Secretary of the Interior Ryan Zinke, institutionalizing the President's mandate for expedition.[49] BOEM rescinded its denials of the seismic survey permits on May 10, 2017,[50] and less than a month later, on June 6, NMFS published the proposed authorizations that are subject of these comments.

II. NMFS' FAILURE TO COMPLY WITH THE MARINE MAMMAL PROTECTION ACT

A. NMFS' preliminary finding that the proposed activities would take "small numbers" of marine mammals would, if adopted, be arbitrary and capricious and in violation of law.

NMFS' proposed take limit of 30% of an estimated population is not a "small number," either under the plain reading of that phrase or when considered against the MMPA's species-protective purpose. Nor is it small in the context of the vulnerable populations of endangered and threatened species that will be affected by seismic blasting in the Atlantic.

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[46] BOEM, Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas: Final Programmatic Environmental Impact Statement, at Table 3-3 (2014) (OCS EIS/EA BOEM 2014-001) [hereinafter "PEIS"].

[47] Memorandum from Abigail Ross Hopper, Director of BOEM, to Michael Celata, BOEM Regional Director for the Gulf of Mexico (Jan. 5, 2017).

[48] Executive Order No. 13795, Implementing an America-First Offshore Energy Strategy, 82 Fed. Reg. 20815 (Apr. 28, 2017).

[49] Department of the Interior Secretarial Order No. 3350, America-First Offshore Energy Strategy (May 1, 2017).

[50] Memorandum from Walter Cruikshank, Acting Director of BOEM, to Michael Celata, BOEM Regional Director for the Gulf of Mexico (May 10, 2017).

1. The agency's interpretation of "small numbers" is contrary to the plain meaning and purpose of the MMPA

The MMPA allows NMFS to authorize takes of "small numbers" of marine mammals under certain conditions. 16 U.S.C. § 1371(a)(5)(D)(i). The statute does not define this term, but the "small numbers" requirement is distinct from the agency's "negligible impact" analysis. *See, e.g.*, *Center for Biological Diversity v. Salazar*, 695 F.3d 893, 903-04 (9th Cir. 2012).

Here, NMFS proposes to authorize take of "30 percent of a stock abundance estimate," with a caveat that the number is not "a hard and fast cut-off." Proposed IHAs at 26,295. The agency asserts that a "relative approach to small numbers" is permissible, citing the Ninth Circuit Court of Appeals' reasoning in *Center for Biological Diversity v. Salazar*. Proposed IHAs at 26,295. Even if a relative approach comports with the statute, however, the agency must provide a reasoned basis for the take limit that it establishes. *See Center for Biological Diversity*, 695 F.3d at 906, 907 (accepting NMFS' interpretation of the standard provided that "it is reasonable"); *see also Natural Res. Def. Council v. EPA,* 966 F.2d 1292, 1306 (9th Cir.1992) (EPA's exclusion from regulation of a category of stormwater dischargers was arbitrary because the agency provided no data supporting its decision to increase the discharge site limit from one to five acres). Yet NMFS fails to provide any such reasoning for its finding that harming one out of every three animals—well in excess of the proportions at issue in *Center for Biological Diversity* (*see* 73 Fed. Reg. 33212, 33236-27 (June 11, 2008))—is a "small" number. On the contrary, the agency appears to have plucked a percentage from thin air and applied it uniformly to all affected marine mammals. Far from having a rational basis, NMFS' interpretation of "small numbers" runs counter to the plain meaning of the MMPA and to the statute's protective purpose.

First, the agency's choice of "30 percent of a stock abundance estimate" is inconsistent with the plain meaning of "small." A number is small if it is "little or close to zero" or "limited in degree."[51] Nearly one out of every three animals in a marine mammal species or population is not limited in number or degree.

Second, while Congress acknowledged the imprecision of the term "small numbers," it intended that the agency limit takes to "infrequent, unavoidable" occurrences. H.R. Rep. No. 97-228, at 19 (Sept. 16, 1981), *as reprinted in* 1981 U.S.C.C.A.N. 1458, 1469. NMFS provides no analysis explaining why taking up to 30% of a population—approximately one out of every three animals—is "infrequent" or "unavoidable."

Third, the agency's interpretation of the requirement fails to consider the conservation status of individual species. What is "small" is not necessarily the same in all contexts. Rather than apply a 30% ceiling for all species, NMFS should revisit its "small numbers" interpretation to consider whether the percentage take for each affected species will ensure that population levels are maintained at or restored to healthy population numbers. H.R. Rep. No. 103-439, at 22, 1994 WL 93670 (Mar. 21, 1994); *see Native Vill. of Chickaloon v. Nat'l Marine Fisheries Serv.*, 947

[51] *Small*, Merriam-Webster Online Dictionary (2017), https://www.merriam-webster.com/dictionary/small (accessed June 26, 2017).

F. Supp. 2d 1031, 1052–53 (D. Alaska 2013) (upholding agency's "small numbers" determination where the agency did not "categorically establish 10% as a small number; rather, it determined, through consideration of the available data, that 10% was a small number in the specific context of the Cook Inlet beluga whale and the nature of the proposed activity").

Fourth, the agency's approach also fails to account for the additive and adverse synergistic effects of animals being exposed to seismic blasting when multiple survey ships operate in the same areas, affecting the same species and populations. *See* Proposed IHAs at 26307; *see also* 71 Fed. Reg. 14,446, 14,458 (Mar. 22, 2006) (considering additive effects of various impacts on polar bear populations). Yet when take is compiled across all five permits, it becomes clear that NMFS is proposing to authorize greater than 100% take for some species: e.g., of sperm whales, for which the combined take authorization amounts to about 106% of the population. That is not acceptable under any rational definition of "small numbers." NMFS has never before found that such a high percentage of take of a marine mammal population, during a single year of activity, meets the "small numbers" requirement.

2. NMFS' calculation of marine mammal take is inconsistent and plainly erroneous, resulting in an underestimation of impacts.

   a. The agency uses an outdated, incorrect threshold to estimate behavioral take.

In quantifying impacts on marine mammal behavior, NMFS relies on what it characterizes as a "historical acoustic exposure" criterion: a single, bright-line, sound pressure-based threshold for harm of 160 dB re 1 μPa (RMS), below which it assumes that no animal would experience a "potential . . . disruption of behavioral patterns." 16 U.S.C. § 1362(18)(A)(ii). This threshold is plainly contradicted by best available science and its application here significantly underestimates the impacts of the proposed activities on marine mammals.

With the development of compact data tags[52] and the continued refinement of locational passive acoustic monitoring, research scientists can now detect and 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 NMFS currently accepts as the threshold for Level B disturbances,[53] and at much larger distances than what onboard 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

[52] 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's responses to environmental conditions such as noise exposure.

[53] 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).

mammals more frequently, than what the agency, adopting the applicants' behavioral take estimates, assumes.

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,[54] then decrease after 127 dB, and stop calling above 160 dB.[55]
- Harbor porpoise buzz rates, a proxy for foraging success,[56] decrease 15% with exposure to seismic airguns at 130 dB and above.[57]
- Sperm whale buzz rates decrease by an average of 19% on exposure to airgun received levels above 130 dB.[58]
- Beluga whales are displaced from foraging areas beyond the 130 dB isopleth.[59]
- Blue whale call rates increase with exposure to seismic "sparkers" at 140 dB.[60]
- Fin whale call rates decrease and migratory disruption occurs on exposure to seismic airgun surveys at 175 to 285 km and noise levels below shipping noise.[61]
- Seismic survey activity disrupts the breeding display, or singing, of humpback whales across large areas of ocean.[62]
- Blue whales cease calling on exposure to airguns at 143 dB.[63]
- 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.[64]

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[54] In these comments, all decibel levels are referenced to 1 µPa.

[55] Blackwell, S.B., et al., Effects of airgun sounds on bowhead whale calling rates, *supra*.

[56] 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.

[57] Pirotta, E., et al., Variation in harbour porpoise activity in response to seismic survey noise, *supra*.

[58] Miller, P.J.O., et al., Using at-sea experiments to study the effects of airguns, *supra*.

[59] 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* 511-542 (2005). *See also* Finley, 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, *Canadian Bulletin of Fisheries & Aquatic 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, *Marine Mammal Science* 9: 285-300 (1993).

[60] Di Iorio, L., and Clark, C.W., Exposure to seismic survey alters blue whale acoustic communication, *supra*. A "sparker" is an electro-dynamic seismic impulse source that generates an electrical spark across a gap producing a plasma or vapor bubble that collapses and generates a low-frequency impulse.

[61] Castellote, M., et al., Acoustic and behavioral changes by fin whales, *supra*.

[62] Cerchio S., et al., Seismic surveys negatively affect humpback whale singing activity, *supra*.

[63] McDonald, M.A., Hildebrand, J.A. and Webb, S.C., Blue and fin whales observed on a seafloor array in the Northeast Pacific, *J. Acoustical Soc'y of America* 98: 712-21 (1995).

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 far lower received levels and far greater distances than what NMFS' regulatory thresholds account for.

Airguns, as indicated above, 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).[65] Consistent with this, researchers have observed harbor porpoises engaging in apparent avoidance responses, in some circumstances, fifty miles from a seismic airgun array;[66] and they have observed sperm whales responding to seismic signals with a complete cessation of vocalization over very large spatial scales, with the seismic source situated some 700 kilometers from the recorder.[67] 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.[68]

All of these disruptions indicate responses that would elevate metabolic stress,[69] cause displacement from areas of biological importance,[70] 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),[71] calling rates of bowhead whales increased as soon as airgun pulses

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[64] Clark C.W. and Gagnon G.C., Considering the temporal and spatial scales of noise exposures, *supra*; Personal communication between C.W. Clark with M. Jasny, NRDC (Apr. 2010). 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. 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 (2012).

[65] Foraging reductions have also been shown in sperm whales exposed to a relatively low-frequency (1-2 kHz) sonar system in the Norwegian Sea. Isojunno, S., et al., Sperm whales reduce foraging effort, *supra*.

[66] Bain, D.E., and Williams, R., Long-range effects of airgun noise on marine mammals, *supra*. This result is consistent with both captive and wild animal studies showing harbor porpoises abandoning habitat in response to pulsed sounds at low received levels.

[67] Bowles, A.E., et al., Relative abundance and behavior of marine mammals exposed to transmissions, *supra*.

[68] 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)?, *Marine Mammal Sci.* 22: 690-699 (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 (2012). *See also* Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, .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 (2011); Wood, J., Southall, B.L., and Tollit, D.J., PG&E Offshore 3-D Seismic Survey Project EIR: Marine Mammal Technical Report, Appendix H (2012) (CSLC EIR No. 758).

[69] Rolland, R.M., et al., Evidence that ship noise increases stress in right whales, *supra*.

[70] Castellote, M., et al., Acoustic and behavioral changes by fin whales, *supra*.

[71] Blackwell, S.B., et al., Effects of airgun sounds on bowhead whale calling rates, *supra*.

were detectable (with a cumulative sound exposure level, or $CSEL_{10min}$, of 94 dB re 1μPa^2-s), well below NMFS' 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 the late 1990s, when the threshold was adopted[72] based, according to NMFS, on a few studies conducted in the mid-1980s, during the infancy of the science. 77 Fed. Reg. 27222 (May 11, 2012) (NMFS, noting origin of the 160 dB threshold in a pair of studies on migrating grey and bowhead whales from the mid-1980s). 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 Inst. v. Gates*, 546 F. Supp. 2d 960, 973–75 (D. Haw. 2008), in which a U.S. District Court invalidated a NMFS threshold that ignored documented impacts at lower received levels as arbitrary and capricious.

Reliance on the outdated 160 dB threshold, in disregard of best available science, is nontrivial. It results in a gross underestimate of the activity's impact area and of the harm, or "take," experienced by marine mammals, and therefore undermines the document's impact analysis. This can easily be seen by comparing the impact area associated with NMFS' 160 dB threshold with that of the 140 dB threshold recommended, as the mid-point of a behavioral risk function, in a 2015 study conducted by leading biologists and bioacousticians [hereinafter "Nowacek et al. (2015)"].[73]

NMFS, for some purposes in the Proposed IHAs, takes its propagation analysis from BOEM, which modeled acoustic propagation from a 5400 $in.^3$ airgun array at 15 different sites across the Atlantic study area. Proposed IHAs at 26,283; PEIS Appendix D at D-62 to D-72. Using BOEM's propagation analysis, which NMFS largely adopts, the radius of the 160 dB (RMS) exposure isopleth is 5,040 m (or a total impact area of 79.8 km^2) at a water depth of 2,560 m. PEIS Appendix D at D-3. At that same depth, by contrast, the radius of the 140 dB (RMS) exposure isopleth is about 20,000 m (or a total impact area of 1,256 km^2). *Id.* Put another way, the area considered ensonified to 140 dB at this site would be more than 15 times greater than the area considered ensonified to 160 dB—a discrepancy that is likely to have an enormous impact on both the total number of marine mammals impacted and the number of times they are impacted. And a behavioral risk function *centered* at 140 dB (RMS), per Nowacek et al. (2015), would result in high percentages of take at still greater distances than those indicated here.

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

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[72] NMFS effectively adopted the 160 dB threshold for behavioral harassment no later than March 5, 1999. *See* 64 Fed. Reg. 10644 (Mar. 5, 1999) (proposed authorization for seismic hazard survey).

[73] Nowacek, D.P., et al., Marine seismic surveys and ocean noise, *supra*.

(1) Optimally, NMFS should employ a combination of specific thresholds for which sufficient species-specific data are available and generalized thresholds for all other species. 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. *See, e.g.*, 74 Fed. Reg. 4,844, 4,844–85 (Jan. 27, 2009). Data from all species should be used to produce generalized thresholds for species lacking sufficient data.

(2) NMFS must revise its general, multi-species behavioral take threshold to reflect the best available science. Nowacek et al. (2015) 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.[74] The agency attempts to dismiss the recommendations in Nowacek et al. (2015) by stating "there is currently no scientific agreement on the matter," Proposed IHAs at 26,282, but this summary treatment does not address that published study's findings or the numerous behavioral response studies, also published, that it cites. For a general behavioral threshold, NMFS should adopt a risk function with a mid-point no higher than the 140 dB cited there.

(3) Should NMFS 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 through most of the exposure area. Fundamentally, the use of a multi-pulse standard for behavioral harassment does not take into account the spreading of seismic pulses over the interpulse interval due to reverberation and multipath propagation. The continuous, or virtually continuous, nature of the airgun sound has been indicated by myriad sources: for example, in published analyses of airgun noise propagation across the interpulse interval;[75] 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;[76] and by NMFS' 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 agency should evaluate its impacts on that basis.[77]

[74] *Id.*

[75] Guerra, M., et al., Quantifying seismic survey reverberation, *supra*; Guerra, M., Dugan, P.J., Ponirakis, D.W., Popescu, M., Shiu, Y., Rice, A.N., and Clark, C.W., High-resolution analysis of seismic air gun impulses and their reverberant field as contributors to an acoustic environment, *Advances in Experimental Medicine and Biology* 875: 371-379 (2016).

[76] Nieukirk, S.L., et al., Sounds from airguns and fin whales, *supra*; Nieukirk, S.L., et al., Low-frequency whale and seismic airgun sounds, *supra*; Roth, E.H., et al., Underwater ambient noise on the Chukchi Sea continental slope, *supra*; Gedamke, J., Ocean basin scale loss of whale communication space, *supra*.

[77] 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) (Open Water 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

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, NMFS must consider that 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.[78]

NMFS must use take standards in line with the best available science. The agency's reliance on its absurdly outdated, non-conservative 160 dB threshold is arbitrary and capricious and undermines everything that follows.

b. The agency fails to account for masking and loss of communication space in its take estimations.

In its Proposed IHAs, NMFS fails to count masking impacts as "take" for purposes of making its "small numbers" determinations, notwithstanding their recognized potential to disrupt behavioral patterns in marine mammals.

As noted above (*see* section I.B), seismic surveys are known to elevate background levels of ocean noise, masking conspecific calls and other biologically important signals over great expanses of ocean. The impact on acoustic species such as marine mammals can be profound. Through masking, seismic surveys can disrupt all marine mammal behaviors that depend on sound, including individual and cooperative foraging, breeding activity, predator avoidance among individuals and groups, and mother-calf interaction.[79]

NMFS rightly acknowledges these impacts at several points within its Proposed IHAs notice, stating explicitly, for example, that "[s]ound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (e.g., those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation)." Proposed IHAs at 26279. Further, the agency states, "when the coincident (masking) sound is man-made, *it may be considered harassment* when disrupting or altering critical behaviors." *Id.* (emphasis added). And yet, even though

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exploration in the Chukchi and Beaufort Seas, 2011: Statoil and ION Geophysical at 9 (2011) (Open Water Expert Panel Review 2011).

[78] 59 Fed. Reg. 28793 (June 3, 1994); 80 Fed. Reg. 9313 (Feb. 20, 2015); National Marine Fisheries Service, Recovery plan for the North Atlantic right whale (August 2004).

[79] *See*, *e.g.*, Clark, C.W., et al., Acoustic masking in marine ecosystems, *supra*; Hatch, L.T., et al., Can you hear me here? *supra*.

the agency recognizes that seismic surveys have this disruptive effect, at least on baleen whales (Proposed IHAs at 26298), it does not quantify masking impacts as "take," or make any effort to adjust its "take" numbers to account for masking effects, in its "small numbers" analysis. Its failure to do so is arbitrary and capricious.

c. NMFS underestimates auditory impacts and injuries.

In July 2016, NMFS released technical guidance for estimating how many marine mammals would suffer temporary or permanent hearing loss as a result of acoustic activity.[80] That technical guidance divides marine mammals into functional hearing groups; sets forth, for each group, exposure thresholds that are associated with hearing loss; and attaches a weighting system that, at least in theory, adjusts the frequency output of a given sound source to each group's acoustic sensitivity. Unfortunately, the technical guidance was roundly criticized by experts from the bioacoustics community, including in published responses, and NMFS' use of it here, which compounds the guidance's errors with a problematic "approximation" (Proposed IHAs at 26292) of exposure estimates, is arbitrary and capricious. The result is not only to underestimate auditory harm in marine mammals, but also to underestimate the total number of injuries, known under the MMPA as "Level A harassment," for which NMFS takes auditory harm as a proxy. *Id.*

(1) NMFS' retrospective application of "Level A" take estimates

NMFS' published its auditory guidance in July 2016, after the five applicants had submitted their requests for authorization. Because, apparently, the applicants were unwilling to rerun their own models and recalculate Level A take based on NMFS' guidance, the agency devised an alternative means of approximating injurious take for each survey. Proposed IHAs at 26292. Simply put, that approach starts with the auditory take estimates set forth in BOEM's 2014 Programmatic EIS, which applied single-pulse thresholds similar to those described in the guidance; pro-rates those estimates among the applicants based on the number of track kilometers they have proposed; and then applies a correction factor for low-frequency cetaceans, to reflect the multi-pulse sound energy threshold that NMFS would apply to those species. *Id.* Even as "approximation[s]," *id.*, however, NMFS' approach contains a number of potentially significant errors, including but not limited to the following:

First, in basing its analysis on BOEM's three-year-old document, NMFS effectively incorporated that agency's marine mammal density estimates, which derive from an earlier, outdated density model known as "NODE" (Navy OPAREA Density Estimates) rather than from the 2016 Atlantic CetMap model represented in Roberts et al. (2016). The CetMap model, which was initiated by NOAA, includes more recent marine mammal sighting data, spans a wider range of sighting data, considers a larger set of environmental covariates, and, unlike NODE, accounts for availability and perception bias.[81] For these reasons, the density estimates produced by CetMap, which NMFS considers "best available science" (Proposed IHAs at 26292), are

[80] NMFS, Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing, *supra*.

[81] Letter from J.J. Roberts and P.N. Halpin, Duke University Marine Geospatial Ecology Lab, to Jolie Harrison, NMFS (Aug. 27, 2015) (comment letter on NMFS' notice of receipt of applications for Atlantic G&G activity).

substantially higher for most species than those produced by NODE—so much higher that they push take for some applicants well above NMFS' "small numbers" threshold of 30%, as discussed at section II.A.3 below. NMFS' incorporation of the outdated NODE model into its auditory impact analysis is likely to result in significantly lower take estimates for most species.

Second, NMFS assumes that auditory take estimates for high-frequency cetaceans depend on the exposure of those species to single seismic shots, *see* Proposed IHAs at 26292, even though the weighted auditory injury zone for high-frequency cetaceans extends as far as 1.5 kilometers, *id.* at 26,253. The size of the injury zone suggests that NMFS' assumption about high-frequency cetaceans is incorrect, and that the agency should calculate auditory injury by applying both the peak-pressure threshold and a metric that accounts for exposure to multiple shots (e.g., the cumulative sound energy thresholds included in NMFS' guidance).

(2) Use of erroneous guidance for estimating "Level A" take

Even if NMFS' alternative means of "approximating" Level A take were not at issue, the auditory guidance that NMFS has applied would remain flawed and non-conservative. Its thresholds and weighting systems are subject to considerable uncertainty, with experimental data available for only a few species, a small number of individuals, and a limited set of noise sources. In our comments on the guidance, attached hereto, we identified numerous technical problems with the models that the agency had adopted from the Navy—numerous ways in which the assumptions made by the agencies were plainly erroneous, inconsistent, or non-conservative.

Many of the problems we identified were echoed by expert commentators. Wright (2015) published a criticism of the guidelines in a peer-reviewed journal, identifying several significant statistical and numerical faults in NOAA's approach—such as pseudo-replication, misapplication of medians and means, and inconsistent treatment of data—that tend to bias the proposed criteria towards an underestimation of effects.[82] Similar and additional issues were raised by a dozen scientists during the public comment period on the draft revised criteria.[83] At the root of the problem is the agency's broad extrapolation from a small number of individual animals, mostly bottlenose dolphins, without taking account of what Racca et al. (2015) have succinctly characterized as a "non-linear accumulation of uncertainty."[84]

The final draft, other than mitigating its flagrantly misguided weighting system for mid-frequency cetaceans, failed to address the basic errors identified by these and other experts; nor

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[82] Wright, A.J., Sound science: Maintaining numerical and statistical standards in the pursuit of noise exposure criteria for marine mammals, *Frontiers in Marine Science* 2: Art. 99 (2015).

[83] Letter from Racca, R., Hannay, D., Yurk, H., McPherson, C., Austin, M., MacGillivray, A., Martin, B., Zeddies, D., Warner, G., Delarue, J., and Denes S., JASCO, to N. LeBoeuf, NMFS (Sept. 14, 2015) (Comment Letter on National Marine Fisheries Service's 31 July 2015 notice (80 Fed. Reg. 45642)); Letter from Racca, R., Yurk, H., Zeddies, D., Hannay, D., Austin, M., MacGillivray, A., Warner, G., Martin, B. and McPherson, C., JASCO, and Tyack, P., University of St. Andrews, to A.R. Scholik-Schlomer, NMFS (Sept. 11, 2015) ("Request for an extension of the public comment period on the proposed acoustic guidelines for assessing the effects of anthropogenic sound on marine mammals").

[84] Letter from Racca, R. et al. (Sept. 14, 2015), *supra*.

did it perform a sensitivity analysis to understand the potential magnitude of those errors. NMFS should not rely exclusively on its auditory guidance in determining "Level A" take, but should, at minimum, produce a conservative upper bound (such as by retaining the 180 dB threshold, or by performing a sensitivity analysis).

(3) Failure to account for other forms of injury

The Proposed IHAs use permanent threshold shift as a proxy for all forms of potential injury from seismic exploration. This approach is not supported by the best available science.

First, NMFS must take account of alternative mechanisms of auditory injury. The new auditory guidelines use permanent threshold shift ("PTS"), specifically the destruction of hair cells in the inner ear, as their basis for auditory injury. Yet consideration of PTS alone is not sufficient to cover all incidences of permanent hearing loss. On the contrary, the best available evidence shows that temporary threshold shift ("TTS") results, at least in part, from swelling of cochlear nerve endings—a mechanistic process that differs from destruction of the hair cells—and that noise levels causing reversible hearing loss can also lead to permanent degradation of cochlear nerves.[85] The outcome, as summarized by Tougaard et al. (2015), is an impairment of complex auditory processing and "a reduction of stimulus encoding under noisy conditions, tinnitus, and hyperacusis."[86] Additionally, it is known that repeated episodes of TTS can also result in PTS itself.[87] While the neural damage seen in Kujawa and Liberman (2009) occurred not far below exposure levels productive of PTS, it remains unknown if smaller exposures would lead to "irreversible neural degeneration," as NMFS itself observed in its draft guidance.[88]

Second, NMFS must account for potential behaviorally mediated injury resulting from exposure to seismic airguns and other disruptive noise. Nowacek et al. (2004) observed that right whales, responding to relatively low received levels from an acoustic alarm (133-148 dB re 1 µPa (RMS)), broke off their foraging dives and positioned themselves directly below the water surface, leaving themselves at substantially greater risk of vessel collision.[89] And numerous studies, including post-stranding pathology, laboratory study of organ tissue, and theoretical work on dive physiology, have linked the severe decompression-like pathologies seen in beaked whales exposed to naval sonar to a maladaptive alteration of the dive pattern.[90] Notably, the

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[85] *E.g.*, 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).

[86] Tougaard, J., Wright, A.J., and Madsen, P.T., Cetacean noise criteria revisited in the light of proposed exposure limits for harbour porpoises, *Marine Pollution Bulletin* 90: 196-208 (2015).

[87] Kujawa, S.G., and Liberman, M.C., Adding insult to injury, *supra*.

[88] NOAA, DRAFT guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater acoustic threshold levels for onset of permanent and temporary threshold shifts, at § 3.2.1 (July 23, 2015) (revised version for second public comment period).

[89] Nowacek, D.P., et al., Right whales ignore ships but respond to alarm stimuli, *supra*.

[90] *E.g.*, Fahlman, A., Tyack, P.L., Miller, P.J.O., and Kvadsheim, P.H., How man-made interference might cause gas bubble emboli in deep diving whales, *Frontiers in Physiology* 5: art. 13 (2014); 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

acute secondary effects seen in right whales and beaked whales are known or are presumed by modeling to occur well below the received levels suggested by NMFS' auditory guidelines.[91]

d. NMFS improperly discounts vessel collision risk in its take estimations.

NMFS, in its Proposed IHAs, concludes that "[n]o incidental take resulting from ship strike is anticipated." Proposed IHAs at 26280. Its dismissal of collision risk relies heavily on the agency's prescribed ship-strike avoidance procedures, which the agency believes "eliminates any foreseeable risk of ship strikes." *Id.* at 26280. In section II.C.6 below, we discuss why NMFS' avoidance provisions, as they stand, are insufficient to eliminate risk from project vessels, particularly due to the loopholes they create for support ships. But, in addition, NMFS' analysis fails to account for the potential of seismic sources to exacerbate ship-strike risk.

Right whales are particularly prone 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.[92] 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);[93] 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.[94]

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.[95] It is certainly possible that broadband airguns could produce the same effects, and 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

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anthropogenic sonar signals, *Veterinary Pathology* 42: 446–457 (2005); Hooker, S.K., Fahlman, A., Moore, M.J., Aguilar de Soto, N., Bernaldo de Quirós, Y., Brubakk, A.O., Costa, D.P., Costidis, A.M., Dennison, S., Falke, J., Fernandez, A., Ferrigno, M., Fitz-Clarke, J.R., Garner, M.M., Houser, D.S., Jepson, P.D., Ketten, D.R., Kvadsheim, P.H., Madsen, P.T., Pollock, N.W., Rotstein, D.S., Rowles, T.K., Simmons, S.E., Van Bonn, W., Weathersby, P.K., Weise, M.J., Williams, T.M., and Tyack, P.L., Deadly diving? Physiological and behavioural management of decompression stress in diving mammals, *Proceedings of the Royal Society of London, Pt. B: Biological Sciences*, 279, 1041–1050 (2012).

[91] *E.g.*, Evans, D.L., and England, G.R., Joint interim report: Bahamas marine mammal stranding event of 15-16 March 2000 (2001); Nowacek, D.P., et al., Right whales ignore ships but respond to alarm stimuli, *supra*; Parsons, E.C.M., Dolman, S.J., Wright, A.J., Rose, N.A., and Burns, W.C.G., Navy sonar and cetaceans: Just how much does the gun need to smoke before we act? *Marine Pollution Bulletin* 56: 1248-1257 (2008).

[92] NMFS, Recovery plan for the North Atlantic right whale, *supra.*

[93] 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).

[94] Reeves, R.R., Read, A.J., 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).

[95] Nowacek, D.P., et al., Right whales ignore ships but respond to alarm stimuli, *supra*.

kilometers. (*See* section II.A.2.a 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 greater speed, presenting a greater danger of ship strikes.[96]

NMFS dismissal of collision risk is not supportable.

e. NMFS fails to account for physiological stress response and chronic stress.

Chronic stress is recognized in the ocean noise literature as a significant concern for marine mammals.[97] The condition is associated across mammalian species with higher mortality and morbidity and reduced reproductive success, and with a variety of pathologies including immuno-suppression, heart disease, depressed reproductive rates, and physical malformations and other defects in the young.[98] In marine mammals, a physiological stress response has been identified in right whales in response to chronic low-frequency ambient noise,[99] as well as in captive small cetaceans.[100] Animals that remain in their habitat may experience greater physiological stress in response to human disturbance than those that abandon it, and these same animals may be more likely to already suffer from compromised health.[101]

In its general discussion of "Acoustic Effects," NMFS properly recognizes "stress responses" as a category of noise-related impact: The available science on marine mammals and other mammals "lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as 'distress.'" Proposed IHAs at 26279. Yet nowhere does the agency enumerate take from physiological stress or, for that matter, address acute or chronic stress in its negligible impact analyses.

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[96] See elsewhere in these comments for discussion of other potential indirect effects on right whales.

[97] *See, e.g.*, King, S.L., Schick, R.S., Donovan, C., Booth, C.G., Burgman, M., Thomas, L., and Harwood, J., An interim framework for assessing the population consequences of disturbance, *Methods in Ecology and Evolution* doi:10.1111/2041-210X.12411 (2015). 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.

[98] Wright, A.J., Aguilar Soto, N., Baldwin, A.L., Bateson, M., Beale, C.M., Clark, C., Deak, T., Edwards, E.F., Fernández, A., Godinho, A., Hatch, L., Kakuschke, A., Lusseau, D., Martineau, D., Romero, L.M., Weilgart, L., Wintle, B., Notarbartolo di Sciara, G., and Martin, V., Do marine mammals experience stress related to anthropogenic noise? *International Journal of Comparative Psychology* 20: 274-316 (2007) (literature review and synthesis).

[99] Rolland, R.M., et al., Evidence that ship noise increases stress in right whales, *supra*.

[100] *E.g.*, Romano, T.A., Keogh, M.J., Kelly, C., Feng, P., Berk, L., Schlundt, C.E., Carder, D.A., and Finneran, J.J., Anthropogenic sound and marine mammal health: Measures of the nervous and immune systems before and after intense sound exposure, *Canadian Journal of Fisheries and Aquatic Sciences* 61: 1124-34 (2004).

[101] Beale, C.M., and Monaghan, P., Behavioural responses to human disturbance: A matter of choice? *Animal Behaviour* 68: 1065-69 (2004).

f. NMFS misapplies the statutory definitions of harassment.

As noted above, the MMPA defines harassment to mean any act that (a) "*has the potential to injure* a marine mammal or marine mammal stock in the wild," or (b) "*has the potential to disturb* a marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." 16 U.S.C. § 1362(18)(A) (emphasis added). These definitions are pointedly distinguished from the parallel harassment definitions that apply to military readiness activities, which, by contrast, include (a) "any act that injures or has the significant potential to injure" a marine mammal, and (b) "any act that disturbs or is likely to disturb" a marine mammal by disrupting natural behavioral patterns "to a point where such behavioral patterns are abandoned or significantly altered." 16 U.S.C. § 1362(18)(B). Notably, the probability standards in the MMPA are lower for industrial activities than for military readiness activities, requiring "potential" in the former case and "significant potential" and "likelihood" in the latter. Yet NMFS has applied the harassment definition to the pending applications as though "potential" were not the operative standard.

The discussion above, at section II.A.2.b.(2), suggests some of the ways in which NMFS, in the auditory impact guidance it applies here, adopts a probability standard other than "potential" in setting its thresholds for auditory injury. For example, the agency derives its thresholds from the average exposure levels at which tested marine mammals experienced hearing loss, discounting instances of similar hearing loss experienced at lower levels of exposure.[102] Thresholds based on mean or median values will lead to roughly 50% of an exposed cohort experiencing the very impacts that the threshold is designed to avoid, at levels that are considered "safe."[103] For purposes of take estimation, such thresholds are likely to result in substantial undercounts of auditory harm.[104] This is true even though some marine mammals exposed to noise levels above the mean and considered "taken" might not actually experience hearing loss, since basic physics (i.e., the way of size of ensonified areas increase exponentially as received levels fall)[105] make it highly likely that more individuals would be exposed to levels below the threshold than above it. A take estimate based on a "potential" standard would either count take from the lowest

[102] NMFS, Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing, *supra*.

[103] Letter from Racca, R., et al. (Sept. 14, 2015), *supra*; Wright, A.J., Sound science, *supra*.

[104] *See* 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) (showing that safety zone distances should increase to account for intraspecific variability).

[105] BOEM's propagation analysis, which NMFS relies on for its proposed IHAs, provides predicted ranges to specified threshold levels, from 210 to 150 dB. PEIS at D-87. At these levels, distances typically increase two to three times for each 10 dB reduction in sound pressure, corresponding to an increase in exposure area of four to nine times. Under BOEM's modeled scenario 1, for example, exposure distances increase from 810m to 2213m as sound pressure levels fall from 180 to 170 dB. This reflects an increase in exposure area of 2.06 km^2 to 15.38 km^2. At 160 dB, the exposure area is 77.53 km^2. For a clear visualization of this principle, *see*, *e.g.*, the propagation map of a seismic survey in the Beaufort Sea provided in Fleishman, E., and Streever, B., Assessment of cumulative effects of anthropogenic underwater sound: project summary and status (2012); *see also* Wood, J., et al., PG&E Offshore 3-D Seismic Survey Project EIR: Marine Mammal Technical Report, *supra* (propagation maps of proposed seismic survey off Central California).

exposure level at which hearing loss can occur or establish a probability function that accounts for the variability in the acoustic sensitivity of individual marine mammals.[106]

Similarly, the 160 dB threshold that NMFS applied to behavioral impacts is plainly inconsistent with the statute's "potential" standard. As discussed above, the best available science indicates that takes will occur with near certainty at exposure levels well below that threshold, not only in baleen whales, but in species as diverse as harbor porpoises and sperm whales. An internal NMFS permitting office document, from 2011, indicates that the agency has for some time failed to distinguish between the "regular" harassment definition and the stricter "military readiness" standard, that it has indeed applied "more like" the higher "military readiness" harassment definition to all activities, and that it was anxious to avoid public discussion of the matter.[107] Again, a take estimate based on "potential" would either count take from the lowest exposure level at which behavioral impacts can occur or establish a probability function that accounts for contextual variability.

As it stands, NMFS' application of the MMPA's take thresholds is in violation of law.

g. NMFS' propagation analysis is based on unrealistic and non-conservative assumptions about spreading loss, bottom composition, and reverberation.

The assumptions that NMFS and the seismic applicants make about acoustic propagation fail to capture the spatial and temporal extent of airgun noise propagation and do not represent best available science.

First, in modeling propagation loss, NMFS cannot assume that normal propagation conditions will apply, and that sound from the applicants' acoustic sources will spread in a typical spherical to cylindrical pattern across the sound field. Such a model falls short of capturing some of the basic transmission conditions that may be expected in the area. For example, the propagation modeling in BOEM's PEIS, which the majority of applicants, and NMFS, adopt, does not appear to adequately account for strong surface ducting, a concentration of acoustic energy in the top boundary of the mixed layer above the marine thermocline. Surface ducting is common in the mid-latitudes in winter and spring and, under certain conditions like becalmed seas and cloud cover, the ducting becomes strong enough to very dramatically increase propagation distances. Indeed, during the March 2000 mass stranding in the Bahamas, when naval mid-frequency sonar drove beaked whales into the shallows, where they perished, a strong surface duct is estimated to

[106] NMFS was made aware of this problem, while drafting its auditory impact guidance, not only by some of the signatories to the present letter, but by expert commenters from the scientific community, one of whom published his critique in a peer-reviewed journal. The agency made no effort to correct the problem, nor did it respond publicly to comments.

[107] Draft Meeting Minutes, Navy/ NMFS Meeting, 13 Apr. 11 (pages NMFS 38656-57 in administrative record of *Conservation Council for Hawaii*, *supra*) (stating, in note from agency, that the NMFS permitting office "does not quantitatively distinguish between the way we apply the regular definition of harassment and the 2004 NDAA definition of MMPA harassment (and we apply more like the NDAA definition)").

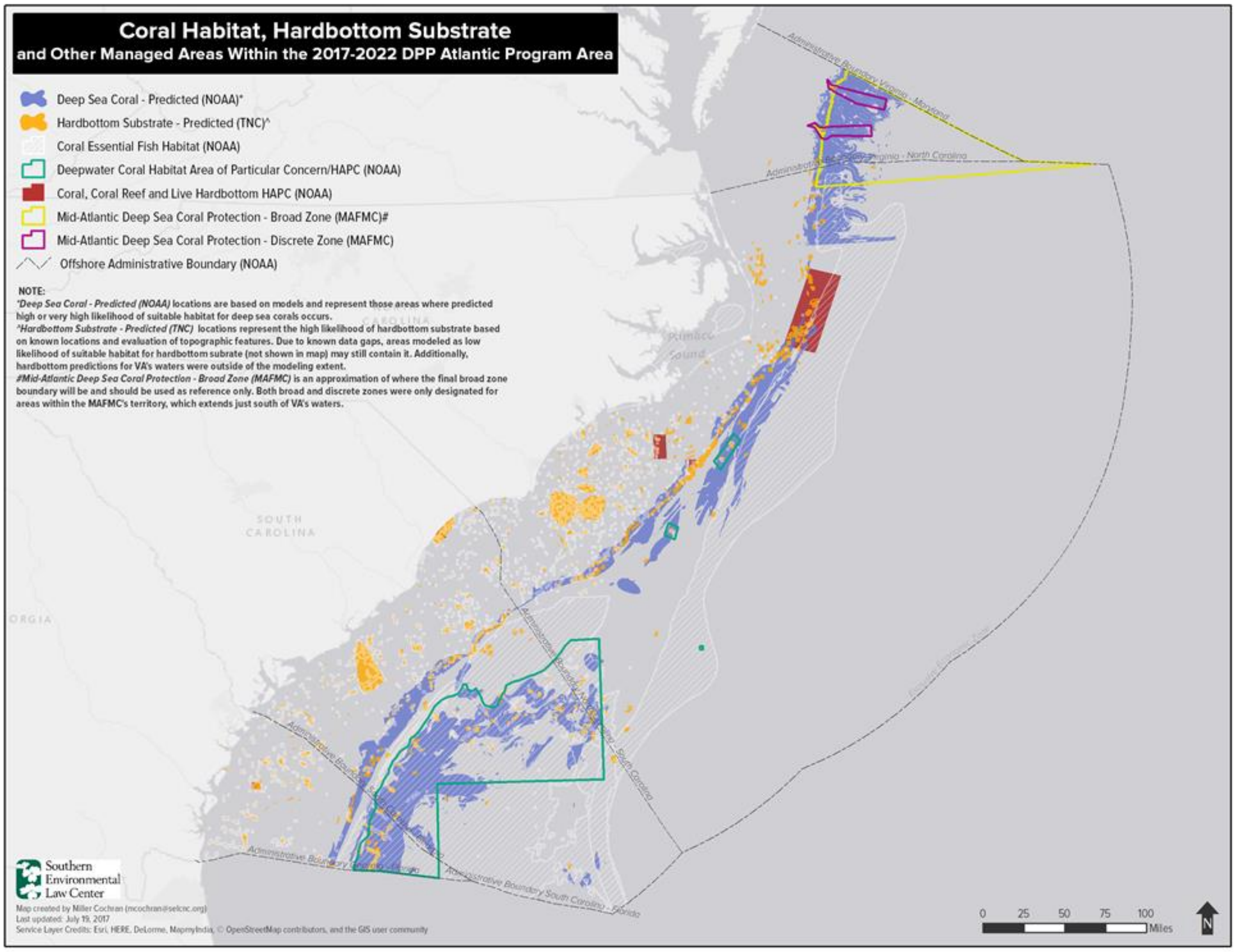

Fig. 1. A map of coral habitat and habitat substrate within the Bureau of Ocean Energy Management's 2017-2022 Draft Proposed Program area for offshore oil and gas development, as that area was defined in January 2015. Blue areas are highly or very highly likely to contain habitat suitable to deep-sea coral, according to NOAA modeling. The map *does not* include coral habitat outside the defined Draft Proposed Program area or off Virginia, so should be regarded as a conservative representation. (SELC, based on NOAA, TNC, and MAFMC data)

have elevated received levels by orders of magnitude above normal.[108] Notably, BOEM's analysis assumes "moderate" surface ducting—a condition in which "moderate" amounts of airgun energy are channeled in the ducting layer—in only three of 21 of its representative modeled areas. PEIS at E-12 to E-16. The rest assume sound ducting would occur only at "shallow" or "the shallowest" angles from the airgun source, with relatively little energy

[108] D'Spain, G., D'Amico, A., and Fromm, D.M., Properties of the underwater sound fields during some well documented beaked whale mass stranding events, *Journal of Cetacean Research and Management* 7(3): 223-238 (2006).

contributed. *Id.* A few days of strong surface ducting could potentially increase take beyond what NMFS has authorized.

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 efficiency than cylindrical propagation would indicate.

Second, NMFS must not assume, as at least three of the present applications do,[109] 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 tracklines. (See Fig. 1, which shows NOAA-modeled coral bottom habitat within the Bureau's Draft Proposed Program, beginning 50 miles from shore.) Additionally, some areas that were not apparently modeled either by BOEM or by most of the applicants, such as mid-Atlantic offshore canyons, contain outcroppings of bedrock, as NMFS itself acknowledges. Proposed IHAs at 26248. As NMFS knows, hard-bottom compositions, including coral bottoms, can significantly increase propagation of airgun noise, as a comparison between modeled sound exposure levels in soft- and hard-bottom areas off Central California illustrates.[110] Indeed, as the Marine Mammal Commission points out in its July 6 comments, the much greater propagation distances estimated in Spectrum's modeling may very well be due to differences in assumptions that Spectrum and BOEM have made about the region's geoacoustics.[111] NMFS, 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.

h. NMFS must use additional data sources in calculating densities of North Atlantic right whales.

In determining the number of marine mammals taken by the proposed surveys, NMFS bases its estimates of marine mammal densities on the Duke University habitat-based density model for the U.S. east coast (*i.e.*, Roberts et al. (2016)), which was funded under the agency's CetMap program.[112] The CetMap model represents the best model available for calculating marine

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[109] *See*, CGG, Request for an incidental harassment authorization under the Marine Mammal Protection Act: CGG Atlantic 2D seismic program, at 14-15 (Dec. 2015); TGS-NOPEC, Request by TGS-NOPEC for an incidental harassment authorization for the incidental take of marine mammals in conjunction with a proposed marine 2D seismic program Mid- and South Atlantic Outer Continental Shelf, 2016-2017, at 7 (Feb. 2016); WesternGeco, Request by WesternGeco, LLC. for an incidental harassment authorization for the incidental take of marine mammals in conjunction with a proposed marine 2D seismic program Mid- and South Atlantic Outer Continental Shelf, 2016-2017, at 7 (Feb. 2016).

[110] Wood, J., et al., PG&E Offshore 3-D Seismic Survey Project EIR: Marine Mammal Technical Report, *supra*.

[111] Letter from Rebecca Lent, Executive Director, MMC, to Jolie Harrison, NMFS, at 5 (July 6, 2017) (comments on Proposed IHAs).

[112] Roberts J.J., Best B.D., Mannocci L., Fujioka E., Halpin P.N., Palka D.L., Garrison L.P., Mullin K.D., Cole T.V.N., Khan C.B., McLellan W.M., Pabst D.A., and Lockhart G.G., Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico, *Scientific Reports* 6:22615 (2016).

mammal densities in the region; nonetheless, as its designers admit,[113] the model is limited. (*See* discussion at section II.C.2.e below.) Most notably, in founding its density estimates entirely on shipboard and aerial line-transect surveys, the Duke model necessarily excludes data obtained through passive acoustic monitoring on North Atlantic right whales.

Right whales occupy waters well beyond the areas in which they have tended to be identified in visual surveys. A recent passive acoustic study from Cornell University's Bioacoustics Research Program indicates a year-round presence of 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.[114] Importantly, some of the most frequent occurrences were found at the sites located furthest offshore, well beyond the area NMFS has identified for seasonal closure.[115] The study made similar findings for right whales off the Georgia coast, making it reasonable and conservative to expect similar right whale occurrence throughout the region. Considering the species' conservation status (*see* section II.B.2.e below), it is incumbent on NMFS to adjust the density estimates it derived from Roberts et al. (2016) as needed to account for the greater offshore presence and broader seasonality than was identified using visual survey data alone.[116]

i. NMFS improperly relies on a habitat-based density model to produce absolute abundance estimates.

In determining the proportion of marine mammal species and populations taken by the proposed activities—a calculation that lies at the heart of the agency's "small numbers" analysis—NMFS relies on abundance estimates that it derived from the Duke University habitat-based density model, described above. Proposed IHAs at 26270-71. This approach is flawed. The data derived from habitat density models do not reflect actual abundance estimates for a species or stock. Absolute abundance is a metric that reflects the number of individuals present in a population at a snapshot in time; by contrast, modeled relative densities represent the average number of individuals expected to be found in each grid cell (pixel), based on environmental variables, relative to other grid cells,[117] in this case using data compiled over multiple decades. While the Duke University model—as supplemented with additional data, per section II.C.2.e

[113] *Id.*

[114] Rice, A.N., Tielens, J.T., Estabrook, B.J., Loman, M.E., Morano, J.L., and Clark, C.W., Baseline bioacoustics surveys of four Atlantic offshore wind energy planning areas (2013) (presentation given to BOEM); Hodge, K.B., Muirhead, C.A., Morano, J.L., Clark, C.W., and Rice, A.N., North Atlantic right whale occurrence near wind energy areas along the mid-Atlantic US coast: implications for management, *Endangered Species Research* 28: 225-234 (2015); Salisbury, D.P., Clark, C.W., and Rice, A.N., Right whale occurrence in the coastal waters of Virginia, U.S.A.: Endangered species presence in a rapidly developing energy market, *Marine Mammal Science* 32(2): 508-519 (2016).

[115] *Id.*

[116] LaBrecque, E., Curtice, C., Harrison, J., van Parijs, S.M., and Halpin, P.N., Biologically important areas for cetaceans within U.S. waters—East coast region, *Aquatic Mammals* 41: 17-29 (2015).

[117] Seber, G.A.F., The Estimation of Animal Abundance (1982); Guisan, A., and Zimmerman, N.E., Predictive habitat distribution models in ecology, *Ecological Modelling* 135(2-3): 147-186 (2000).

below—represents best available science for purposes of calculating relative density and, by extension, relative abundance, it cannot readily be used to determine species and population absolute abundance.[118] Any "small numbers" determination that relies on abundance estimates derived simplistically from the model's density data is arbitrary and capricious.

NMFS should, at least for data rich species, derive its absolute abundance estimates from NMFS' Stock Assessment Reports ("SARs"). The SARs present a measure of absolute abundance from the most recent survey data, and in some instances data from multiple types of platforms. In doing so, they provide the best representation of *current* absolute abundance of a species or stock. In contrast, an abundance estimate derived from multiple years of historic data is likely to overestimate, or in some cases underestimate, current absolute abundance. The argument put forth by NMFS, that the Roberts et al. (2016) models are preferred due to their being derived from multiple years of data (Proposed IHAs at 26270-71), is, in the case of estimating absolute abundance, invalid.

We suggest that the Roberts et al. (2016) models, while still not being directly comparable to the abundance estimates provided by the SARs, have utility for deriving the abundance of species that are considered data-deficient and therefore lack abundance estimates in the SARs. Use of these models (for this purpose) does present a risk of overestimating current abundance for these data-poor species, particularly as the models are likely to be derived from fewer data points than they would be for better known species. To mitigate this risk, we recommend that NMFS adjust the averaged model outputs to the lower bound of the standard deviation estimated by the model for each grid cell.[119]

j. The applicants', and thus NMFS', take analyses are inconsistent and contradictory.

The applications submitted by Spectrum, TGS, ION, Western, and CGG differ substantially in their approach to impact analysis, using different sources and methods in calculating species densities, noise propagation, and marine mammal take. And yet, with few exceptions, NMFS appears to have largely accepted the impact analysis proffered by each of the applicants, such that the agency's process of take estimation changes arbitrarily from proposed authorization to proposed authorization. *See* Proposed IHAs at 26383-92. For example:[120]

(1) TGS and Western did not use the density estimates produced by Roberts et al. (2016), which NMFS considers the best available source for cetacean densities in the region (Proposed IHAs at 26287), but rather applied a different model using different marine mammal data;

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[118] *Id.*

[119] NMFS' GAMMS III workshop spoke to the need of assuming lower abundance where data are dated or lacking. Moore, J.E., and Merrick, R. (eds.), Guidelines for assessing marine mammal stocks: Report of the GAMMS III workshop (2011) (NOAA Tech. Memo. NMFS-OPR-47).

[120] Most of the following examples are discussed at greater length in the Marine Mammal Commission's comments on the proposed seismic IHAs. *See* Letter from Rebecca Lent (July 6. 2017), *supra*.

(2) TGS, Western, and CGG based their noise exposure estimates on the same (problematic) propagation analysis that BOEM produced for its EIS, while ION applied BOEM's modeling methodology (the JASCO Airgun Array Source Model) to a different group of sites, and Spectrum adopted a different, and possibly more accurate, approach (the Gundalf source model) that results in significantly greater take distances in waters of shallow (<100m) and intermediate (100-1000m) depth;

(3) In its exposure simulations, Spectrum used animat densities (0.05 animats/ km^2) that were lower by a factor of two than those used by the other applicants (0.1 animats/ km^2) and inconsistent with Roberts et al. (2016); and

(4) Spectrum, alone among the applicants, was allowed to reduce its Level A take estimates based on assumptions about its exclusion zone mitigation, including the assumption that the vessel's protected species observers would achieve Carr et al. (2011) detection probabilities in their monitoring (see II.A.3 below).

All of this disagreement seems to show in the agency's take estimates, which vary widely from survey to survey notwithstanding the applicants' use of similarly sized airgun arrays conducting the same type of 2D survey activities across the same BOEM planning areas, and impacting the same marine mammal populations in the same habitat. By way of illustration, Spectrum's take numbers are uniformly higher for both coastal and offshore species than are Western's and CGG's—in some instances by more than two orders of magnitude—notwithstanding Spectrum's proposal of a shorter survey and a (slightly) smaller airgun array. These results are contradictory on their face and require further examination and explanation from NMFS.

In any case, the agency cannot use grossly inconsistent data and methods to assess the environmental impacts of what are substantially similar activities. Its irrational deference to the applicants here is arbitrary and capricious. *See Conservation Council for Hawaii*, 97 F. Supp. 3d at 1230 (holding that NMFS "cannot just parrot" what the applicant says).

3. NMFS would allow operators to take more marine mammals than the agency has proposed to authorize, in excess of its own "small numbers" threshold.

Even assuming *arguendo* that NMFS' 30 percent threshold for "small numbers" were correctly set and calculated, four out of the five applicants would exceed that threshold, by NMFS' estimates, for many of the region's marine mammal species. Specifically, the applicant Spectrum would exceed the threshold for rough-toothed dolphins (39% taken), common bottlenose dolphins (39%), Clymene dolphins (53%), Atlantic spotted dolphins (31%), and pantropical spotted dolphins (38%); TGS for fin whales (33%), sperm whales (74%), pygmy and dwarf sperm whales (33%), multiple beaked whale species (93%), rough-toothed dolphins (52%), common bottlenose dolphins (46%), Atlantic spotted dolphins (82%), pantropical spotted dolphins (35%), striped dolphins (35%), short-beaked common dolphins (33%), Risso's dolphins (46%), and short- and long-finned pilot whales (52%); Western for sperm whales (37%), beaked whale species (35%), Atlantic spotted dolphins (34%); and CGG for rough-toothed dolphins

(34%), Clymene dolphins (53%), and pantropical spotted dolphins (37%). *See* Proposed IHAs at 26295 (Table 10). In sum, all but four of the region's commonly occurring marine mammal species would be taken in excess of the agency's own statutory limits by at least one applicant.

NMFS, in an attempt to ensure that only "small numbers" of marine mammals are taken, proposes an applicant reporting scheme, whereby the applicant must submit a monthly account of the number of marine mammals spotted during operations by visual observers, with a correction factor applied to account for animals present yet undetected. *Id.* at 26307, 26311. If the 30 percent threshold were ever reached, the authorization would be withdrawn. *Id.* at 26307. Unfortunately, NMFS' proposal is based on assumptions about marine mammal detection that are plainly erroneous.

First, the proposed reporting scheme fails to accurately account for the detectability of marine mammals within the operator-monitored area. As NMFS notes, marine mammals can come within a monitored area and yet go undetected, either because they are beneath the surface and thus not available for viewing (known as availability bias), or because they are missed by the observer (known as detection bias). Proposed IHAs at 26311; *see also id.* at 26256 (noting that "even under good conditions, not all animals will be observed and cryptic species may not be observed at all"). To account for this, NMFS would adjust the number of observed marine mammals by using a slate of correction factors set forth by Carr et al. (2011),[121] arriving at a total that represents the total number of that species, both detected and undetected, within the observation area. Proposed IHAs at 26311.

But the use of those particular correction factors is grossly inappropriate here. Detection probabilities in Carr et al. (2011) are derived from dedicated marine mammal line-transect surveys conducted by NOAA. Those surveys tend to have a greater number of on-task observers (three instead of two), with greater experience than those proposed for these surveys.[122] Moreover, unlike the seismic surveys conducted by industry, NOAA marine mammal surveys are limited to daylight hours and calm sea conditions,[123] as detection probabilities fall quickly even in moderate sea states.[124] Even for the most conspicuous large whale species, estimates of

[121] Carr, S.A., Gaboury, I., Laurinolli, M., MacGillivray, A.O., Turner, S.P., Zykov, M., Frankel, A.S., Ellison, W.T., Vigness-Raposa, K., Richardson, W.J., Smultea, M.A., and Koski, W.R., Acoustic modeling report (2011) (acoustic modeling report prepared for TEC, Inc., Annapolis, Maryland). Remarkably, at least one of the three papers used by Carr et al. (2011) to derive detection probabilities (Thomas et al. (2002)) is based on aerial survey data, and is therefore not directly applicable to vessel-based observation in any case. And a second of those papers produces detection probabilities for animals located directly on the trackline of a vessel (known as g(0) probabilities), rather than within a distance from a trackline (known as f(0) probabilities), such as the exclusion and buffer zones at issue here. Barlow, J., Trackline detection probability for long-diving whales, Garner, G.W., Amstrup, S.C., Laake, J.L., Manly, B.F.J., McDonald, L.L., and Robertson, D.G. (eds.), *Marine Mammal Survey and Assessment Methods* 209-221 (1999). Apart from the obvious inconsistencies with seismic monitoring operations, NMFS' reliance on this particular set of correction factors is inexplicable.

[122] *See* Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *Journal of Cetacean Research and Management* 7: 239-249 (2006).

[123] *Id.*

[124] Barlow, J., Inferring trackline detection probabilities, g(0), for cetaceans from apparent densities in different survey conditions, *Marine Mammal Science* 31: 923-943 (2015).

relative detection probability for a Beaufort sea state of 6 is less than half that for a Beaufort Sea State of 0 (see Fig. 2 for estimated values of transect detection probability).[125] Sea state has been demonstrated to have a direct effect on the sighting probability of North Atlantic right whales in the Lower Bay of Fundy and in Roseway Basin of the Southwest Scotian Shelf.[126] In line with Barlow (2015), the probability of sighting a North Atlantic right whale in this area changed by a factor of 0.628 (95% CI: 0.428-0.921) for every unit increase in sea state.[127]

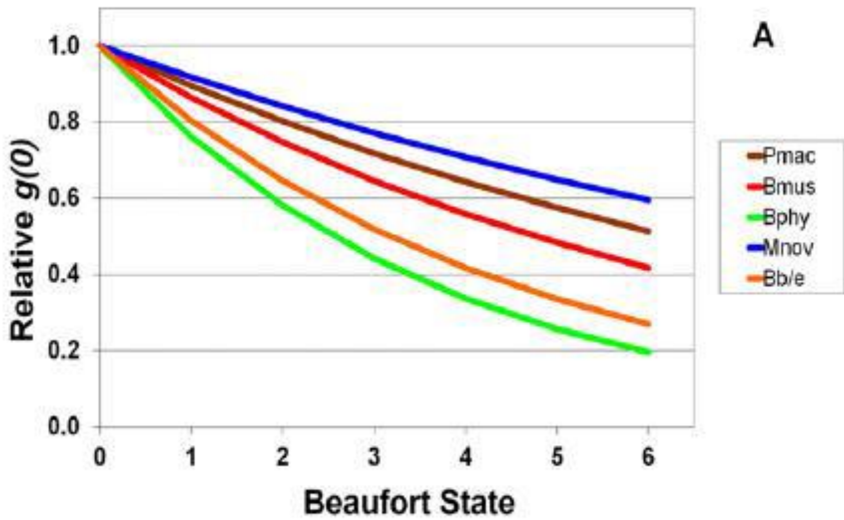

Fig. 2. Estimated values of transect detection probability, g(0), in Beaufort Sea States 1-6 relative to Beaufort 0 for five large whale species: Physeter microcephalus (Pmac), Balaenoptera musculus (Bmus), Balaenoptera physalus (Bphy), Megaptera novaeangliae (Mnov), and Baleanoptera borealis/edeni (Bb/e). Figure taken directly from Barlow (2015), at 10.

These studies indicate the effect of increasing Beaufort sea state in reducing the probability of detection of large whales, including the North Atlantic right whale. This is a salient consideration in the evaluation of whether or not a species can be adequately protected by species observers alone, given the relatively high mean wave heights and Beaufort sea states in the areas off the U.S. East Coast where the proposed surveys would take place. Based on the data collected by the National Buoy Data Center (see Table 1), an annual average Beaufort sea state of 3 or 4 can be expected, with maximal extremes ranging from 7-9 on the Beaufort scale.

Given these data, observers are certain to significantly undercount the number of large whales in the mitigation area based on sea state alone. From the findings of Baumgartner et al. (2003), we would expect a reduction in detection probability of North Atlantic right whales by up to 84.5%

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[125] *Id*.

[126] Baumgartner, M.F., Cole, T.V.N., Clapham, P.J., and Mate, R., North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001, *Marine Ecology Progress Series* 264: 137-154 (2003).

[127] *Id*.

based on an average Beaufort sea state of 4 (Table 1), relative to ideal sighting conditions (*i.e.*, Beaufort Sea State = 0). Notably, the detectability of right whales even under ideal sighting conditions is likely to be significantly less than 100 percent given availability and perception biases other than those involving sea state, including behavioral factors limiting right whale detection.[128] Indeed, these behavioral responses are likely to be heightened when whales are in the proximity of the acoustic disturbance from seismic surveys meaning that animals may be less detectable by observers during the survey period relative to other times of the year.[129]

Table 1. Mean, standard deviation (S.D.), minimum (min), and maximum (max) wave height (m), and mean and range on Beaufort Sea State (BS) values for up to ten years of data collected at seven buoys positioned along the U.S. East Coast from Delaware to Florida. Data source: NOAA National Buoy Data Center (NBDC) (2015).

Buoy	Location	Years	Wave Height (m)				BS (Mean [Range])
			Mean	S.D.	Min	Max	
Delaware Bay 26 M Southeast of Cape May, NJ	38.461 N, 74.703 W	2007-2016	1.23	0.70	0.15	8.41	4 [1-9]
Cape Henry, VA	36.915 N, 75.720 W	2008-2016	1.01	0.49	0.21	5.17	4 [2-7]
Oregon Inlet, NC	35.750 N,	2012-	1.36	0.79	0.3	7.9	4 [2-9]

128 *See* Winn, H.E., Price, C.A. and Sorenson, P.W., The distributional biology of the right whale (*Eubalaena glacialis*) in the western North Atlantic, *Report of the International Whaling Commission*, Special Issue, 10: 129-138 (1986); Baumgartner, M. F., and Mate. B.R., Summertime foraging ecology of North Atlantic right whales, *Marine Ecology Progress Series* 264: 123-135 (2003); Nowacek, D.P., et al., North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli, *supra;* Parks, S.E., Warren, J.D., Stamieszkin, K., Mayo, C.A., and Wiley, D., Surface foraging of North Atlantic right whales increases risk of vessel collision, *Biology Letters* 11: rsbl20110578 (2011); Morano, J.L., Rice, A.N., Tielens, J.T., Estabrook, B.J., Murray, A., Roberts, B.L., and Clark, C.W., Acoustically detected year-round presence of right whales in an urbanized migration corridor, *Conservation Biology* 26: 698-707 (2012); Robertson, F.C., Koski, W.R., and Thomas, T.A., Seismic operations have variable effects on dive-cycle behavior of bowhead whales in the Beaufort Sea, *Endangered Species Research*, 21: 143–60 (2013). In addition to the effect of sighting conditions, studies suggest that North Atlantic right whales exhibit a number of behaviors that reduce the likelihood that they would be detected by protected species observers. The fact that right whales often go undetected by observers has been demonstrated by acoustic data. For example, acoustic surveys have detected right whale vocal presence throughout the year and over the entire spatial extent of a study area in Massachusetts Bay (Morano et al. 2012) even though visual surveys have rarely reported sightings of right whales in the winter off the coast of Massachusetts (Winn et al. 1986; Pittman et al. 2006). Additionally, there is evidence that right whales spend significantly more time at subsurface depths (1-10 m) compared to normal surfacing periods (within 1 m of the surface) when exposed to certain types of acoustic disturbance (Nowacek et al. 2004). Significant reductions of surfacing time have also been found in bowhead whales exposed to seismic airgun surveys, leading to calls for adjustments in correction factors for industry survey monitoring (Robertson et al. 2013).

129 Robertson, F.C., et al., Seismic operations have variable effects on dive-cycle behavior of bowhead whales, *supra*.

	75.330 W	2016					
Diamond Shoals, NC	35.006 N, 75.402 W	2007-2016	1.51	0.76	0	8.44	4 [0-9]
EDISTO – 41 NM Southeast of Charleston, SC	32.501 N, 79.099 W	2007-2012, 2014-2016	1.27	0.66	0	7.7	4 [0-9]
Grays Reef – 40 NM Southeast of Savannah, GA	31.400 N, 80.868 W	2007-2016	0.95	0.45	0	5.88	3 [0-8]
Offshore Fernandina Beach, FL	30.709 N, 81.292 W	2006-2016	0.87	0.43	0.16	5.96	3 [1-8]

Similar concerns exist for other species, such as beaked whales. The differences in observer numbers and visibility conditions alone were estimated, in one paper, to result in a 16-times decrement in beaked whale detections during mitigation surveys,[130] meaning that the correction factor for beaked whales, which stands at 0.244 in NMFS' notice (at 26311), should be no greater than 0.014 and probably should be much lower. And NMFS' estimate assumes—wrongly—that the active seismic source will not cause most marine mammals to attempt to vacate the area or otherwise make themselves less available for detection.[131] No effort has been made to compensate for these differences.

Second, and perhaps even more significantly, the monitoring scheme does not appear to account for the detection availability of marine mammals occurring within the impact zone but outside the operator-monitored area. *See id.* at 26311. While applicants are required to report every marine mammal observation, regardless of distance, it is reasonable to assume that observer effort will focus primarily on the 1 km buffer zone around the airgun array, which the Proposed IHAs require the applicants to monitor for mitigation purposes. *E.g.*, Proposed IHAs at 26322 ("The PSOs [Protected Species Observers] shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone."). As a matter of simple math, that 1 km buffer zone is *roughly 100 times smaller* than the area in which, according to NMFS, sound exceeding the assumed take threshold of 160 dB (RMS) "would reasonably be expected to occur" (Proposed IHAs at

[130] Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *supra*.

[131] *See, e.g.,* Dunlop, R.A., Noad, M.J., McCauley, R.D., Kneist, E., Slade, R., Paton, D., and Cato, D.H., Response of humpback whales (*Megaptera novaeangliae*) to ramp-up of a small experimental air gun array, *Marine Pollution Bulletin* 103(1-2): 72-83 (2016); Miller, G.W., et al., Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002, *supra*; Robertson, F., Koski, W.R., Brandon, J.R., and Rites, A.W.T., Correction factors account for the availability of bowhead whales exposed to seismic operations in the Beaufort Sea, *Journal of Cetacean Research and Management* 15: 35-44 (2015); Stone, C.J., and Tasker, M.L., The effects of seismic airguns on cetaceans in UK waters, *Journal of Cetacean Research and Management* 8(3): 255-263 (2006).

26256).[132] And this assumes, contrary to best available science (see section II.A.2.a, above), that marine mammals would not experience behavioral disruption beyond the 160 dB isopleth.

NMFS should have based its "small numbers" implementation scheme on modeled take—a system that does not depend on the vagaries and limitations of marine mammal monitoring—as it has done for seismic IHAs in Cook Inlet, Alaska. *See*, *e.g.*, 80 Fed. Reg. 29162, 29183 (May 20, 2015) (limiting seismic company's takes of Cook Inlet beluga by multiplying the "daily ensonified area" by "the average density of beluga whales" in that area). Its proposed reporting scheme for Atlantic seismic surveys cannot ensure that take is kept within the bounds even of NMFS' 30-percent authorization, and the agency, in promulgating it, would be acting in violation of law.

B. NMFS' preliminary finding that the proposed activities would not have a "greater than negligible impact" on marine mammal species and stocks would, if adopted, be arbitrary and capricious and in violation of law.

The MMPA authorizes NMFS to issue an IHA only if the agency finds that the authorized harassment caused by a "specified activity" will have a "negligible impact" on marine mammals. 16 U.S.C. § 1371(a)(5)(D)(i). To make a finding of "negligible impact" under its regulations, NMFS must determine that the authorized harassment "cannot be reasonably expected to, and is not reasonably likely to, adversely affect" annual rates of recruitment or survival in any marine mammal species or population. 50 C.F.R. § 216.103.

1. NMFS' negligible impact determination fails to consider the total impact of all five seismic surveys.

NMFS proposes to issue five permits for geophysical survey activities that will take place in the same geographical region, over the same period of time, and that will have substantially similar impacts on marine mammals. *See* Proposed IHAs at 26,244-45. But the agency nowhere even purports to make a determination that the specified activities, taken together, will have a negligible impact on marine mammal species. Instead, despite proposing authorization for all five surveys in a single document, NMFS conducts its negligible impact analysis separately for each survey. This approach fails to meet the agency's legal obligations and is contrary to common sense and principles of sound science.

First, the agency's approach is unlawful. The MMPA provides, in pertinent part, that, "[u]pon request therefor by citizens . . . who engage in a specified activity . . . within a specific geographic region, the Secretary shall authorize . . . taking by harassment . . . by such citizens

[132] The buffer zone extends 1 kilometer around the airgun array, making for an area roughly 3.14 km^2 in size, while the area denoted by NMFS in which take "would reasonably be expected to occur" extends 10 kilometers around the airgun array, making for an area roughly 314 km^2 in size—100 times larger than the buffer zone. Notably, the median $R_{95\%}$ "take" distance in BOEM's propagation analysis is slightly greater than 8 km (PEIS at D-21), so even applying this non-conservative value, the impact zone would remain 64 times larger than the zone observers are required to monitor.

while engaging in that activity . . . if the Secretary finds that such harassment . . . will have a negligible impact on such species or stock." 16 U.S.C. § 1371(a)(5)(D)(i).

In enacting this provision, Congress indicated that a "specified activity" includes all actions for which "the anticipated effects will be substantially similar." *See* H.R. Rep. No. 97–228 (Sept. 16, 1981), *as reprinted in* 1981 U.S.C.C.A.N. 1458, 1469. While "it would not be appropriate . . . to specify an activity as broad and diverse as outer continental shelf oil and gas development" as a single "specified activity," the legislative history holds up "seismic exploration" as an appropriately defined "specified activity." *Id*. Thus, to meet the Act's requirements, NMFS must make the finding that the authorized activity—which includes all five applications for seismic exploration permits—will have a negligible impact on marine mammal species or stocks. *Cf. Conservation Council for Hawaii*, 97 F. Supp. 3d at 1221 ("[T]he MMPA makes it clear that it is *authorized* take that must be evaluated in determining whether there will be only a negligible impact.").

This is not a novel interpretation of the MMPA. In considering whether to allow incidental take, it has long been NMFS' policy that "[t]he Service will evaluate the impacts resulting from all persons conducting the specified activity, not just the impacts from one entity's activities." 54 Fed. Reg. 40,338, 40,338 (Sept. 29, 1989). It is also consistent with the purpose of the MMPA, which was intended not simply to prevent a single activity from causing harm to a species, but to provide broad and sustainable protections against anthropogenic impacts on marine mammals. *See* 16 U.S.C. § 1361. Yet in addressing one of the fundamental requirements for permit issuance—whether the specified activity will have a negligible impact on marine mammals—the agency analyzes each application separately. In so doing, it completely fails to acknowledge its own conclusion that "the specified activity, specified geographic region, and proposed dates of activity are substantially similar for the five separate requests for authorization." Proposed IHAs at 26245.

Second, NMFS' approach contradicts basic principles of common sense and scientific analysis, and creates a significant risk for the marine mammal species covered by NMFS' proposed IHA. The endangered sperm whale, for example, is expected to suffer *high* impacts from four of the five surveys (Proposed IHAs at 26301-06), yet NMFS entirely fails to evaluate the impact that these surveys, taken together, will have on the sperm whale's annual rates of recruitment or survival. The same is true of beaked whales, for which impacts from several of the proposed surveys are also considered *high*; and the *moderate* impacts that NMFS expects for some baleen whales might certainly become *high* when aggregated. *Id.* And even though, as NMFS acknowledges, stressors acting together on a marine mammal may produce an effect greater than that of any single stressor acting alone (Proposed IHAs at 26275), the agency never considers the adverse synergistic impacts of multiple exposures. It is arbitrary and capricious for NMFS, in determining whether impacts would be negligible, to disregard other activities affecting the same marine mammal species and populations.

Authorizations cannot lawfully issue unless the agency concludes that all five permit applications, taken together, will have a negligible impact on all marine species and stock.

2. NMFS' analysis underestimates impacts to marine mammal species and populations.

For its negligible impact analysis, NMFS adopts a "matrix assessment approach" that purports to consider "the potential impacts [of the activity] on affected marine mammals and the likely significance of those impacts to the affected stock or population as a whole." Proposed IHAs at 26296. This approach establishes an "impact rating" for each species, derived from a combination of two factors: "magnitude," which consists of the amount of take, and the spatial and temporal extent of the effect on marine mammal populations and their habitat; and "consequence," a qualitative assessment of the biological consequences of those impacts based on a variety of species-specific factors, such as "acoustic sensitivity, communication range, residency, known behaviors, and important areas." *Id.* at 26297. Impact ratings range by species and by survey applicant from *de minimis* to *high* (*id.* at 26298), as in the case of the beaked whales species and sperm whales mentioned above. Finally, NMFS considers qualitatively whether contextual factors, such as the population's conservation status or mitigation measures that the agency has proposed, would "offset" the impact rating, on which basis the agency arrives at its impact determination. *Id.* at 26297. Unfortunately, in practice, this approach turns significantly on cursory assessments of mitigation measures and other factors that, for many species, are plainly erroneous.

a. NMFS fails to consider the effects of other anticipated activities on the same marine mammal populations.

Although NMFS purports to incorporate "the impacts of other past and ongoing anthropogenic activities" into its impact analyses as part of an "environmental baseline," Proposed IHAs at 26296 (citing the preamble to the agency's implementing regulations, 54 Fed. Reg. 40338 (Sept. 29, 1989)), the agency has not adequately considered the impacts of other sources of ocean noise and habitat disturbance in reaching its preliminary determination that seismic operations will have a negligible impact on marine mammal species or stock.

In describing its negligible impact methodology, NMFS indicates that it "generate[d] relative impact ratings," which were "then combined with consideration of contextual information . . . to ultimately inform our preliminary determinations." Proposed IHAs at 26296. The agency states that effects of other activities are reflected in the "context" step of its assessment. *Id.* at 26299 (citing "other stressors" as a contextual factor).

Even assuming such an approach is lawful, the agency's execution of this approach exhibits several flaws. First, the agency provides a wholly deficient accounting of relevant other stressors. As noted at section II.B.1 above, the agency makes its negligible impact determination for each application individually; yet in each evaluation, NMFS fails to acknowledge the existence of the other four surveys, as though the proffered survey would occur in isolation from the other four survey applications pending before the agency. Further, NMFS fails to account for other current and anticipated stressors in the area, including but not limited to:

(1) the extensive additional geological and geophysical activity estimated in BOEM's Programmatic EIS, which NMFS proposes to adopt, *see* Proposed IHAs at 26296-307, and which includes more than 350,000 track miles of 2D seismic and 3500 lease blocks of intensive 3D seismic shooting, beyond the more than 90,000 track miles that NMFS proposes to authorize here, PEIS at Table 3-3; and

(2) extensive U.S. Navy training and testing in areas extending from Virginia to central Florida. NMFS previously authorized the Navy to take the same populations millions of times from December 2013 through December 2018 (78 Fed. Reg. 73009 (Dec. 4, 2013)), and the Navy's next MMPA application, covering the five-year period ending in late 2023, almost certainly has already been received by NMFS. 80 Fed. Reg. 69952 (Nov. 12, 2015) (giving public notice of Navy's intent to prepare EIS for next five-year period of activity).

Moreover, the agency provides no support for its conclusion that, when considered in the context of other stressors, the proposed seismic surveys will have no more than a negligible impact on marine mammal species. Bafflingly, the agency acknowledges that average annual human-caused mortality and significant injuries to five impacted species, including the North Atlantic right whale, *already* exceed sustainable levels (Proposed IHAs at 26300), then nonetheless concludes that the significant additional harassment that would be caused by the proposed seismic surveys will have no more than a negligible impact on these depleted species.

For these already stressed populations, the agency must incorporate the expected impacts of the full range of other activities, whether proposed, authorized, or unauthorized, into its analysis. NMFS must then provide a reasoned basis for its conclusion that, even in the context of these activities, the proposed seismic surveys will have no more than a negligible impact on the species.

b. NMFS underestimates the "magnitude" of the applicants' impacts on marine mammals.

NMFS' "magnitude" factor has been substantially underestimated for all cetaceans, with decisive effects on its negligible impact determinations.

Under the agency's new "matrix assessment approach," the "magnitude" of a survey's impact is based on its estimated amount of take and on its spatial and temporal overlap with a given species. In this, the take estimate is especially influential. For example, a finding that an activity produces a *de minimis* amount of take means that the "magnitude" of its impact is also considered *de minimis*, and if its "magnitude" is considered *de minimis*, that means its overall impact rating must be judged *de minimis* as well. *See* Proposed IHAs at 26298 ("Magnitude Rating" and "Impact Rating" matrices). The effect can quite clearly be seen in the agency's preliminary impact determinations for right whales. As four of the five proposed surveys purport to take a *de minimis* number of that critically endangered species, NMFS has characterized their overall impact as *de minimis*, too. *Id.* at 26302-06.

But the agency's take estimates, and its assessments of spatial and temporal overlap, are erroneous. As detailed in section II.A above, NMFS, *inter alia*, predicates its behavioral take estimates on an outdated standard that is plainly inconsistent with best available science; bases its estimates of auditory injury on non-conservative guidance that contains basic statistical errors; disregards the disruptive effects of masking in calculating behavioral take; ignores the potential for other forms of injury and mortality; and makes non-conservative assumptions about how airgun noise propagates through water; and when, notwithstanding all these problems, applicants are still found to individually exceed a statutory "small numbers" limit that NMFS has set at 30 percent, designs a plainly ineffectual reporting scheme that will allow surveys to take marine mammals beyond what the agency has authorized. In short, NMFS' analysis utterly fails to reflect the scale at which impacts from this activity are known to occur, resulting in underestimates of all three components of its "magnitude" factor, and for all cetacean species. This is especially concerning for right whales, which, like other baleen whales, are likely to incur behavioral disruption—resulting, for example, in loss of communication ability, in stress, and potentially in mother-calf separation—at very far distances from the source. (See section II.A.2.a above.) Given this, it is inconceivable that the "magnitude" of right whale impacts should be considered *de minimis* or *medium*, as it is in all of NMFS' negligible impact determinations. Proposed IHAs at 36301-06.

The problem is exacerbated by NMFS' use of a non-conservative metric to characterize amounts of species take. Under the agency's matrix system, seismic surveys that purport to behaviorally take less than 5% of a marine mammal population are said to have *de minimis* amounts of take, those that take between 5 and 15% are characterized as *low*, those that take between 15 and 25% are characterized as *moderate*, and those that take greater than 25% are characterized as *high*. *Id.* at 26297. In this, NMFS professes to adopt an analytical method produced five years ago for a seismic hazards survey off the California coast, which the agency cites as Wood et al. (2012). Proposed IHAs at 26297. Yet those authors took account of some vulnerable populations, at least, by applying a more conservative set of metrics for species listed under the Endangered Species Act.[133] Should NMFS have applied here a similar set of metrics, which are generally set an order of magnitude lower than the one applied to non-listed species,[134] three of the five proposed surveys (Spectrum, TGS, and ION) would have seen their right whale take characterized as *high* and two (Western and CGG) as *low*. *See* Proposed IHAs at 26295 (Table 10, providing estimates by survey and species of Level B take). In any case, NMFS never explains why it chose these metrics and why it considers them consistent with the mandate of the MMPA.

c. NMFS' summary consideration of masking effects misapprehends the scale of impacts.

As noted above at section II.A.2.b, NMFS recognizes that the masking of biologically important sounds can constitute harassment and affect the survival and reproduction of marine mammals. *See, e.g.*, Proposed IHAs at 26279 (masking can "potentially have long-term chronic effects on

[133] Wood, J., et al., PG&E Offshore 3-D Seismic Survey Project EIR—Marine Mammal Technical Report, *supra*.
[134] *Id.*

marine mammals at the population level as well as at the individual level"). Yet NMFS' treatment of masking in its "negligible impact" analysis is cursory and seems to misapprehend the spatial and temporal scope of the effects implicated here.

The agency's only mention of masking, in that analysis, comes in its general discussion of the "consequences" of seismic impacts on various species and groups of species, "consequences" being one of the two main factors in determining the "impact ratings" of seismic surveys. Specifically, NMFS characterizes those consequences as *medium* for each species of mysticete whales with greater than a *de minimis* amount of exposure, due to the greater potential that survey noise may subject individuals of these species to masking of acoustic space for social purposes (*i.e.*, they are low-frequency hearing specialists). *Id.* at 26298 (second italics added). Yet NMFS offers no analysis or explanation of why those "consequences" should be considered *medium* rather than *high*, and its reference, in this sentence, to a "de minimis amount of exposure" suggests that the agency believes that masking effects are co-extensive with the 160 dB "exposure" areas that the applicants have modeled for behavioral take. *Compare* id at 26298 ("*de minimis* amount of exposure") and, *e.g., id.* at 26295 (repeatedly characterizing Table 10 as "exposure estimates").

Yet the best available science indicates that masking is more closely connected to audibility thresholds than to NMFS' outdated threshold of behavioral harassment and, in baleen whales at least, operates at a potentially enormous scale. 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.[135] In a natural or even moderately disturbed acoustic environment, these levels are well below 100 dB.[136] Studies of airgun propagation in several regions around the world, and under varied propagation conditions, demonstrate that seismic surveys raise ambient noise levels across the interpulse interval and, in the low frequencies that baleen whales, sperm whales, pinnipeds, and certain non-marine mammal species (*e.g.*, many species of fish) depend on, can do so over enormous distances.[137] It would be plainly erroneous for NMFS to evaluate masking effects as though they were conditioned on a 160 dB harassment zone. The amount of behavioral disruption, causing take, should be higher as a result (as noted at section II.A.2.a above); and for purposes of NMFS' "spatial and temporal extent" analysis, the overlap between the activity's "expected footprint" (Proposed IHAs at 26297) and the range of many regional populations would be more extensive than NMFS envisions.

To assess the footprint of masking effects, the Fisheries Service should consider implementing the published model developed by researchers at NOAA and Cornell that quantifies impacts on

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[135] *See, e.g.*, Clark, C.W., et al., Acoustic masking in marine ecosystems, *supra*; Hatch, L.T., Clark, C.W., van Parijs, S.M., Frankel, A.S., and Ponirakis, D.W., Quantifying loss of acoustic communication space for right whales in and around a U.S. National Marine Sanctuary, *Conservation Biology* 26: 983-994 (2012).

[136] *E.g.*, Hatch et al., Quantifying loss of acoustic communication space, *supra*.

[137] *See, e.g.*, Guerra, M., Quantifying seismic survey reverberation, *supra*; Nieukirk, S.L., et al., Sounds from airguns and fin whales, *supra*; Estabrook, B.J., Ponirakis, D.W., Clark, C.W., and Rice, A.N., Widespread spatial and temporal extent of anthropogenic noise across the northeastern Gulf of Mexico shelf ecosystem, *Endangered Species Research* 30: 267-382 (2016); BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, *supra*, at K-19.

the communication space of marine mammals,[138] or a similar model. The NOAA/ Cornell model is widely accepted by the scientific and regulatory communities. Researchers have applied it to shipping noise off Massachusetts and off British Columbia,[139] the National Park Service has used it to map underwater noise in Glacier Bay National Park,[140] and conceptually similar acoustic habitat models have been applied in many other parts of the world. It has also been applied specifically to airgun surveys, *e.g.*, in the Beaufort Sea.[141] Notably, a complementary model of cumulative noise exposures was commissioned by NMFS for the northern Gulf of Mexico and included in the recent EIS for geological and geophysical activities in that region.[142] That model focused on a subspecies of Bryde's whale because of its dire conservation status; a similar analysis could be prepared for the North Atlantic right whale, looking, for example, at propagation of offshore seismic surveys into right whale critical habitat.

The agency is on the verge of approving activity—indeed, the first year of what BOEM expects to be many years of activity—that would raise natural ambient levels across the Northwest Atlantic and fundamentally alter acoustic habitat for low-frequency dependent species.[143] As it stands, NMFS has failed to adequately assess the impacts of masking on marine mammals.

d. NMFS underestimates the "consequences" of impacts from the proposed activities.

In evaluating the "consequences" of the proposed action, NMFS considers factors such as "acoustic sensitivity, communication range, known aspects of behavior relative to a consideration of consequences of effect, and assumed compensatory abilities to engage in important behaviors (*e.g.*, breeding, foraging) in alternate areas." Proposed IHAs at 26298. Yet these factors, while relevant, are misapplied to certain species, resulting in "impact ratings" that are improperly skewed downwards.

(1) Baleen whales

NMFS characterizes the probable consequences for all baleen whales "with greater than a *de minimis* amount of exposure" as *medium*, due to "the greater potential that survey noise may

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[138] Hatch et al., Quantifying loss of acoustic communication space, *supra*.

[139] *Id.*; Williams, R., Clark, C.W., Ponirakis, D., and Ashe, E., Acoustic quality of critical habitats for three threatened whale populations, *Animal Conservation* 17: 174-85 (2014).

[140] Gabriele, C.M., Clark, C.W., Frankel, A.S., and Kipple, B., Glacier Bay's underwater sound environment: The effects of cruise ship noise on humpback whale habitat (2017), available at https://www.nps.gov/articles/aps-9-2-3.htm (accessed July 2017).

[141] Fleishman, E., and Streever, B., Assessment of cumulative effects of anthropogenic underwater sound, *supra*.

[142] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, *supra*, at App. K.

[143] NOAA has recently identified acoustic habitat as a conservation priority and the focus of a new management effort. *See* Gedamke, J., et al., *Ocean Noise Strategy Roadmap*, *supra*; Hatch, L.T., et al., Can you hear me here? *supra*.

subject individuals of these species to masking of acoustic space for social purposes (*i.e.*, they are low-frequency hearing specialists).” Proposed IHAs at 26298 (first italics added). That characterization does not comport with the science on baleen whale impacts.

The best available science indicates that seismic airgun noise not only masks biologically important sounds and reduces communication space in baleen whales, but disrupts vocalizations in those species over large and, in some cases, vast distances (*i.e.*, tens to hundreds of thousands of square kilometers).[144] This effect has been documented in a diversity of baleen whale taxa, and the vocalizations that have been disrupted are associated with a variety of behavioral states, including foraging, breeding, and migrating.[145] NMFS does not discuss this effect, nor does it provide any rationale for why such large-scale disruption of vocalizations linked to biologically important activity would not constitute a *high* rather than *medium* “consequence.”

Similarly, NMFS provides no explanation of why acoustic masking would not have greater consequences for baleen whales. New science has demonstrated that communication calls between humpback whale mothers and calves are remarkably quiet,[146] suggestive of an anti-predator behavioral adaptation that may be conserved across other baleen whale species. Acoustic masking of these calls has the potential to directly affect calf survival, which, in the case of the North Atlantic right whale, could have catastrophic consequences for the survival of the species. Furthermore, population-level impacts of seismic surveys have previously been observed in the endangered western North Pacific gray whale, where noise from seismic surveys and pile driving has been shown to negatively impact calf survival, by up to two standard deviations.[147]

Reviewing these and other data, twenty-eight right whale experts—among them some of the world’s leading authorities on this endangered species—recently stated that the cumulative impacts of the proposed seismic surveys would “substantially increase the risk that the population will slip further in decline and would jeopardize its survival.”[148] For baleen whales in general and right whales in particular, NMFS’ finding that the “consequences” of each proposed survey would necessarily be medium is dangerously arbitrary.

(2) Other species

NMFS evaluation of the “consequences” for other species is also problematic.

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[144] *E.g.*, Castellote M., et al., Acoustic and behavioural changes by fin whales, *supra*; Cerchio S., et al., Seismic surveys negatively affect humpback whale singing activity, *supra*; Blackwell S.B., et al., Effects of airgun sounds on bowhead whale calling rates, *supra*. *See also* sections I.B and II.A.2.a.

[145] *Id.*

[146] Videsen, S.K.A., Bejder, L., Johnson, M., and Madsen, P.T., High suckling rates and acoustic crypsis of humpback whale neonates maximize potential for mother-calf energy transfer, *Functional Ecology* doi:10.1111/1365-2435.12871 (2017). It should also be noted, as we do elsewhere in these comments, that manmade sound can increase subsurfacing behavior, and thus ship-strike risk, in right whales. Nowacek, D.P., et al., Right whales ignore ships but respond to alarm stimuli, *supra*.

[147] Cooke, J.G., et al., Updated population assessment of the Sakhalin gray whale aggregation, *supra*.

[148] Statement from Clark, C.W., et al. (April 14, 2016), *supra*.

The agency considers "consequences" for sperm whales to be *medium* "due to potential for survey noise to disrupt foraging activity." Proposed IHAs at 26298. Yet it provides no explanation for why such disruption should not be considered more highly consequential given the amount of lost foraging success that has been documented (a nearly 20% loss) and the relatively low levels of airgun noise needed to cause that disruption (130 dB broadband SPL), even in a frequently exposed sperm whale population.[149] Moreover, airgun surveys have been documented to silence sperm whales, in some contexts, over extraordinarily wide expanses of ocean, hundreds of kilometers from an operating vessel.[150] NMFS has provided no rational basis for assuming only *medium* consequences for sperm whales.

NMFS ranks "consequences" for *kogia* as *low* since, while "presumed to be a more acoustically sensitive species," they would have "a reasonable compensatory ability to perform important behavior in alternate areas, as they are expected to occur broadly over the continental slope." Proposed IHAs at 26298. Yet the one paper NMFS cites for the latter proposition makes clear that, "[b]ecause of cryptic behavior, difficulty in identifying kogiids to species, and a generally deepwater distribution, little information is available regarding stock structure [among other population characteristics]."[151] Moreover, even if the species were wide-ranging, it cannot be supposed that displacement from optimal to suboptimal habitat comes without significant biological cost.[152] NMFS must provide more justification for why easily spooked, acoustically sensitive species are necessarily presumed, without sufficient information, to suffer relatively inconsequential impacts from the proposed activities.

NMFS finds that, with the exception of pilot whales (due to their residency in the region), the "consequences" of impacts on delphinids would necessarily be *low*, given a presumed unlikelihood that "disturbance due to survey noise would entail significant disruption of normal behavioral patterns, long-term displacement, or significant potential for masking of acoustic space." Proposed IHAs at 26298. Yet NMFS reaches this conclusion without any analysis of the existing science, which indicates the potential for displacement, shifts in behavioral states, and silencing and alteration of vocalizations in delphinids,[153] with potentially adverse energetic

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[149] Miller, P.J.O., et al., Using at-sea experiments to study the effects of airguns, *supra*. *See also* Isojunno, S., et al., Sperm whales reduce foraging effort, *supra*; Pirotta, E., et al., Variation in harbour porpoise activity in response to seismic survey noise, *supra*.

[150] Bowles, A.E., et al., Relative abundance and behavior of marine mammals exposed to transmissions, *supra*.

[151] Bloodworth, B.E., and Odell, D.K., *Kogia breviceps* (Cetacea: Kogiidae), *Mammalian Species* 819: 1-12 (2008) (entry published by American Society of Mammalogists). According to NMFS' recent stock assessment reports, the population biology of the two *kogia* species, dwarf sperm whales and pygmy sperm whales, "is inadequately known," including in the western North Atlantic. Dwarf sperm whale (*Kogia sima*): Western North Atlantic stock, *in* Hayes, S.A., Josephson, E., Maze-Foley, K., and Rosel, P.E., U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2016, at 67-72 (2017); Pygmy sperm whale (*Kogia breviceps*): Western North Atlantic stock, *in id.* at 73-78 (2017)

[152] *See, e.g.*, Bateson, M., Environmental noise and decision making: Possible implications of increases in anthropogenic noise for information processing in marine mammals, *International Journal of Comparative Psychology* 20: 169-178 (2007).

[153] *See, e.g.*, Lammers, M.O., Howe, M., Engelhaupt, A., Zang, E., Munger, L., and Nosal, E.M., Acoustic monitoring of dolphin occurrence and activity in a MINEX training range, *Proceedings of Meetings on Acoustics* 27:

effects even from apparently minor changes.[154] Nor does the agency, in casting all delphinids other than pilot whales into a single, low-impact category, account for the likelihood that some species in this large family of cetaceans, being more skittish, are likely to be more reactive than others to human disturbance.[155] Particularly where the magnitude of impact is considered *high*, as it is for some delphinid species in all but the ION survey (*see* Proposed IHAs at 26301-06), NMFS cannot assume without further analysis that the "consequences" for delphinids will be *low*.

Finally, and more generally, the matrix scheme that NMFS developed tends to undervalue the "consequences" factor in cases where the "magnitude" factor is low. Indeed, even when consequences are considered *high* for a marine mammal population, a *low* magnitude rating will result in a finding of only *moderate* impact. This outcome appears inconsistent with the common-sense finding in *Center for Biological Diversity v. Salazar*, originally advanced by NMFS in its briefing in that case, that even if an activity takes only small numbers of marine mammals, it can still have a greater than negligible impact on that species or population. 695 F.3d at 906-07 (noting, by way of example, that "anticipated harassment of even small numbers of mammals might prevent mating or reproduction during key times of year"). NMFS must modify its matrix scheme to account for that potential outcome.

e. NMFS erroneously relies on inadequate mitigation measures to make its "negligible impact" findings.

To reach its preliminary findings of negligible impact, NMFS puts decisive weight for a number of marine mammal populations on the effectiveness of the mitigation measures it has proposed. Among these species are those, like beaked whales, that receive *high* "impact ratings" under NMFS' analysis, and those of conservation concern, like the North Atlantic right whale. *See* Proposed IHAs at 26298-307. Unfortunately, NMFS' reliance on mitigation is based on wishful thinking unsupported by the evidence.

010011 (2016) (showing repeated cessation of dolphin calls around Navy training with low-weight explosives); Stone, C.J., and Tasker, M.L., The effects of seismic airguns on cetaceans, *supra* (showing, in the area observable from seismic vessels, more pronounced displacement in small odontocetes than in larger cetaceans).

[154] Williams, T.M., Kendall, T.L., Richter, B.P., Ribeiro-French, C.R., John, J.S., Odell, K.L., Losch, B.A., Feuerbach, D.A., and Stamper, M.A., Swimming and diving energetics in dolphins: A stroke-by-stroke analysis for predicting the cost of flight responses in wild odontocetes, *Journal of Experimental Biology* 200: 1135-1145 (2017); Holt, M.M., Noren, D.P., Dunkin, R.C., and Williams, T.M., Vocal performance affects metabolic rate in dolphins: Implications for animals communicating in noisy environments, *Journal of Experimental Biology* 218: 1647-1154 (2015); 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).

[155] For a general review, *see* Wartzok, D., Popper, A.N., Gordon, J., and Merrill, J., Factors affecting the responses of marine mammals to acoustic disturbance, *Marine Technology Society Journal* 37(4): 6-15 (2003). For illustration: On the potentially greater susceptibility of spotted dolphins, *see* Gray, H., and Van Waerebeek, K., Postural instability and akinesia in a pantropical spotted dolphin, *supra* (severe injury or neurological pathology seen in spotted dolphin exposed to airgun noise); Weir, C.R., Overt responses of humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter microcephalus*), and Atlantic spotted dolphins (*Stenella frontalis*) to seismic exploration off Angola, *Aquatic Mammals* 34(1): 71-83 (2008) (pronounced response of spotted dolphins to operating airguns).

(1) North Atlantic right whale

As NMFS' notice makes clear, the agency's proposed mitigation is "important" to reaching a negligible impact finding for right whales. *E.g.*, *id.* at 26304 (impact analysis for ION). This is true even of the four authorizations for which the agency, relying on the applicants' gross mischaracterizations of acoustic exposure, concludes that impacts on the species would be *de minimis*, given that the right whale is "endangered, has a very low population size, and faces significant additional stressors." *Id.* For all five surveys, the agency bases its "negligible impact" finding on the effectiveness of two proposed mitigation measures: its seasonal area closure and its requirement to shut down whenever a right whale is spotted, at any distance. *See id.* at 26299. That reliance runs counter to the facts.

NMFS' assertion that the proposed surveys will "avoid all areas where the right whale . . . may be reasonably expected to occur" (*id.*) ignores passive acoustic and other data demonstrating right whale occurrence offshore of the proposed ~47 km seasonal closure and outside the winter months covered by the exclusion.[156] Moreover, the 10 km buffer zone incorporated into the seasonal closure is insufficient to eliminate or even significantly reduce behavioral impacts on right whales given best available science showing the extent of impacts of seismic and other sources on baleen whales. *See* section II.A.2.a above. Nor would the measure meaningfully address the long-range problem of masking (*see, e.g.*, sections II.A.2.b and II.B.2.c) which NMFS recognizes as a significant concern for right whales given, most prominently, its potential to cause mother-calf separation. Proposed IHAs at 26254.

Similarly, NMFS' suggestion that its shut-down measure will effectively minimize the duration of harassment and reduce its significance "as much as possible" (Proposed IHAs at 26299) is not supportable. For vessel-based observers, right whale sighting probabilities are typically below NMFS' supposed 0.259 probability, even during dedicated research efforts in foraging habitat where right whales are often aggregated.[157] And dedicated surveys take place during daylight hours, with good visibility and reasonably low sea states, and with a greater number of professional observers on task; and, unlike high-energy airgun surveys, they do not put sound in the water that may induce dangerous subsurfacing behavior in the target species. See section II.A.3 above. The idea that marine mammal observers will be able to spot right whales under the suboptimal conditions prevalent in the proposed seismic surveys, and at the distances beyond 1 kilometer that NMFS' expanded shutdown requirement is intended to reach,[158] is absurd. Given the admitted importance of mitigation in reaching the "negligible impact" finding for right

[156] *E.g.*, Rice, A.N., et al., Baseline bioacoustics surveys of four Atlantic offshore wind energy planning areas, *supra*; LaBrecque, E., et al., Biologically important areas for cetaceans within U.S. waters—East coast region, *supra*.

[157] *See*, *e.g.*, Baumgartner, M.F., et al., North Atlantic right whale habitat in the lower Bay of Fundy and on the Scotian Shelf, *supra*.

[158] *See* Barlow, J., Ballance, L.T., and Forney, K.A., Effective strip widths for ship-based line-transect surveys of cetaceans (2011) (NOAA Tech. Memo. NMFS-SWFSC-484) (finding effective strip width for North Pacific right whales to be only 2.03 km in dedicated vessel surveys).

whales (*id.* at 26304), NMFS must do more than make summary claims about the effectiveness of its measures.

It is worth noting particular to right whales that NMFS presumes away impact at each stage of the agency's "negligible impact" analysis. "Magnitude" is found to be *low* or *de minimis*, despite the wide range over which behavioral responses and masking can occur; the "consequences" of those effects are considered *medium*, notwithstanding the potential for mother-calf separation and other significant adverse impacts; and, as a matter of "context," the inadequate mitigation is assumed, against evidence, to sufficiently prevent harm. NMFS' approach is egregious in view of the right whale's conservation status: its continued endangerment, its recent decline, its struggle with the morbidity and loss of reproduction resulting from non-lethal entanglements, and, most recently, a stunning die-off of at least eight whales in the Gulf of St. Lawrence.[159] No attempt is made to consider the effects on right whale health (or the health of any other marine mammal population, for that matter) from decrements in foraging or other vital activity. By contrast, the right whale scientific community—which includes numerous bioacousticians and senior experts on the species—takes the risk of seismic surveys in this region seriously, concluding that it "may well represent a tipping point for the survival of this endangered whale, contributing significantly to a decline towards extinction."[160]

NMFS' impact analysis for this vulnerable species is arbitrary and capricious.

(2) Beaked whales

NMFS likewise recognizes the importance of mitigation in attaining a negligible impact finding for beaked whales. In the case of TGS, for example, it concludes that the "magnitude" of beaked

[159] Pettis, H.M., and Hamilton, P.K., North Atlantic Whale Consortium annual report card: Report to the North Atlantic Right Whale Consortium, November 2016 (2016); Rolland R.M., Schick R.S., Pettis H.M., Knowlton A.R., Hamilton P.K., Clark J.S., and Kraus S.D., Health of North Atlantic right whales Eubalaena glacialis over three decades: From individual health to demographic and population health trends, *Marine Ecology Progress Series* 542: 265-282 (2016); Atlantic Scientific Review Group, Letter to Eileen Sobeck, Assistant Administrator for Fisheries, NMFS (Apr. 4, 2016); Knowlton, A.R., Hamilton, P.K., Marx, M.K., Pettis, H.M., and Kraus, S.D., Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: A 30-yr retrospective, *Marine Ecology Progress Series* 466: 293-302 (2012); van der Hoop, J., Corkeron, P., and Moore, M., Entanglement is a costly life-history stage in large whales, *Ecology and Evolution* 7(1): 92-106 (2017); Gill, J., "Unprecedented event: 6 North Atlantic right whales found dead in June," *CBC News*, June 24, 2017, available at www.cbc.ca/news/canada/new-brunswick/six-dead-right-whales-1.4176832 (accessed July 2017); "7th right whale found dead in Gulf of St. Lawrence," *CBC News*, July 7, 2017, available at www.cbc.ca/news/canada/montreal/seventh-right-whale-found-dead-1.4194215 (accessed July 2017); Wang, A.B., and Phillips, K., "U.S. to suspend efforts to free trapped whales after Canadian rescuer is killed," *Washington Post*, July 15, 2017, available at www.washingtonpost.com/news/animalia/wp/2017/07/15/u-s-to-suspend-efforts-to-free-trapped-whales-after-canadian-rescuer-is-killed/?utm_term=.bfe71aebfc67 (accessed July 2017); Russ Bynum, "Endangered right whales deliver fewest births in 17 years," *Phys.org*, Apr. 12, 2017, available at https://phys.org/news/2017-04-endangered-whales-fewest-births-years.html (accessed July 2017); Fraser, E., "8th right whale found dead in Gulf of St. Lawrence, 1 more entangled," July 20, 2017, available at cbc.ca/news/Canada/new-brunswick/right-whale-dead-gulf-st-lawrence-1.4213660 (accessed July 2017). As of the date of this letter, NMFS has suspended its disentanglement program for right whales in the wake of a rescuer's death.

[160] Statement from Clark, C.W., et al. (Apr. 14, 2016), *supra*..

whale impacts would be *high*, that the agency's "consequence" factors "reinforce high impact ratings," and that, "regardless of impact rating, the consideration of likely consequences and contextual factors leads us to conclude that targeted mitigation is important to support a finding that the effects of the proposed survey will have a negligible impact." Proposed IHAs at 26303. In mitigating impacts on beaked whales, the agency depends on two measures similar to those it proposes for right whales: an expanded shutdown requirement that applies when a beaked whale is spotted "at any distance" from the airgun array and time-area closures that, it argues, would benefit this family of species. *Id.* at 26299, 26303. But again its reliance on those measures is not supported by facts.

There is no evidence that NMFS' expanded shutdown measure would have any benefit whatsoever for beaked whales. Beaked whales are "cryptic" species, difficult to spot in the water even under optimal oceanographic conditions, which are seldom present here; and they quickly approach undetectability in higher sea states (*i.e.*, sea states > Beaufort 2), with sightings so rare in those conditions that density "is often estimated only from survey data collected in calm seas."[161] As noted above at section II.A.3, the visibility conditions and observer requirements that apply to seismic surveys make for a 16-fold decrement in the detection probabilities expected of a typical large-vessel survey, meaning that the likelihood of spotting a beaked whale (using NMFS' dubious 0.244 probability) hovers around 0.014.[162] And that is for beaked whales occurring directly on the vessel trackline, not beyond 1 kilometer, where the expanded shutdown requirement kicks in.[163]

The only proposed measure that might in any way ameliorate impacts on beaked whales is its Closure Areas #2-4, encompassing three small subcanyon areas that are rightly assumed to be areas important for beaked whale foraging (Proposed IHAs at 26264 (explaining rationale for Areas #2-4 in Roberts et al. (2016) habitat modeilng); but these areas are small, appear to lack a buffer zone sufficient to eliminate impacts on such highly sensitive species, and make up a small part of the 25% core abundance area that is NMFS' basis for geospatial mitigation. Meanwhile, the larger Area #5, which mark-recapture, tagging, and other data indicate is home to a resident population of Cuvier's beaked whales—in addition to including one of the most biologically important areas for marine mammals in the entire ocean basin (see section II.C.2.a below)—receives a three-month area closure that bears no relationship to beaked whale seasonality and thus would have no benefit for those species.

Again, for beaked whales as for right whales, NMFS must do more than make summary, unsubstantiated claims about the effectiveness of its mitigation measures.

(3) Other species and populations

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[161] Barlow, J., Inferring trackline detection probabilities, g(0), for cetaceans, *supra*.

[162] Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *supra*.

[163] According to Barlow, the probability of detecting a Cuvier's beaked whale directly on the trackline of a dedicated survey vessel, in relatively calm sea states (Beaufort 0-2), is 0.23. Barlow, J., Inferring trackline detection probabilities, g(0), for cetaceans, *supra*. Sighting probabilities decrease as the whale gains distance from the trackline.

NMFS relies on mitigation for other species, including but not limited to sperm whales and pilot whales. *E.g.*, Proposed IHAs at 26303 (impact analysis for the Spectrum survey). For these species, too, the agency briefly cites an expanded safety zone and time-area closures as rationales for its "negligible impact" determinations. Proposed IHAs at 26298-307. Its dependence on these measures fails for reasons analogous to those discussed above. NMFS cannot use unsubstantiated measures as its basis for avoiding a greater than negligible impact.

3. NMFS' consideration of effects on marine mammal prey species and habitat is grossly inadequate in light of the available scientific evidence.

In its general discussion of impacts, NMFS assesses the potential effects of the proposed surveys on marine mammal prey species and acoustic habitat, concluding, in a single page, that such impacts are "not expected to cause significant or long-term consequences for individual marine mammals or their populations." Proposed IHAs at 26281. It is for this reason, perhaps, that the agency does not include any consideration of these effects in its negligible impact analysis. *See id.* at 26296-26307. But NMFS' summary dismissal is plainly inadequate in light of the best available science.

a. NMFS ignores effects on prey species.

NMFS asserts that the effect of seismic surveying on marine mammal prey will be "minor and temporary" and limited to those fish species that are unable to avoid the area during the survey period. Proposed IHAs at 26281. Unfortunately, the agency has ignored in its analysis the wealth of scientific evidence that has been amassed over the past two-and-a-half decades demonstrating the significant harm that noise generated by seismic airguns can cause fish and marine invertebrates. Alarmingly, potential impacts to marine invertebrates, which include direct prey species for marine mammals (*e.g.*, squid) and form the base of the oceanic food chains upon which marine mammals rely, were completely ignored.

As the synthesis below demonstrates, both impulsive low-frequency noise from seismic airguns and the continuous low-frequency noise into which the impulsive blasts transform over long distances have the potential to cause significant harm to both fish and marine invertebrates, and potentially compromise marine mammal habitat. There is no scientific support for NMFS' assumptions that impacts will be limited to behavioral responses in fish, that the majority of fish would be capable of moving out of the project area during surveys, that a rapid return to normal recruitment, distribution, and behavior would be anticipated, and that, overall, impacts would be minor and temporary.

In fact, the best available science indicates the impacts of seismic on marine mammal prey species will:

- Cause harm to a wide variety of fish and marine invertebrate species, over massive geographic areas, in both the immediate and long term;

- Result in a wide range of impacts to individuals and populations, including mortality and physical injury, impairment of hearing and other vital sensory functions, compromised health, reductions in recruitment, and changes to natural behaviors and acoustic masking of biologically important sounds that may reduce reproductive potential and foraging success and increase the risk of predation; and
- Potentially result in ecosystem-level effects, with concomitant impacts on marine mammals, by significantly reducing the abundance and diversity of zooplankton over vast areas and inducing changes in community composition due to the aggregation of individual- and population-level impacts across multiple fish and invertebrate species.

More specifically, impulsive noise from seismic airgun blasts:

(1) *Causes severe physical injury and mortality*. Research into the impacts of exposure to pile driving (which generates similar acute, high-intensity, low-frequency sound as seismic operations) has shown substantial damage to the internal organs of fish, including the swim bladder, liver, kidney, and gonads.[164] For marine invertebrates, exposure to near-field low-frequency sound may cause anatomical damage. Strikingly, zooplankton abundance was found to decline by up to 50% (in 58% of the species examined) up to three quarters of a mile from a single airgun source (volume: 150 cubic inches)[165] in 24 hours following exposure; krill larvae were completely wiped out.[166] Pronounced sensory organ ("statocyst") and internal organ damage was observed in seven stranded giant squid after nearby seismic surveys.[167] Exposure of scallops to seismic signals was found to significantly increase mortality, particularly over long periods of time after exposure.[168]

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[164] Casper, B.M., Popper, A.N., Matthews, F., Carlson, T.J., and Halvorsen, M.B., Recovery of barotrauma injuries in Chinook salmon, *Oncorhynchus tshawytscha,* from exposure to pile driving sound, *PLoS ONE* 7(6): e39593 (2012); Halvorsen, M.B., Casper, B.M., Woodley, C.M., Carlson, T.J., and Popper, A.N., Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds, *PLoS ONE* 7(6): e38968 (2012); Casper, B.M., Halvorsen, M.B., Matthews, F., Carlson, T.J., and Popper, A.N., Recovery of barotrauma injuries resulting from exposure to pile driving sound in two sizes of hybrid striped bass, *PLoS ONE* 8(9): e73844 (2013); Halvorsen, M.B., Zeddies, D.G., Chicoine, D., and Popper, A.N., Effects of low-frequency naval sonar exposure on three species of fish, *Journal of the Acoustical Society of America* 134: EL205-EL210 (2013); Halvorsen, M.B., Casper, B.M., Carlson, T.J., and Popper, A.N., Presentation at Oceanoise2017 Conference (May 8-12, 2017).

[165] As noted elsewhere, the proposed surveys will use vessels that will each tow an airgun array comprising between 24-40 airguns, with a combined value of 4808-6420 in^3 per vessel.

[166] McCauley, R.D., et al., Widely used marine seismic survey air gun operations negatively impact zooplankton, *supra*.

[167] Guerra, Á., González, Á.F., and Rocha F., A review of the records of giant squid in the north-eastern Atlantic and severe injuries in *Architeuthis dux* stranded after acoustic explorations, *ICES CM* 200: 29 (2004).

[168] Day, R.D., McCauley, R., Fitzgibbon, Q.P., and Semmens, J.M., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries (2016) (Fisheries Research & Development Corporation Report 2012-008-DLD); Semmens, J., Day, R.D., Fitzgibbon, Q.P., Hartmann, K., and Simon, C.J., Presentation at Oceanoise2017 Conference: Are seismic surveys putting bivalve and spiny lobster fisheries at risk? (May 8-12, 2017).

(2) *Damages the hearing and sensory abilities of fish and marine invertebrates*. For fish, the high-intensity of airgun emissions may damage hair cells and cause changes in associated hearing capabilities. Exposure to repeated emissions of a single airgun caused extensive damage to the sensory hair cells in the inner ear of the caged pink snapper; the damage was so severe that no repair or replacement of hair cells was observed for up to 58 days after exposure.[169] Airgun exposure was found to cause damaged statocysts in rock lobsters and spiny lobsters up to a year following exposure.[170] It was hypothesized that the devastating impacts of a single seismic airgun on zooplankton was, at least in part, due to severe statocyst damage.[171]

(3) *Impedes development of early life history stages.* Early life history stages of some groups of fish and invertebrates may be more susceptible to the impacts of underwater noise. Exposure to a single seismic airgun resulted in complete mortality of krill larvae up to three quarters of a mile from the source.[172] Repeated exposure to nearby seismic sound caused slower development rates in the larvae of crabs[173] and scallops.[174] Lesions on the statocysts of squid and cuttlefish appeared 48 hours following noise exposure in adults, whereas the same degree of damage was observed immediately after exposure in hatchlings.[175]

(4) *Induces stress that physically damages marine invertebrates and compromises fish health*. Experimental seismic noise has been shown to affect primary stress hormones (adrenaline and cortisol) in Atlantic salmon[176] and European seabass have shown elevated ventilation rates, indicating heightened stress, in response to seismic surveys;[177] elevated stress hormones and chemicals have also been

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[169] McCauley R.D., et al., High intensity anthropogenic sound damages fish ears, *supra*.

[170] Day, R.D., et al., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries, *supra*; Semmens, J., et al., Presentation at Oceanoise2017 Conference: Are seismic surveys putting bivalve and spiny lobster fisheries at risk? *supra*.

[171] McCauley, R.D., et al., Widely used marine seismic survey air gun operations negatively impact zooplankton, *supra*.

[172] *Id*.

[173] Christian, J.R., Mathieu, A., Thompson, D.H., White, D., and Buchanan, R.A., Effect of seismic energy on snow crab (*Chionoecetes opilio*) (2003) (Environmental Studies Research Fund File No. CAL-1-00364).

[174] Aguilar de Soto, N., et al., Anthropogenic noise causes body malformations and delays development in marine larvae, *supra*.

[175] Solé, M., Lenoir, M., Fortuño, J.M., van der Schaar, M., and André, M., Presentation at Oceanoise2017 Conference: Sensitivity to sound of cephalopod hatchlings (May 8-12, 2017).

[176] Sverdrup, A., Kjellsby, E., Krüger, P., Fløysand, R., Knudsen, F., Enger, P., Serck-Hanssen, G., and Helle, K., Effects of experimental seismic shock on vasoactivity of arteries, integrity of the vascular endothelium and on primary stress hormones of the Atlantic salmon, *Journal of Fish Biology* 45: 973-995 (1994).

[177] Radford, A.N., Lèbre, L., Lecaillon, G., Nedelec, S.L., and Simpson, S.D., Repeated exposure reduces the response to impulsive noise in European seabass, *Global Change Biology* 22: 3349-3360 (2016).

recorded in sea bass following airgun exposure.[178] Invertebrates may exhibit common immune suppression and compromised ability to maintain homeostasis, with similar responses observed in scallops and spiny lobsters up to 120 days post-exposure,[179] potentially affecting the long-term health of associated fisheries.[180]

(5) *Causes startle and alarm responses that interrupt other vital behaviors, such as feeding and reproduction.* Airgun discharges elicit varying degrees of startle and alarm responses in fish, including escape responses and changes in schooling patterns, water column positions, and swim speeds.[181] Startle and alarm responses have been observed in captive fish several kilometers from the sound source, with European sea bass and the lesser sand eel responding at distances up to 2.5 and 5 km from a seismic source, respectively.[182] Startle responses are also commonly observed in marine invertebrates; jetting and inking – behaviors typically induced by ambush predators – have been observed in squid,[183] and scallops have shown a distinctive flinching response in response to airgun signals and persistent

[178] Santulli, A., Modica, A., Messina, C., Ceffa, L., Curatolo, A., Rivas, G., Fabi, G., and D'Amelio, V., Biochemical responses of European sea bass (*Dicentrarchus labrax* L) to the stress induced by offshore experimental seismic prospecting, *Marine Pollution Bulletin* 38: 1105-1114 (1999).

[179] Day, R.D., et al., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries, *supra*; Semmens, J., et al., Presentation at Oceanoise2017 Conference: Are seismic surveys putting bivalve and spiny lobster fisheries at risk? *supra*.

[180] Day, R.D., et al., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries, *supra*.

[181] Skalski, J.R., et al., Effects of sounds from a geophysical survey device on catch-per-unit-effort, *supra*; Santulli, A., Modica, A., Messina, C., Ceffa, L., Curatolo, A., Rivas, G., Fabi, G., and D'Amelio, V., Biochemical responses of European sea bass (*Dicentrarchus labrax* L) to the stress induced by offshore experimental seismic prospecting," *Marine Pollution Bulletin* 38: 1105-1114 (1999); Wardle, C.S., Carter, T.J., Urquhart, G.G., Johnstone, A.D.F., Ziolkowski, A.M., Hampson, G., and Mackie, D., Effects of seismic air guns on marine fish, *Continental Shelf Research* 21: 1005-1027 (2001); Hassel, A., Knutsen, T., Dalen, J., Skaar, K., Løkkeborg, S., Misund, O.A., Østensen, Ø., Fonn, M., and Haugland, E.K., Influence of seismic shooting on the lesser sandeel (*Ammodytes marinus*), *ICES Journal of Marine Science* 61: 1165-1173 (2004); Boeger, W.A., Pie, M.R., Ostrensky, A., and Cardoso, M.F., The effect of exposure to seismic prospecting on coral reef fishes, *Brazilian Journal of Oceanography* 54: 235-239 (2006); Fewtrell, J.L., and McCauley, R.D., Impact of air gun noise on the behavior of marine fish and squid, *Marine Pollution Bulletin* 64: 984-993 (2012); Hansen, R., Silve, L.D., Karlsen, H.E., and Handegaard, N.O., Presentation at Oceanoise2017 Conference: Playback of seismic airgun signals and infrasound elicit evasive swimming responses in the Atlantic mackerel (*Scomber scombrus*) (May 8-12, 2017); Forland, T.N., Hansen, R.H., Karlsen, H.E., Kvadsheim, P.H., Andersson, M., Linné, M., Grimsbí, E., and Silve, L.D., Presentation at Oceanoise2017 Conference: Behavior of penned Atlantic mackerel exposed to increasing levels of seismic airgun pulses (May 8-12, 2017).

[182] Santulli, A., et al., Biochemical responses of European sea bass (*Dicentrarchus labrax* L) to the stress induced by offshore experimental seismic prospecting, *supra*; Hassel, A., et al., Influence of seismic shooting on the lesser sandeel, *supra*.

[183] Fewtrell, J.L., and McCauley, R.D., Impact of air gun noise on the behavior of marine fish and squid, *supra*; Samson, J.E., Mooney, T.A., Gussekloo, S.W.S., and Hanlon, R.T., Graded behavioral responses and habituation to sound in the common cuttlefish *Sepia officinalis*, *Journal of Experimental Biology* 217: 4347-4355 (2014); Mooney, T.A., Samson, J.E., Schlunk, A.D., and Zacarias, S., Loudness-dependent behavioural responses and habituation to sound by the longfin squid (*Doryteuthis pealeii*), *Journal of Comparative Physiology A* 202(7): 489-501 (2016).

alterations in reflex behavior following exposure.[184] Field studies suggest that airgun exposure can lead to schools of fish to move lower in the water column[185] and squid have been observed to shelter in the quiet area near the ocean surface.[186] Seismic noise may also cause significant shifts in distribution that may compromise life history behaviors: reef fish abundance on the inner continental shelf of North Carolina declined by 78% during evening hours when fish habitat use was usually highest in the absence of seismic noise,[187] for example.

(6) *Alters predator avoidance behaviors that may reduce probability of survival.* Airgun exposure may have population-level implications if predation rates increase due to sound-induced behavioral changes. Scallops, rock lobster, and spiny lobster were slower to right themselves after exposure to airguns, increasing their chance of mortality from predation.[188] Some fish and invertebrates may become habituated to sound and show fewer responses over exposure trials;[189] however, habituation may also make individuals less sensitive to predatory cues and increase their vulnerability to predation.

(7) *Affects catchability of prey species.* Commercial trawl and longline catches of Atlantic cod have been shown to fall by 45% and 70%, respectively, five days after seismic surveys in the Barents Sea.[190] Similar reductions in catch rates (52% decrease in catch per unit effort relative to controls) have been demonstrated in the hook-and-line fishery for rockfish during seismic discharges off the California coast.[191] Impacts may be species-specific. These observed effects on the catch and abundance of commercially important species, suggests that marine mammals may also be faced with alterations in the behavior of at least some prey species, potentially affecting their ability to catch prey or altering the composition of their diet.

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[184] Day, R.D., et al., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries, *supra*; Semmens, J., et al., Presentation at Oceanoise2017 Conference: Are seismic surveys putting bivalve and spiny lobster fisheries at risk? *supra.*

[185] Chapman, C. and Hawkins, A., The importance of sound in fish behavior in relation to capture by trawls, *FAO Fisheries and Aquaculture Report* 62(3): 717-718 (1969); Slotte, A., et al., Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area, *supra*.

[186] McCauley, R.D., et al., Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure, *supra*.

[187] Paxton, A.B., Taylor, J.C., Nowacek, D.P., Dale, J., Cole, E., Voss, C.M., and Peterson, C.H., Seismic survey noise disrupted fish use of a temperate reef, *Marine Policy* 78: 68-73 (2017).

[188] Day, R.D., et al., Assessing the impact of marine seismic surveys on Southeast Australian scallop and lobster fisheries, *supra*; Semmens, J., et al., Presentation at Oceanoise2017 Conference: Are seismic surveys putting bivalve and spiny lobster fisheries at risk? *supra*.

[189] Fewtrell, J.L. and McCauley, R.D., Impact of air gun noise on the behaviour of marine fish and squid, *supra*; Samson, J.E., et al., Graded behavioral responses and habituation to sound in the common cuttlefish, *supra*; Mooney, T.A., et al., Loudness-dependent behavioural responses and habituation to sound by the longfin squid, *supra*.

[190] Engås, A., et al., Effects of seismic shooting on local abundance and catch rates, *supra*.

[191] Skalski, J.R., et al., Effects of sounds from a geophysical survey device on catch-per-unit-effort, *supra*.

The biological impact of continuous low frequency noise, which is produced by seismic surveys over long distances:

(8) *Damages the hearing and sensory abilities of fish and marine invertebrates*. Continuous noise physically damages hair cells in fish ears[192] and the "statocysts" of marine invertebrates, including octopus, squid, and cuttlefish, that are responsible for their balance and position.[193] This damage can lead to permanent or temporary hearing loss in both groups.[194] Young individuals appear to be most sensitive; three species of cephalopod hatchlings showed more severe lesions in less time (almost immediately after sound exposure) than adults.[195] Even temporary loss of hearing or sensory capability can compromise an individual's chance of survival and the important role that they play in the larger marine ecosystem.

(9) *Induces stress that physically damages marine invertebrates and compromises fish health*. When exposed to continuous noise, marine invertebrates, including prawns and mussels, produce stress chemicals that degrade their DNA, alter gene expression, damage proteins, and elicit an immune response.[196] Fish exhibit

[192] Smith, M.E., Schuck, J.B., Gilley, R.R., and Rogers, B.D., Structural and functional effects of acoustic exposure in goldfish: evidence for tonotopy in the teleost saccule, *BMC neuroscience* 12(19): doi:10.1186/1471-2202-12-19, (2011).

[193] Solé, M., Lenoir, M., Durfort, M., López-Bejar, M., Lombarte, A., and André, M., Ultrastructural damage of *Loligo vulgaris* and *Illex coindetii* statocysts after low frequency sound exposure, *PLoS ONE* 8(10): 1–12 (2013); Solé, M., Lenoir M., Durfort, M., López-Bejar, M., Lombarte, A., Van Der Schaar, M., and André, M., Does exposure to noise from human activities compromise sensory information from cephalopod statocysts? *Deep-Sea Research Part II: Topical Studies in Oceanography* 95: 160–181 (2013); Solan, M., Hauton, C., Godbold, J.A., Wood, C.L., Leighton, T.G., and White, P., Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties, *Scientific Reports* 6: art. 20540 (2016).

[194] Belanger, A.J., Bobeica, I., and Higgs, D.M., The effect of stimulus type and background noise on hearing abilities of the round goby *Neogobius melanostomus*, *Journal of Fish Biology* 77: 1488–1504 (2010); Gutscher, M., Wysocki, L.E., and Ladich, F., Effects of aquarium and pond noise on hearing sensitivity in an otophysine fish, *Bioacoustics* 20(2): 117–136 (2011); Liu, M., Wei, Q.W., Du, H., Fu, Z.Y., and Chen, Q.C., Ship noise-induced temporary hearing threshold shift in the Chinese sucker *Myxocyprinus asiaticus* (Bleeker, 1864), *Journal of Applied Ichthyology* 29(6): 1416–1422 (2013); Scholik, A.R., and Yan, H.Y., Effects of boat engine noise on the auditory sensitivity of the fathead minnow, *supra*; Scholik, A.R. and Yan, H.Y., The effects of noise on the auditory sensitivity of the bluegill sunfish, *Lepomis macrochirus*, *Comparative Biochemistry and Physiology Part A* 133: 43–52 (2002); Smith, M.E., Noise-induced stress response and hearing loss in goldfish (*Carassius auratus*), *Journal of Experimental Biology* 207(3): 427–435 (2004); Smith, M.E., et al., Structural and functional effects of acoustic exposure in goldfish, *supra*.

[195] Solé, M, Lenoir, M, Fortuño, JM, van der Schaar, M., and André, M, Sensitivity of sound to cephalopod hatchlings, Presentation at Oceanoise 2017 Conference, Vilanova i la Geltrú, Barcelona, Spain, May 8-12, 2017.

[196] Filiciotto, F., Vazzana, M., Celi, M., Maccarrone, V., Ceraulo, M., Buffa, G., Arizza, V., de Vincenzi, G., Grammauta, R., Mazzola, S., and Buscaino, G., Underwater noise from boats: Measurement of its influence on the behaviour and biochemistry of the common prawn (*Palaemon serratus*, Pennant 1777), *Journal of Experimental Marine Biology and Ecology* 478: 24–33 (2016); Wale, M., Briars, R.A., Hartl, M. G. J., and Diele, K., Effect of anthropogenic noise playbacks on the blue mussel *Mytilus edulis*, Presentation at the 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, July 10-15, 2016.

increases in ventilation and metabolic rate[197] and release stress chemicals, such as cortisol, [198] following noise exposure. Noise-induced cortisol exposure can compromise the long-term health of the individual.[199]

(10) *Masks important biological sounds essential to survival*. Many fish communicate using frequency ranges that overlap least with the natural background noise of the ocean.[200] Similarly, the sensory systems of marine invertebrates are attuned to natural background noise conditions. Continuous noise pollution raises the background noise level and reduces the distance over which individuals of a species can communicate with one another,[201] which can have negative consequences for survival and reproduction.

(11) *Reduces reproductive success, potentially jeopardizing the long-term sustainability of fish populations*. Noise can mask courtship vocalizations necessary for successful mating[202] and can also disrupt other social behaviors

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[197] Bruintjes, R., and Radford, A.N., Context-dependent impacts of anthropogenic noise on individual and social behaviour in a cooperatively breeding fish, *Animal Behaviour* 85(6): 1343–1349 (2013); Simpson, S.D., Purser, J., and Radford, A.N., Anthropogenic noise compromises antipredator behaviour in European eels, *Global Change Biology* 21(2): 586–593 (2015); Bruintjes, R., Purser, J., Everley, K.A., Mangan, S., Simpson, S.D., and Radford, A.D., Rapid recovery following short-term acoustic disturbance in two fish species, *Royal Society Open Science* 3: 150686 (2016); Nedelec, S.L., Mills, S.C., Lecchini, D., Nedelec, B., Simpson, S.D., and Radford, A.N., Repeated exposure to noise increases tolerance in a coral reef fish, *Environmental Pollution* 216: 428–436 (2016); Purser, J., Bruintjes, R., Simpson, S.D., and Radford, A.N., Condition-dependent physiological and behavioural responses to anthropogenic noise, *Physiology and Behavior* 155: 157–161 (2016).

[198] Wysocki, T. and Gavin, L., Paternal involvement in the management of pediatric chronic diseases: Associations with adherence, quality of life, and health status, *Journal of Pediatric Psychology* 31(5): 501–511 (2006); J. A. Crovo, J.A., Mendon, M.T., Holt, D.E., and Johnston, C.E., Stress and auditory responses of the otophysan fish, *Cyprinella venusta*, to road traffic noise, *PLoS ONE* 10(9): 3–11 (2015); Sierra-Flores, R., Atack, T., Migaud, H., and Davie, A., Stress response to anthropogenic noise in Atlantic cod *Gadus morhua L.*, *Aquacultural Engineering* 67: 67–76 (2015); Bruintjes, R., et al., Rapid recovery following short-term acoustic disturbance in two fish species, *supra*.

[199] Spreng, M., Possible health effects of noise induced cortisol increase, *Noise and Health* 2(7): 59-63 (2000).

[200] Codarin, A., Wysocki, L.E., Ladich, F., and Picciulin, M., Effects of ambient and boat noise on hearing and communication in three fish species living in a marine protected area (Miramare, Italy), *Marine Pollution Bulletin*, 58(12): 1880–1887 (2009); Speares, P., Holt, D., and Johnston, C., The relationship between ambient noise and dominant frequency of vocalizations in two species of darters (*Percidae: Etheostoma*), *Environmental Biology of Fishes* 90(1): 103–110 (2011); Holt, D.E., and Johnston, C.E., Traffic noise masks acoustic signals of freshwater stream fish, *Biological Conservation* 187: 27–33 (2015).

[201] Codarin, A., Wysocki, L.E., Ladich, F., and Picciulin, M., Effects of ambient and boat noise on hearing and communication in three fish species living in a marine protected area (Miramare, Italy), *Marine Pollution Bulletin*, 58(12): 1880–1887 (2009); Speares, P., et al., The relationship between ambient noise and dominant frequency of vocalizations in two species of darters, *supra*; Speares, P., Traffic noise masks acoustic signals of freshwater stream fish, *Biological Conservation* 187: 27–33 (2015); Fonseca, P.J., Amorim, C.M., and Alves, D., Boat noise reduces acoustic active space in the Lusitanian toadfish *Halobatrachus didactylus*, Presentation at the 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, July 10-15, 2016.

[202] Vasconcelos, RO., Amorim, M. C. P., and Ladich, F., Effects of ship noise on the detectability of communication signals in the Lusitanian toadfish, *Journal of Experimental Biology* 210(12): 2104–2112 (2007); Bruintjes, R. and Radford, A.N., Context-dependent impacts of anthropogenic noise on individual and social behavior, *supra*.

such as nest-digging, antipredator defense, and other social interactions necessary to successfully rear young.[203] Gobies and damselfish spend less time caring for their nests under noisy conditions,[204] and common goby males exposed to noise had significantly fewer egg clutches and eggs hatched earlier than under ambient conditions.[205] Nesting success of the oyster toadfish was significantly lower in areas where their mating calls were masked.[206] In Atlantic cod, exposure to noise during spawning resulted in a significant reduction in total egg production and fertilization rates, which reduced the total production of viable embryos by over 50%.[207] Startle responses and faster yolk sac consumption have been observed in newly hatched Atlantic cod, which then grew to a smaller size than hatchlings not exposed to noise; this demonstrates that noise can impact survival related measures during development.[208]

(12) *Interrupts feeding behaviors and induces other species-specific effects that may increase the risk of starvation, reduce reproduction, and alter community structure*. Increased noise has been found to lead to significantly less foraging activity in fish, as individuals are startled,[209] take shelter,[210] or undertake an

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[203] Bruintjes, R. and Radford, A. N., Context-dependent impacts of anthropogenic noise on individual and social behavior, *supra*.

[204] Picciulin, M., Sebastianutto, L., Codarin, A., Farina, A. and Ferrero, E.A., In situ behavioural responses to boat noise exposure of *Gobius cruentatus* (Gmelin, 1789; fam. Gobiidae) and *Chromis chromis* (Linnaeus, 1758; fam. Pomacentridae) living in a Marine Protected Area, *Journal of Experimental Marine Biology and Ecology* 386(1–2): 125–132 (2010).

[205] Blom, E-L., Schöld, S., Kvarnemo, L., Svensson, O. and Amorim, C., Silence is golden, at least for a common goby male who wants to mate, Presentation at the 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, July 10-15, 2016.

[206] Luczokovich, J. J., Krahforst, C. S., Hoppe, H. and Sprague, M. W., Does vessel noise affect oyster toadfish calling rates?, *in* Popper, A.N. and Hawkins, A. (eds.), The effects of noise on aquatic life II, *Advances in Experimental Medicine and Biology* 875: 647-653 (2013); Krahforst, C. S., Sprague, M. W., Rose, M., Heater, M., Fine, M. L. and Luczkovich, J. J., Impact of vessel noise on fish communication, reproduction, and larval development, Presentation at the 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, July 10-15, 2016.

[207] Sierra-Flores, R., et al., Stress response to anthropogenic noise in Atlantic cod, *supra*.

[208] Nedelec, S. L., Simpson, S. D., Morley, E. L., Nedelec, B. and Radford, A. N., Impacts of regular and random noise on the behaviour, growth and development of larval Atlantic cod (*Gadus morhua*), *Proceedings of the Royal Society of London B: Biological Sciences* 282(1817): 1–7 (2015).

[209] Purser, J. and Radford, A. N., Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks, *supra*; Voellmy, I. K., Purser, J., Flynn, D., Kennedy, P., Simpson, S. D. and Radford, A. N., Acoustic noise reduces foraging success in two sympatric fish species via different mechanisms, *Animal Behaviour* 89: 191–198 (2014); Sabet, S. S., Neo, Y. Y., and Slabbekoorn, H., The effect of temporal variation in sound exposure on swimming and foraging behaviour of captive zebrafish, *Animal Behaviour* 107: 49–60 (2015).

[210] McLaughlin, K. E. and Kunc, H. P., Changes in the acoustic environment alter the foraging and sheltering behaviour of the cichlid *Amititlania nigrofasciata*, *Behavioural Processes* 116: 75–79 (2015); Payne, N. L., van der Meulen, D. E., Suthers, I. M., Gray, C. A., and Taylor, M. D., Foraging intensity of wild mulloway *Argyrosomus japonicus* decreases with increasing anthropogenic disturbance, *Marine Biology* 162(3): 539–546 (2015).

escape response.[211] The common cockle also suspends feeding and buries deeper into the sand in response to noise.[212] Disturbance from noise can force fish to feed at night when prey availability is also lowest,[213] which also result in an altered and likely sub-optimal diet composition.[214] In cases where fish and crabs are still able to locate prey, noise results in an increase in food handling errors and a reduced ability to discriminate between food and non-food items, consistent with a shift in attention.[215] Interruption of natural behaviors may, over the long-term, disrupt important ecosystem processes, such as the nutrient cycling carried out by sediment-dwelling invertebrates.[216]

(13) *Increases risk of predation of fish and marine invertebrates, reducing survival and reproduction, and altering community structure*. Response time to predators was significantly slower and the type of anti-predator behavior more variable in hermit crabs[217] and damselfish[218] exposed to noise. European eels were 50% less likely and 25% slower to show a startle response to an 'ambush' predator, and were caught more than twice as quickly by a 'pursuit' predator;[219] eels in poor condition were more likely to exhibit these behaviors than healthy individuals.[220] Shore crabs exhibit a 'freeze' response to noise, making them more vulnerable to predation from natural predators.[221] Noise can increase the foraging success of predatory species less affected by noise; for example, more than twice as many prey were consumed by the dusky dottyback in field experiments when

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[211] Bracciali, C., Campobello, D., Giacoma, C. and Sarà, G., Effects of nautical traffic and noise on foraging patterns of Mediterranean Damselfish (*Chromis chromis*), *PLoS ONE* 7(7) (2012).

[212] Dijkstra, D. and Kastelein, R., Acoustic dose-behavioral response relationship in a bivalve mollusk, the common cockle (*Cerastoderma edule*), Presentation at the 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, July 10-15, 2016.

[213] Bracciali, C., et al., Effects of nautical traffic and noise on foraging patterns of Mediterranean Damselfish, *supra*.

[214] Payne, N. L., van der Meulen, D. E., Suthers, I. M., Gray, C. A., and Taylor, M. D., Foraging intensity of wild mulloway *Argyrosomus japonicus* decreases with increasing anthropogenic disturbance, *Marine Biology* 162(3): 539–546 (2015).

[215] Purser, J. and Radford, A. N., Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks, *supra*; Voellmy, I. K., et al., Acoustic noise reduces foraging success in two sympatric fish species, *supra*; Sabet, S.S., et al., The effect of temporal variation in sound exposure on swimming and foraging behaviour of captive zebrafish, *supra*; Wale, M. A., Simpson, S. D., and Radford, A. N., Noise negatively affects foraging and antipredator behaviour in shore crabs, *Animal Behaviour* 86(1): 111–118 (2013).

[216] Solan, M., et al., Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties, *supra*.

[217] Nousek-McGregor, A. E., Tee, F., and Mei, L., Does noise from shipping and boat traffic affect predator vigilance in the European common hermit crab?, *in* Popper, A.N. and Hawkins, A. (eds.), The effects of noise on aquatic life II, *Advances in Experimental Medicine and Biology*, 875: 767–774 (2016).

[218] Simpson, S.D., Radford, A.N., Nedelec, S.L., Ferrari, M.C.O., Chivers, D.P., McCormick, M.I., and Meekan, M.G., Anthropogenic noise increases fish mortality by predation, *Nature Communication* 7:10544 (2016).

[219] Simpson, S.D., et al., Anthropogenic noise compromises antipredator behaviour in European eels, *supra*.

[220] Purser, J., et al., Condition-dependent physiological and behavioural responses to anthropogenic noise, *supra*.

[221] Wale, M.A., et al., Noise negatively affects foraging and antipredator behaviour in shore crabs, *supra*.

motorboats were passing, compared to under ambient conditions.[222] This has the potential to disrupt community composition with potentially cascading effects up the food chain.

(14) *Compromises the orientation of fish larvae with potential ecosystem-level affects*. Most settlement stage fish move towards the component of coral reef noise that is produced by marine invertebrates to orient towards suitable settlement habitat.[223] The number of settlement stage coral reef fish larvae that moved towards a recording of natural coral reef with boat noise added was found to be 13% less than with the natural sound alone. In addition, 44% moved away from the noise playback compared to only 8% during the natural reef playback.[224] Overall, fewer fish settled to reefs with added boat noise compared to reefs with only reef noise.[225] In the lab, settlement-stage larvae (~20 days old) exposed to man-made noise developed an attraction to that noise rather than the natural noise of the reef, whereas wild-caught larvae showed an attraction to reef noise and responded adversely to man-made noise.[226] Noise pollution can therefore affect the natural behavior of reef fish at a critical stage in their life history, and can disrupt the community composition of natural ecosystems.[227]

b. NMFS improperly discounts effects on acoustic habitat.

NMFS states that, as the "activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat or on the quality of acoustic habitat[,] . . . any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations" (FR 82:107, 26281). The best available scientific evidence does not by any means support this assertion.

NMFS acknowledges the importance of acoustic habitat to marine mammals and observes that the "problems" that arise from marine mammals being unable to detect important acoustic cues are "more likely to occur when noise stimuli are chronic and overlap." Proposed IHAs at 26281.

[222] Voellmy, I.K., Purser, J., Simpson, S.D. and Radford, A.N., Increased noise levels have different impacts on the anti-predator behaviour of two sympatric fish species, *PLoS ONE* 9(7): 1–8 (2014).

[223] Simpson, S.D., Meekan, M.G., Jeffs, A., Montgomery, J.C., and McCauley, R.D., Settlement-stage coral reef fish prefer the higher-frequency invertebrate-generated audible component of reef noise, *Animal Behaviour* 75(6): 1861–1868 (2008). *See also* Simpson, S.D., Jeffs, A., Montgomery, J.C., McCauley, R.D. and Meekan, M.G., Nocturnal relocation of adult and juvenile coral reef fishes in response to reef noise, *Coral Reefs* 27(1): 97–104 (2008)..

[224] Holles, S.H., Simpson, S.D., Radford, A.N., Berten, L., and Lecchini, D., Boat noise disrupts orientation behaviour in a coral reef fish, *Marine Ecology Progress Series* 485: 295–300 (2013).

[225] Simpson, S.D., Radford, A.N., Ferarri, M.C.O., Chivers, D.P., McCormick, M.I., and Meekan, M.G., Small-boat noise impacts natural settlement behavior of coral reef fish larvae, *in* Popper A.N. and Hawkins A. (eds.), The effects of noise on aquatic life II, *Advances in Experimental Medicine and Biology* 875: 1041-1048 (2013).

[226] Simpson, S.D., Meekan, M.G., Larsen, N.J., McCauley, R.D., and Jeffs, A., Behavioral plasticity in larval reef fish: Orientation is influenced by recent acoustic experiences, *Behavioral Ecology* 21(5): 1098–1105 (2010).

[227] Simpson, S.D., et al., Settlement-stage coral reef fish prefer the higher-frequency invertebrate-generated audible component of reef noise, *supra*.

Unfortunately, the agency then proceeds to dismiss seismic surveys as a concern in this regard, emphasizing that seismic airgun emissions are of "short duration and transient in any given area . . . and therefore would not be considered to be chronic in any given location." *Id.* at 26281. In doing so, the agency disregards best available science about the size of the acoustic footprint of high-energy seismic surveys and the continuous nature of the noise they generate at distance.

Again, as described in section I.B, *supra*, the sound produced by airgun shots, while distinctly impulsive within some kilometers or tens of kilometers of the source, can sound virtually continuous at greater distances due to the effects of reverberation and multi-path propagation, with little diminution of the acoustic signal within the inter-pulse interval.[228] The enormous scale of this acoustic footprint in some locations has been confirmed by studies in many regions of the globe, including the Arctic, the northeast Atlantic, Greenland, and Australia, where it has been shown to raise ambient noise levels and mask whale calls from distances of thousands of kilometers.[229] This effect is extended further by the scale of the activity itself, involving more than 90,000 track miles of seismic shooting during the first year, as well as hundreds of thousands of additional track miles over the next several years. (*See* section I.C above.) As NMFS and the scientific community have repeatedly observed, the degradation of acoustic habitat over large areas can have population-level impacts on marine mammals.[230]

The unfounded claim by NMFS that that nature of the noise produced by seismic airguns is of short duration and transient is plainly erroneous, and the agency's conclusion that therefore "any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations" (Proposed IHAs at 26281) is arbitrary and capricious.

C. NMFS' proposed authorizations, if adopted, would fail to satisfy the MMPA's mitigation and monitoring requirements.

In authorizing "take" under the general authorization provision of the MMPA, NMFS has the burden of meeting the Act's mitigation standard. Specifically, and as noted above, the agency must prescribe "methods" and "means of effecting the least practicable adverse impact" on marine mammals and set additional "requirements pertaining to the monitoring and reporting of such taking." 16 U.S.C. § 1371(a)(5)(A)(ii), (D)(vi). As courts have made clear, "least practicable adverse impact" is a stringent standard. *NRDC v. Pritzker*, 828 F.3d at 1133; *Conservation Council for Hawaii*, 97 F.Supp.3d at 1231; *NRDC v. Evans*, 279 F. Supp. 2d 1129, 1152 (N.D. Cal. 2003). NMFS has not met that standard here. As explained below, the agency

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[228] Guerra, M., et al., Quantifying seismic survey reverberation, *supra*; *see also* Nieukirk, S.L., et al., Sounds from airguns and fin whales, *supra*.

[229] Gedamke, J., Ocean basin scale loss of whale communication space, *supra*; Nieukirk, S.L., et al., Sounds from airguns and fin whales, *supra*; Nieukirk, S.L., et al., Low-frequency whale and seismic airgun sounds, *supra*; Roth, E.H., et al., Underwater ambient noise on the Chukchi Sea continental slope, *supra*.

[230] *See, e.g.*, Convention on Biological Diversity, Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats, *supra*; Gedamke, J., et al., *Ocean Noise Strategy Roadmap* (2016); Statement from C. Clark and 74 other marine scientists (Mar. 5, 2015), *supra*.

relies on a faulty interpretation of the standard and fails to consider more effective mitigation measures.

1. NMFS relies on a flawed interpretation of the "least practicable adverse impact" standard.

The proposed IHAs appear to incorporate by reference the interpretive "framework" that NMFS set forth earlier this year in a proposed rulemaking for the Navy's SURTASS LFA system. *See* Proposed IHAs at 26250 (referencing 82 Fed. Reg. 19460, 19502 (Apr. 27, 2017)). That interpretation introduces several elements that are plainly inconsistent with the "least practicable adverse impact" requirement. Most significantly, NMFS has wrongly imported the "population-level focus" of the MMPA's "negligible impact" requirement into the Act's mitigation provision, despite the fact that this approach has been squarely rejected by a U.S. Court of Appeals. *See NRDC v. Pritzker*, 828 F.3d at 1134. Further, by erring on the side of underprotection in the face of uncertainty, the agency fails to carry out the MMPA's "aim[] at protecting marine mammals to the greatest extent practicable." *Id.* at 1134. As a result, the mitigation measures in the proposed IHAs are premised on several elements that are unlawful under the statute.

These elements include, but are not limited to:

(1) *Importation of population-level harm into the "least practicable adverse impact" provision.* The *Pritzker* Court made clear that NMFS, in justifying its failure to prescribe additional mitigation measures, had improperly imported a "population-level focus" into the MMPA's mitigation standard. 828 F.3d at 1134. Yet here, as in the Proposed Rule for SURTASS LFA (82 Fed. Reg. at 19502), NMFS apparently has again set population-level impact as the basis for mitigation. Proposed IHAs at 26250 (incorporating by reference the LFA Proposed Rule's framework and referencing the "associated potential for population-level effects" as one of two factors, in addition to take of "large numbers," warranting mitigation).

(2) *Use of "balancing" language without sufficient analysis.* NMFS, in both its Proposed Rule for SURTASS LFA (82 Fed. Reg. at 19502, 19511) and its Proposed IHAs for Atlantic seismic (*e.g.*, Proposed IHAs at 26250, 26262), characterizes its analysis under the MMPA's mitigation provision as a weighing or "balance" of a measure's effectiveness in reducing adverse impacts against "the practicability for the applicant." Proposed IHAs at 26250. The *Pritzker* Court made clear that the mitigation standard requires reduction of impacts to "the least level practicable." 828 F.3d at 1135. Any "balancing" that NMFS undertakes must be consistent with that "stringent standard." *Id.* Yet, for example (and as noted below), NMFS inappropriately "balances" species protection against practicability, rather than ensuring reduction of impacts to "the least level practicable," in limiting its Area #5 closure to a three-month exclusion and in selecting 25% and 5% as its benchmarks for protecting core abundance areas.

(3) *Equation of practicality with practicability.* NMFS, in its Proposed Rule for SURTASS LFA, misstates the mitigation standard as "least practical adverse impact." Proposed Rule at 19503. As even a cursory look at a dictionary demonstrates, "practicality" is not equivalent to "practicability." *See, e.g.*, American Heritage Dictionary (in usage note, distinguishing between the connotation of "usefulness" in the word "practical" and the connotation of "feasibility" in the word "practicable"). While NMFS does not explicitly make the same error in the Proposed IHAs, to the extent that it incorporates that misinterpretation by referencing the SURTASS LFA Proposed Rule, its approach would be arbitrary and capricious and in violation of law.

NMFS must correct these misinterpretations and misstatements.

2. NMFS' time-area closures fail to satisfy the "least practicable adverse impact" requirement for mitigation.

Time and place restrictions designed to protect important habitat can be one of the most effective available means to reduce the potential impacts of noise and disturbance on marine mammals.[231] The effectiveness of time-area closures, however, depends on the targeted management objectives for each closure, on the use of best available science, and on the precautionary nature of their design.[232] The Proposed IHAs recognize that time-area closures are necessary "given the proposed spatiotemporal scope of these specific activities and associated potential for population-level effects and/or take of large numbers of individuals of certain species." Proposed IHAs at 26290. Nonetheless, NMFS has failed to adequately consider time-area closures within the proposed study area, in contravention of its statutory duty to prescribe means and methods of achieving the "least practicable adverse impact" on marine mammals and their habitat.

a. Year-round exclusion is required in the area off Cape Hatteras.

As NMFS acknowledges, the shelf break from Cape Hatteras northward is one of "the most productive areas in the world." Proposed IHAs at 26247. The area is uniquely positioned at the confluence of the Gulf Stream and the cool Labrador Current, and these dynamic ocean fronts provide a sustained source of nutrients that support an abundance of marine life year-round, as well as some of the region's most economically important commercial and recreational

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[231] *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); Dolman S., Aguilar Soto, N., Notarbartolo di Sciara, G., and Evans, P., Technical report on effective mitigation for active sonar and beaked whales, Working group convened by European Cetacean Society (2009); Memorandum from Dr. Jane Lubchenco, NOAA Administrator, to Ms. Nancy Sutley, CEQ Chair (Jan. 19, 2010); Convention on Biological Diversity, Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats, *supra*.

[232] Agardy, M.T., Advances in marine conservation: The role of marine protected areas, *Trends in Ecology & Evolution* 9(7): 267-70 (1994).

fisheries.[233] The waters off Cape Hatteras have the highest marine mammal diversity of any area along the U.S. east coast, and are internationally renowned for their diversity of species;[234] nine taxonomic families and 34 species (29 cetaceans, 4 pinnipeds, and 1 manatee) were recorded for North Carolina in a recent study.[235] Sightings records and habitat-based density models[236] indicate that marine mammals reside in the vicinity of the shelf break at particularly high densities, and satellite telemetry data shows that common bottlenose dolphin, short-finned pilot whale, and Cuvier's beaked whale are actively selecting the shelf-break edge, indicating that this is important foraging habitat for these species.[237] Similarly, acoustic data indicates that endangered sperm whales and highly sensitive beaked whales are present in this area year-round.[238] Some of these waters are also considered, by NMFS, to be a Biologically Important Area (BIA) for migratory cetaceans, as they form part of the migratory corridor for the endangered North Atlantic right whale.[239]

NMFS proposes a time-area closure ("Area #5") to protect the shelf break off Cape Hatteras and to the north, including the slope areas around "The Point." Proposed IHAs at 26247 (tbl. 3). Area #5 is proposed for closure to airgun surveys from July through September, with NMFS claiming that such a closure would be particularly beneficial for beaked whales, sperm whales, and pilot whales. Outside of this closure period, however, the area would be at significant risk of acoustic impacts as, for example, survey track lines directly overlap with the shelf and the

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[233] Ross, S.W., Unique deep-water ecosystems off the southeastern United States, *Oceanography* 20(4): 130-139 (2007); NOAA, A profile of The Point, available at oceanexplorer.noo.gov/explorations/islands01/background/islands/sup8_thepoint.html (accessed July 2017).

[234] Byrd, B.L., Hohn, A.A., Lovewell, G.N., Altman, K.M., Barco, S.G., Friedlaender, A., Harms, C.A., McLellan, W.A., Moore, K.T., Rosel, P.E., and Thayer, V.G., Strandings as indicators of marine mammal biodiversity and human interactions off the coast of North Carolina, *Fishery Bulletin* 112(1):1-23 (2014).

[235] *Id*.

[236] Halpin P.N., Read, A.J., Fujioka, E., Best, B.D., Donnelly, B., Hazen, L.J., Kot, C., Urian, K., LaBrecque, E., Dimatteo, A., Cleary, J., Good, C., Crowder, L.B., and Hyrenbach, K.D., OBIS-SEAMAP: The world data center for marine mammal, sea bird, and sea turtle distributions, *Oceanography* 22(2):104-115 (2009); Roberts, J.J., et al., Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico, *supra*. NMFS should consult OBIS-SEAMAP before finalizing any decisions about the closure area, as that model is constantly updated.

[237] Baird, R.W., Webster, D.L., Swaim, Z., Foley, H.J., Anderson, D.B., and Read, A.J., Spatial use by odontocetes satellite tagged off Cape Hatteras, North Carolina in 2015, Final report. (July 2016) (Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470-10-3011, Task Order 57 and N62470-15-8006, Task Order 07, issued to HDR Inc., Virginia Beach, Virginia).

[238] McLellan, W.A., McAlarney, R.J., Cummings, E.W., Bell, J.T., Read, A.J., and Pabst, D.A., Year-round presence of beaked whales off Cape Hatteras, North Carolina, Poster presentation at the 21st Biennial Conference on the Society of Marine Mammalogy, San Francisco, CA (Dec. 13-18, 2015); Cummings, E., McAlarney, R., Keenan-Bateman, T., Pabst, D.A., Read, A., Bell, J., and W. McLellan, Sperm whale (*Physeter macrocephalus*) presence and behavior off the mid-Atlantic states of North Carolina and Virginia from 2011 to 2016 (2017) (presented at the Southeast and Mid-Atlantic Marine Mammal Symposium, Beaufort, NC, April 7-9, 2017); Stanistreet, J.E., Nowacek, D.P., Baumann-Pickering, S., Bell, J.T., Cholewiak, D.M., Hildebrand, J.A., Hodge, L.E., Moors-Murphy, H.B., Van Parijs, S.M., and Read, A.J., Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean, *Canadian Journal of Fisheries and Aquatic Sciences* (2017).

[239] LaBrecque, E., et al., Biologically important areas for cetaceans within U.S. waters – east coast region, *supra*.

critically important shelf-break habitat. *See, e.g.*, Proposed IHAs at 26248 (noting that Spectrum's track lines approach the shore a mere 35 km (21.7 mi) off Cape Hatteras).

The decision made by NMFS to propose a seasonal three-month closure runs counter to the evidence before the agency. Notwithstanding the agency's claims of benefits for beaked whales and pilot whales, there exists no evidence to suggest that they have lower densities outside the July through September period. To the contrary, the best available science indicates that these species are resident in the area. Nine satellite-tagged Cuvier's beaked whales that were tracked for up to two months demonstrated remarkable fidelity to the area.[240] Photo-identification studies indicate that this site fidelity extends over seasons and years,[241] and aerial surveys have also shown year-round residency of Cuvier's beaked whales in this region.[242] Similarly, short-finned pilot whales are regularly observed and tagged by researchers in months outside of the proposed closure.[243] Importantly, recent acoustic data suggest that, like beaked whales, sperm whales are present year-round at Cape Hatteras, and may be more abundant in winter.[244] There is therefore no tenable scientific support for limiting the closure period for Area #5 to July-September.

The Cuvier's beaked whale population off Cape Hatteras was recently cited as a key example in a scientific study highlighting the relatively greater potential harm to the population from seismic surveys, given its residency to the area.[245] The authors emphasize how "displacement can also be a source of significant harm (including injury or death), particularly for small, resident populations that may have 'nowhere to go' and for which the costs of leaving their habitat may be severe."[246] The study, the authorship of which was led by NMFS biologists, emphasizes how "[f]ailure to consider effects of both noise exposure and displacement of Cuvier's beaked whales from their habitat in this region could lead to more severe biological consequences than 'Level B Harassment' (as defined under US law), because (1) not all animals that can be injured are likely to be detected, and (2) displacement out of their population range may adversely affect foraging rates, reproduction or the health of Cuvier's beaked whales."[247]

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[240] Baird, R.W., et al., Spatial use by odontocetes satellite tagged off Cape Hatteras, North Carolina, *supra*.

[241] Read, A.J., unpublished data, *in* Forney K.A., et al., Nowhere to go: Noise impact assessments for marine mammal populations with high site fidelity, *supra*.

[242] McLellan, W.A., et al., Year-round presence of beaked whales off Cape Hatteras, North Carolina, *supra*.

[243] Baird, R.W., et al., Spatial use by odontocetes satellite tagged off Cape Hatteras, North Carolina, *supra*; Quick, N., Isojunno, S., Sadykova, D., Bowers, M., Nowacek, D., and Read, A., Hidden Markov models reveal complexity in the diving behavior of short-finned pilot whales, *Scientific Reports* 7: 45765 (2017). *See also* Duke Univ. Read Lab, Tagging Whales off Cape Hatteras, http://superpod.ml.duke.edu/read/2014/05/15/tagging-whales-off-cape-hatteras/ (visited July 2017)

[244] Cummings, E., et al., Sperm whale (*Physeter macrocephalus*) presence and behavior off the mid-Atlantic states of North Carolina and Virginia from 2011 to 2016, *supra*.

[245] Forney, K.A., et al., Nowhere to go: Noise impact assessments for marine mammal populations with high site fidelity, *supra*.

[246] *Id.* at 403.

[247] *Id.* at 401.

Additionally, as we describe in section II.B.3.a of these comments, seismic noise has the potential to seriously harm zooplankton and other marine invertebrates and fish that form the prey base for marine mammals, and support the livelihoods of coastal communities. These foundational elements of the food chain—in some of the most bio-rich waters in the western North Atlantic—would be at risk year-round from the impacts of seismic noise, compromising important foraging habitat for endangered and protected marine mammal species in all months of the year.

The habitat encompassed by Area #5 is of extraordinary importance to multiple populations of marine mammals and to cetacean species as a whole. NMFS' rationale for limiting protection to three months of the year, which would have no discernable benefit for any species other than sperm whales, is achieving "balance" between species protection and applicant need (Proposed IHAs at 26265); but, as noted above, the agency's responsibility is still to reduce impacts on marine mammals and their habitat to "the least level practicable." *NRDC v. Pritzker*, 828 F.3d at 1135. In consideration of its admitted biological importance, NMFS' summary dismissal of the practicability of providing a year-round exclusion of this important area (Proposed IHAs at 26265), as well as other important shelf-break habitat defined as Area #5 in Fig. 4, is arbitrary and capricious. *See Conservation Council for Hawaii*, 97 F. Supp. 3d at 1229-31 (holding that NMFS' practicability analysis for time-area closures off Hawaii failed to meet the MMPA's stringent mitigation standard).

b. Expansion of protection to North Atlantic right whale migratory habitat is necessary.

NMFS, in its notice, proposes prohibiting the surveys from taking place within a "coastal strip" of 47 km width (37 km coastal strip plus 10 km buffer), seaward from the coast, from November to April. Proposed IHAs at 26259. Its rationale is to encompass the existing Mid-Atlantic Seasonal Management Areas ("SMAs") from Delaware to northern Georgia, which are intended to protect right whales during their migration route and are generally defined as a 20 nmi (37 km) radial distance around the entrance to certain ports. In the southern portion of the survey area, the coastal strip is superseded by designated critical habitat and the southeast SMA, which provide a larger restricted area in order to protect some of the right whale's calving and nursery grounds.

NMFS acknowledges that the SMAs were originally intended to protect whales from vessel strikes rather than from noise, and has made the decision to extend them, forming a continuous coastal strip. While this area may afford some protection to migrating right whales given an adequate buffer zone (see next section), the decision to base the width of the strip on the same premise of the SMA (i.e., 20 nmi radial distance around ports) is not founded on the best available science regarding the distribution of North Atlantic right whales during their migration.

North Atlantic right whales are known to travel along the U.S. continental shelf.[248] Surveys undertaken in the northern part of the whales' migratory route indicate that the whales may make broader use of offshore waters than originally supposed[249] and inhabit the migratory corridor year-round.[250] More recent passive acoustic monitoring, discussed elsewhere in these comments (*see*, *e.g.*, section II.A.2.g), indicate similar habitat use in the southern part of the route.[251] In 2015, NOAA scientists designated the North Atlantic right whale migratory corridor along the U.S. east coast as a year-round biologically important area ("BIA").[252] The migratory corridor BIA spans the continental shelf to account for the North Atlantic right whales' potential use of these waters; including waters well beyond designated critical habitat and other time-area protections. The BIA was substantiated through vessel- and aerial-based survey data, photo-identification data, radio-tracking data, and expert judgment.

The extreme level of endangerment of the North Atlantic right whale compels NMFS to do everything necessary to protect this species from harm. As such, the coastal strip should be expanded to reflect the boundaries of the BIA, bounded by a buffer zone of adequate width to prevent and mitigate behavioral harassment and loss of communication space (see next section), and enforced year-round.

c. NMFS' 10 km buffer zone is not based on best available science.

NMFS proposes placing a 10 km buffer zone around its general coastal restriction area as well as its coastal seasonal closure area for North Atlantic right whales. *See*, *e.g.*, Proposed IHAs at 26257. The buffer zones are based on the sound propagation modeling results provided for a notional large airgun array in BOEM's PEIS, which indicate that a 10 km distance would likely contain received levels of sound exceeding 160 dB RMS. *Id*. NMFS' intent, in relying on BOEM's propagation modeling and its own behavioral take threshold, is to "reasonably prevent sound output from the acoustic source exceeding received levels expected to result in behavioral harassment from entering the proposed closure areas." *Id.* at 26262. Unfortunately, NMFS, in

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[248] Schick, R.S., Halpin, P.N., Read, A.J., Slay, C.K., Kraus, S.D., Mate, B.R., Baumgartner, M.F., Roberts J.J., Best, B.D., Good, C.P., Loarie, S.R., and Clark, J.S., Striking the *right* balance in right whale conservation, *Canadian Journal of Fisheries and Aquatic Sciences* 66(1399-1403) (2009); Whitt, A.D., Dudzinski, K., and Laliberté, J.R., North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management *Endangered Species Research* (20): 59-69 (2013).

[249] Kraus, S.D., Personal communication with F. Kershaw, BOEM Workshop on Best Management Practices for Atlantic Offshore Wind Facilities and Marine Protected Species, NOAA Fisheries, Silver Spring (Mar. 7-9, 2017).

[250] Morano, J.L., et al., Acoustically detected year-round presence of right whales in an urbanized migration corridor, *supra*; Whitt, A.D., Dudzinski, K., and Laliberté, J.R., North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management, *Endangered Species Research* (20): 59-69 (2013); Hodge, K.B., et al., North Atlantic right whale occurrence near wind energy areas along the mid-Atlantic US coast, *supra*.

[251] *See also* Foley, H.J., Holt, R.C., Hardee, R.E., Nilsson, P.B., Jackson, K.A., Read, A.J., Pabst, D.A., and McLellan, W.A., Observations of a western North Atlantic right whale (*Eubalaena glacialis*) birth offshore of the protected southeast U.S. critical habitat, *Marine Mammal Science* 27(3): E234-E240 (2011).

[252] LaBrecque E., et al., Biologically important areas for cetaceans within U.S. waters – east coast region, *supra*.

applying BOEM's propagation modeling to the present applications, makes a number of erroneous and misplaced assumptions, as we discuss at section II.A.2.g above. But even assuming that NMFS' use of that modeling were correct, the agency's 10 km buffer zone is based on an outdated threshold for "Level B" take that is inconsistent with the best available science and is therefore arbitrary and capricious—as we also describe earlier in these comments, at section II.A.2.a.

The agency should have considered and established larger buffer zones. We recommend that, for most cetacean species, NMFS consider instead the interim standard proposed in Nowacek et al. (2015): a dose function centered on 140 dB re 1 uPA (RMS). For North Atlantic right whales, NMFS should consider a larger buffer zone of no less than 100 km from the expanded protected area described just above at section II.C.2.b, given best available science on the behavioral impacts of seismic on baleen whales, as well as consider a complete seasonal closure given the serious consequences of masking for that species. In any case, the agency must establish a buffer zone that achieves the "least practicable adverse impact" on marine mammals and their habitat, consistent with the statute. 16 U.S.C. §§ 1371(a)(5)(A)(ii), (D)(vi).

d. NMFS should consider time-area closures for additional marine mammal species.

In addition to the time-area closures for the North Atlantic right whale, NMFS proposes five time-area closures (Areas #1-5) with the rationale of protecting selected priority species: Atlantic spotted dolphin (Area #1), beaked whales (Areas #2-5), sperm whales (Areas #3-5), and pilot whales (Area #5). However, the agency inexplicably fails to afford protection to a number of other species of conservation concern that are present in the survey area, including, *inter alia*, the humpback whale (Gulf of Maine stock), sei whale (Nova Scotia stock), fin whale (Western North Atlantic, or "WNA," stock), and the blue whale (WNA stock).

The sei whale (Nova Scotia stock), fin whale (WNA stock), and blue whale (WNA stock) are listed as "endangered" under the Endangered Species Act (ESA), and are listed as "depleted" and considered a "strategic stock" under the MMPA, where a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining. The Gulf of Maine humpback whale stock was one of several humpback whale populations recently delisted under the ESA; however, since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine to North Carolina. Post mortem evidence implicates vessel collision as the primary cause in half of the individuals examined. These high levels of mortality led NMFS to declare an Unusual Mortality Event (UME) for this stock in April 2017.[253]

Akin to the North Atlantic right whale, the behavioral harassment that the proposed seismic surveys would impose on these other baleen whales, when acting cumulatively and synergistically with other stressors (*e.g.*, vessel collision, entanglement, etc.), may reduce

[253] *See* NOAA Fisheries, 2016-2017 Humpback Whale Unusual Mortality Event along the Atlantic Coast, http://www.nmfs.noaa.gov/pr/health/mmume/2017humpbackatlanticume.html (visited July 2017).

population health and negatively impact fitness, accelerating the species' decline.[254] Scientific evidence demonstrates the vulnerability of baleen whales to large-scale adverse behavioral impacts of noise from seismic surveys, including the reduction and cessation of essential vocalizations and large-scale habitat displacement.[255] In light of the vulnerability of baleen whales to noise from seismic surveys and the protected and declining status of the aforementioned stocks, the agency has an obligation to afford protection to these species.

The recently published habitat-density models of Roberts et al. (2016)[256] offer a useful source of information for NMFS to identify areas for time-area closures based on thoughtful development of species-specific core abundance threshold measures. As the models are known to underrepresent important habitat in some cases (*e.g.*, migratory routes where density is low) and also do not accurately reflect baleen whale abundance and distribution in all parts of the U.S. east coast (*e.g.*, the New York Bight), the models should always be deployed in concert with other analyses, such as BIAs, that are capable of taking into account other data sources such as PAM and opportunistic sightings. Notably, NMFS scientists authored a white paper with three simple guidelines to identify areas of biological importance for cetaceans where data are lacking, based largely on the ecological principle that marine mammals are generally associated with areas of high primary productivity.[257] These guidelines comprise: (1) continental shelf waters and waters 100 km seaward of the continental slope; (2) waters within 100 km of all islands and seamounts that rise within 500 m of the surface; and (3) high productivity regions not included under the previous two guidelines. Where data are limited, NMFS should adopt these principles to protect baleen whale stocks and other marine mammals expected to be present in the survey area. This approach aligns with our previous recommendation to afford year-round protection to the North Atlantic right whale migratory corridor BIA, which spans the continental shelf north of Cape Hatteras; based on the guidelines of the white paper, this action, when combined with an appropriate acoustic buffer, would also serve to protect a wide array of other marine mammal species from the impacts of seismic surveys.

In light of the data, information, and guidance provided by the models of Roberts et al. (2016), the BIAs, and the white paper, other baleen species can no longer be considered by the agency to be too "data poor" or broadly distributed to justify specific mitigation measures for their protection, including time-area closures.

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[254] Rolland R.M., et al., Health of North Atlantic right whales Eubalaena glacialis over three decades, *supra*.

[255] *E.g.*, Clark C.W., and Gagnon G.C., Considering the temporal and spatial scales of noise exposures, *supra*; C.W. Clark, pers. comm. with M. Jasny, NRDC, Apr. 2010; Castellote M., et al., Acoustic and behavioural changes by fin whales, *supra*; Risch, D., et al., Changes in humpback whale song occurrence in response to an acoustic source 200 km away, *supra*; Blackwell, S.B., Nations, C.S., McDonald, T.L., Greene, Jr., C.R., Thode, A.M., Guerra, M., and Macrander, M., Effects of airgun sounds on bowhead whale calling rates in the Alaskan Beaufort Sea, *Marine Mammal Science* 29(4): E342-E365 (2013); Cerchio S., et al., Seismic surveys negatively affect humpback whale singing activity, *supra*; Blackwell, S.B., et al., Effects of airgun sounds on bowhead whale calling rates, *supra*.

[256] Roberts, J.J., et al., Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico, *supra*.

[257] Ferguson, M., Barlow, J., Brownell, Jr., R., and Pitman, R., Identifying areas of biological importance for cetaceans in data-poor regions (Apr. 21, 2010) (white paper submitted by NMFS scientists to J. Cody and J. Harrison, NMFS).

e. NMFS application of the "core areas" concept is inadequate.

In its consideration of potential time-area restrictions, NMFS used the habitat-density models presented in Roberts et al. (2016) to develop "core abundance areas," which it defines as the smallest area containing a given percentage of the predicted abundance of each species. Proposed IHAs at 26262. The agency determined that a 25% core abundance area was most appropriate for most species, providing the best "balance" (*id.*) between practicability and effectiveness. In the case of the sperm whale, a 5% core abundance area was selected to define discrete habitat areas for time-area restrictions.

NMFS' identification of "core abundance areas"—while an improvement over previous efforts to identify high-density areas for mitigation—is nonetheless flawed. A 25% threshold may represent what, to the agency, is an appealing "balance" between practicability for industry and species protection (*id.*), but the agency's mandate under the MMPA's mitigation provision is to achieve the "least practicable adverse impact" on marine mammals and their habitat. *NRDC v. Pritzker*, 828 F.3d at 1135. At no point does NMFS provide a scientifically supported rationale for the blanket selection of 25%core abundance areas across all species in terms of the actual protection they provide. Species and stocks differ from one another almost by definition (*e.g.*, in their ecology, vital rates, and degrees of endangerment), which means they may have different levels of vulnerability to seismic survey impacts. While a 25% threshold may be adequate to protect one population, it may be entirely inadequate to protect another. NMFS should present a transparent analysis of appropriate core abundance thresholds for each species and stock, so that the designation of time-area restrictions can be made with species protection at the fore.

For sperm whales, an endangered species proven to be highly sensitive to the noise produced by seismic surveys,[258] a 5% core abundance area threshold is entirely inadequate. NMFS offers no biological explanation for how a 5% core abundance threshold will protect sperm whale populations from the impacts of seismic surveys; rather, the threshold is based entirely on the agency's suppositions of practicability for management. As we recommend above for other species, the agency should carry out a scientifically defensible analysis to determine the most appropriate threshold for effective protection of sperm whales.

The exclusive reliance on the density models of Roberts et al. (2016) for this purpose is also troubling. The intent of a density modeling approach is to predict the number of individuals expected in a given grid cell (pixel) based on underlying environment variables. In essence, this is a prediction of a species' fundamental niche, or the entire area over which a species may be found based on environmental conditions. However, this may not represent the true distribution of a species, or the "realized niche," due to differences in behavior (*e.g.*, a tendency to aggregate at ephemeral feeding habitats) and other ecological constraints, such as competition, predation, and lack of suitable prey species.[259] Complementary information indicating important habitat for

[258] *E.g.*, Miller, P.J.O., et al., Using at-sea experiments to study the effects of airguns, *supra*; Isojunno, S., et al., Sperm whales reduce foraging effort, *supra*; Bowles, A.E., et al., Relative abundance and behavior of marine mammals exposed to transmissions, *supra*.

[259] Pulliam, H.R., On the relationship between niche and distribution, *Ecology Letters* 3: 349-361 (2000).

marine mammals (*e.g.*, photo-identification, telemetry, acoustic monitoring) should be used in *addition* to the density models to identify important habitat areas rather than only to validate model outputs (per Proposed IHAs at 26262). Indeed, it was the recognition of this need that led agency scientists to embark on a separate process of BIA identification in addition to developing habitat-based density models. For the species and populations they cover, the BIAs capture ephemeral or seasonal feeding and breeding aggregations that the density models cannot reflect due to their coarser temporal scale, as well as migratory corridors, which by their nature have relatively low densities but are still of high biological importance.

Moreover, the density models of Roberts et al. (2016) are based only on the systematic survey efforts carried out by NOAA and U.S. Fish & Wildlife Service, and omit important passive acoustic detections, opportunistic sightings, and other data that indicate marine mammals are present in areas and times of year not reflected by the models. The New York Bight is one such case,[260] and the same issue is likely to be present in other areas. While Roberts et al. (2016) is the best available model in general, its data layers therefore may not fully reflect the distribution and density of marine mammals in the survey area and should therefore be considered in tandem with other data and information.

As a result of these omissions, NMFS' methodology of defining time-area closures fails to take into account some areas of known biological importance. For example, south of Cape Hatteras, offshore areas in the middle and outer continental shelf—as NMFS itself recognizes in its description of the "specified geographic region" (*see* Proposed IHAs at 26248)—including the Charleston Bump, are other areas of notably high productivity. NMFS should therefore consider the density models of Roberts et al. (2016) alongside the BIAs and other data and information on important marine mammal habitat (*e.g.*, passive acoustic monitoring and opportunistic sightings) when defining time-area restrictions.

3. NMFS has failed to consider consolidating the proposed surveys.

At no point in the proposed authorizations does NMFS consider the practicability of requiring applicants to consolidate their surveys in whole or part, to reduce cumulative impacts on important habitat areas, including those proposed for seasonal closure.

As one example, Area #5 is intended to protect the shelf break off Cape Hatteras and to the north, including slope waters around "The Point," between July 1 and September 30. Proposed IHAs at 26264. NMFS views the area as being particularly beneficial for beaked whales, sperm whales, and pilot whales, which represent some of the most vulnerable taxa in the region. The agency, however, does not acknowledge that all five proposed surveys directly overlap there, meaning that this important habitat area will be subjected to seismic surveying by five different

[260] Letter from WCS, CRESLI, and Gotham Whale on the Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf (OCS) Offshore New York, MMAA104000 (July 13th, 2016); Antunes, R., Kopelman, A.H., Sieswerda, P.L., DiGiovanni, R., Good, C., Spagnoli, C., and Rosenbaum, H.C., Occurrence and distribution of baleen whales in the New York Bight: Implications for conservation and management (paper submitted to *Marine Mammal Science*); WCS-WHOI, unpublished data.

companies during the nine-month “open” season. The cumulative impacts of these multiple surveys would dramatically increase levels of take of the acoustically sensitive marine mammal species, such as beaked whales, that reside year-round within Area #5. As mentioned previously, some populations of these species are likely to be resident to Area #5, increasing the likelihood of population-level harm.[261]

NMFS has authority under the mitigation provision of the MMPA to consider directing the companies to consolidate their surveys or, for that matter, capping the amount of activities or number of surveys that may take place each year. 16 U.S.C. § 1371(a)(5)(D)(vi) (requiring NMFS to prescribe “other means of effecting the least practicable adverse impact on such species or stock and its habitat”). We believe that survey consolidation is practicable. In the United States, prior to area-wide leasing on the Outer Continental Shelf, companies engaged in collaborative survey acquisitions, known as “group shoots.”[262] And surveys have been conducted collaboratively among seismic companies in several other jurisdictions, including Mexico.[263] Yet NMFS never considers the practicability of consolidation in its proposed rule. Furthermore, consolidation is necessary for these projects to have any chance of reasonably meeting the MMPA’s critical “small numbers” and “negligible impact” standards. To reduce impact, NMFS should consider requiring companies to consolidate surveys—at minimum, within important habitat areas.

4. NMFS has failed to consider prescribing quieter alternatives to conventional seismic airguns.

In its discussion of “Miscellaneous Protocols,” NMFS “encourage[s]” the applicants to reduce and attenuate the noise from seismic prospecting, specifically by “(1) [using] the minimum amount of energy necessary to achieve operational objectives (i.e., lowest practicable source level; (2) minimiz[ing] horizontal propagation of sound energy; and (3) minimiz[ing] the amount of energy at frequencies above those necessary for the purposes of the survey.” Proposed IHAs at 26256. Yet NMFS demurs from actually prescribing requirements for applicants, noting that it is “not aware of available specific measures by which to achieve” these quieting objectives. NMFS is mistaken, and its dismissal of quieting as a mitigation measure is not supportable.

a. Use of best available technology

NMFS should require noise-quieting technology for oil and gas exploration surveys or set a standard for noise output. New technologies—including at least one that is now commercially

[261] Forney K.A., et al., Nowhere to go: Noise impact assessments for marine mammal populations with high site fidelity, *supra*.

[262] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, *supra*, at L-16.

[263] Schlumberger, “Schlumberger executes contract with Pemex for multiclient wide-aximuth seismic survey in the Campeche Basin,” Apr. 28, 2017, available at https://www.slb.com/news/press_releases/2017/2017_0428_slb_pemex_campeche_pr.aspx (accessed July 2017); Subsea World News, “PGS, Schlumberger, and Spectrum cooperate off Mexico,” July 1, 2015, available at http://subseaworldnews.com/2015/07/01/pgs-spectrum-and-schlumberger-cooperate-off-mexico (accessed July 2017).

available and others that could become available during the authorization period—can reduce noise output and, if implemented, would reduce marine mammal take. The agency must consider these new technologies, and it should prescribe targets to drive research, development, and adoption of alternatives to conventional 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.[264] A 2007 report by Noise Control Engineering reached similar conclusions,[265] and, in 2013, BOEM hosted an international workshop focused in substantial part on seismic oil and gas surveys as a target for mitigation.

Contrary to NMFS' representation (*id.*), methods to reduce output are presently available. Notably, the Bolt eSource airgun, a modified airgun that reduces noise output by 15 dB (SPL) or more in frequencies above 80–120 Hz, is newly commercially available to the seismic industry.[266] NMFS must consider whether use of a Bolt eSource airgun is necessary, for example, to reduce impacts on beaked whales (which could benefit significantly from reduced noise output above the very low frequencies) below the negligible impact threshold and, even if not, whether its use is practicable and should be prescribed by NMFS under the "least practicable adverse impact" provision.

Other quieting technologies lie just on the horizon. Marine vibroseis is an alternative to airguns that significantly reduces source levels and nearly eliminates acoustic output above 100 Hz. A Geo-Kinetics system known as AquaVib was field-tested in the Gulf of Mexico in 2015 for shallow-water application and should soon be commercially available.[267] Three other vibroseis systems are in Joint Industry Program development under the terms of the *NRDC v. Jewell* settlement agreement, with field tests to be conducted on at least one device and final results

[264] 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).

[265] 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).

[266] Teledyne Bolt, eSource Introduction (c. 2015) (undated PowerPoint presentation); *see also* Teledyne Bolt, eSource, *available at* http://www.teledynemarine.com/eSource?ProductLineID=70 (accessed July 2017) (company webpage on eSource, providing product information and putting product on offer).

[267] Pers. comm. from B. Pramik, Geo-Kinetics, to M. Jasny, NRDC (Apr. 2015).

submitted for publication by mid-2017.[268] Researchers report 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.[269] Other quieting technology in development includes BP's "staggered-fire" method, which is compatible with both conventional and modified airguns and could reduce amplitudes by as much as 20 dB.[270]

NMFS should consider setting a noise output standard that would incentivize the development and use of alternative technologies. By way of illustration, the German Federal Environment Agency (or "UBA"), in 2011, set a standard for pile-driving noise emissions in turbine construction such that, in two years, received levels at 750 meters from the source would not be allowed to exceed a single-strike unweighted sound energy level of 160 dB or a single-strike peak-to-peak sound pressure level of 190 dB.[271] In 2013. the German government began incorporating this standard into lease terms,[272] and represented that all companies operating under that country's jurisdiction were meeting the standard through use of commercially available technologies.[273] Such an approach to noise-quieting technology development, with standards tailored to seismic exploration, is patently reasonable and should be considered.

Quieting alternatives have the potential to significantly reduce impacts on acoustic habitat and marine mammal populations. That is true not only of large-scale chronic effects, but also of near-source auditory injury. A recent study concluded that a seismic source-level reduction of 3 dB (broadband RMS) would be more effective under most operating conditions at mitigating marine mammal harm than a monitoring-based safety zone requirement.[274] We urge NMFS to prescribe noise-quieting mitigation in the Atlantic.

b. Use of lowest practicable source level

[268] Settlement Agreement, *NRDC v. Jewell*, Case. No. 2:10-cv-01882 (E.D. La.) (settlement entered June 24, 2013); *see also* Jenkerson, M., The marine vibrator JIP: Technical and operational specifications—Status update (presentation given at OceanNoise2017, May 11-15, 2017, Barcelona, Spain).

[269] Duncan, A.J., Weilgart, L.S., Leaper, R., Jasny, M., and Livermore, S., A modelling comparison between received sound levels produced by a marine Vibroseis array and those from an airgun array for some typical seismic survey scenarios, *Marine Pollution Bulletin* http://dx.doi.org/10.1016/j.marpolbul.2017.04.001 (2017).

[270] BP, Patent application: Seismic acquisition method and system (filed Dec. 9, 2011) (Patent No. 8837255), *available at*: http://patents.justia.com/patent/8837255 (accessed July 2017); *see also*, *e.g.*, Guigné, J.Y., Stacey, A.J., Clements, C., Azad, S., Pant, A., Gogacz, A., Hunt, W., and Pace, N.G., Acoustic zoom high-resolution seismic beamforming for imaging specular and non-specular energy of deep oil and gas bearing geological formations, *Journal of Natural Gas Science and Engineering* 21: 568 (2014).

[271] Umwelt Bundes Amt, Empfehlung von Larmschutzwerten bei der Errichtung von Offshore-Windenergieanlagen (OWEA) (May 2011).

[272] *E.g.*, BSH, Genehmigungsbescheid auf den Antrag der Innogy Nordsee 1 (2013).

[273] Pers. comm. from T. Merck, Bundesamt fur Naturschutz, Germany, to L. Weilgart, Dalhousie University (Sept. 2014).

[274] Leaper, R., Calderan, S., and Cooke, J., A simulation framework to evaluate the efficiency of using visual observers to reduce the risk of injury from loud sound sources, *Aquatic Mammals* 41: 375-387 (2015).

Although NMFS encourages applicants to “use the minimum amount of energy necessary to achieve operational objectives (i.e., lowest practicable source level),” it refuses to prescribe that objective as a requirement. Proposed IHAs at 26256. Its apparent reason for demurring is the lack of “available specific measures” known to NMFS that would allow industry to “achieve such certifications.” *Id.* In particular, it notes that an expert BOEM panel recently convened by that agency to determine whether a “lowest practicable source level” standard was feasible to develop, concluded that developing the standard was not “reasonable or practicable,” at least for the Gulf of Mexico. *Id.* Yet BOEM’s determination, set forth in its Gulf of Mexico Draft EIS at Appendix L, that such standards are not feasible, is misguided as it misapprehends the operative question. NMFS’s adoption of this determination as a rationale for rejecting imposition of a source-level requirement would be arbitrary under the MMPA.

BOEM appears to have reached its conclusion by making a number of artificially limiting misassumptions about the “lowest practicable source level” standard. Notably, it seems to assume that the objective of the standard is to reduce direct horizontal propagation from the seismic array while leaving vertical propagation otherwise undisturbed. Thus it finds that any modification “to achieve reduced lateral propagation will be difficult and will most certainly reduce image quality,” as such a modification would interfere with an array design optimized to support vertical propagation.[275] But this statement of the objective presumes that the seismic operator has already chosen the minimum optimal source level necessary to achieve her vertical imaging goals—a presumption that the agency makes no attempt to verify.[276]

Additionally, BOEM seems to assume that ostensibly small reductions in source level, such as 3 or 6 dB (SPL), would not achieve a biologically significant attenuation of the sound field.[277] But this ignores that even small numerical declines in sound pressure levels, as measured in decibels, can make a significant difference in acoustic propagation, given the logarithmic nature of the decibel scale.

The question BOEM should have considered—and the one that NMFS must consider now—is whether the operator has selected the minimum optimal source level, or, relatedly, the minimum field effort, necessary to image the survey target through vertical propagation. Such analysis has been done in many instances for land-based seismic surveys.[278] For in-water seismic, it could be

[275] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, *supra*, at L-10.

[276] It also seems to presume that bottom reflection and other artifacts of vertical propagation do not contribute to the sound field at distances from the array, and that reduction of direct horizontal propagation is the only relevant metric.

[277] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities Draft Programmatic Environmental Impact Statement, *supra*, at L-5.

[278] *See, e.g.*., Spitzer, R., Nitsche, F.O., and Green, A.G., Reducing field effort in 3-D high-resolution seismic surveying, Expanded Abstracts of the 69th Annual International Meeting, Society of Exploration Geophysicists, Houston, U.S.A., 512-515 (1999); Sopher, D., Juhlin, C., Huang, F., Ivandic, M., and Lueth, S., Quantitative assessment of seismic source performance: Feasibility of small and affordable seismic sources for long-term monitoring at the Ketzin CO_2 storage site, Germany, *Journal of Applied Geophysics* 107: 171-186 (2014); *see also* Suarez, G.M., and Stewart, R.R., Seismic source comparison for compressional and converted wave-generation at Spring Coulee, Alberta; Part I: Heavy vibroseis-dynamite comparison, *CREWES Research Report* 20: 1-20 (2008).

undertaken in several ways: by using existing seismic data to perform signal strength testing (i.e., decimating common depth point stacks particularly in what are expected to be poor signal areas and then performing signal strength analysis), by modeling expected geology with various source strengths, and/or, perhaps most usefully, by field testing (*i.e.*, acquiring selected lines over both good and poor expected signal areas using highest sampling and largest source strength, and then decimating common depth point stacks and performing signal strength analysis using on-board processing).

Pursuant to its independent responsibilities under the MMPA, NMFS must consider a standard that would require such an analysis and selection of the minimum optimal seismic source level.

To further reduce undersea noise, NMFS should consider requiring that all vessels authorized to incidentally take marine mammals for oil and gas activities 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.[279] The agency should also consider requiring those vessels to undergo measurement for their underwater noise output, optimally though not necessarily per American National Standards Institute/ Acoustical Society of America standards (S12.64), sufficient to identify the loudest vessels for quieting purposes. Finally, NMFS should consider extending its existing ship-speed requirement (*see* section 6, *infra*) to all project vessels, including support vessels less than 65 feet in length, at least within the North Atlantic right whale BIA. Reducing speed has repeatedly been shown to substantially reduce noise output from commercial vessels, other than those equipped with controlled pitch propellers.[280]

5. NMFS has not prescribed basic mitigation for reducing near-source injury to the least practicable levels.

To reduce the risk of near-source acoustic injury, NMFS establishes a ramp-up and safety-zone scheme that differs in some ways from prior MMPA authorizations. *See* Proposed IHAs at 26250-56. While some of these changes, such as the limiting of marine mammal observers to two consecutive hours of duty (*id.* at 26251), constitute long-overdue improvements that we and

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As this last reference suggests, a lowest practicable source level standard could and should encompass use of alternative technologies.

[279] IMO, Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life (2014) (IMO Doc. MEPC.1/Circ.833); s*ee also, e.g.*, Hemmera Envirochem, Vessel quieting design, technology, and maintenance options for potential inclusion in EcoAction Program, Enhancing Cetacean Habitat and Observation Program (2016) (prepared for Vancouver Fraser Port Authority); Spence, J.H., and Fischer, R.W., Requirements for reducing underwater noise from ships, *IEEE Journal of Oceanic Engineering* 42: 388-398 (2017).

[280] *E.g.*, Leaper, R.C., and Renilson, M.R., A review of practical methods for reducing underwater noise pollution from large commercial vessels, *International Journal of Maritime Engineering* doi: 10.3940/rina.ijme.2012.a2.227 (2012); McKenna, M.F., Wiggins, S.M., and Hildebrand, J.A., Relationship between container ship underwater nose levels and ship design, operational and oceanographic conditions, *Scientific Reports* 3: 1760. doi: 10.1038/srep01760 (2013).

others have called for,[281] we believe NMFS must consider making additional changes to reduce injury risk to the lowest levels practicable, as the MMPA requires.

a. Use of ramp-up

As NMFS concedes, ramp-up remains unproven as a mitigation measure (Proposed IHAs at 26292), and, indeed, a number of commenters have raised questions about the environmental costs and benefits, including the introduction of additional noise into the environment.[282] If prescribed, it should be implemented consistent with the conclusions in the Australian humpback whale study, which found that ramping up over several stages is more likely to minimize exposure, at least in some species, while achieving the same aversion as a soft-start with a constant source level.[283]

Additionally, NMFS should give greater consideration to the requirements that apply after shutdown periods, as when survey vessels have completed a line turn. Under NMFS' proposal, applicants may recommence operations without first undergoing a ramp-up procedure after a shutdown of one half-hour or less, provided that the shutdown is not due to marine mammal exclusion, as the agency believes that continuous visual and passive acoustic monitoring is sufficient to maintain a cleared injury zone. *Id.* at 26255. Yet it is difficult to appreciate how visual monitoring could possibly be sufficient for that purpose at night, or in low-visibility conditions, and with a moving boat; and passive acoustic monitoring, though beneficial, has, as NMFS recognizes, "significant limitations." *Id.* at 26251. Moreover, the use of a half-hour cut-off perversely incentivizes the continuous firing of the airgun array during such events as line changes, so that operators may avoid the delay of ramp-up and pre-operational clearance. NMFS should give careful consideration to the requirements that apply to the resumption of operations.

b. Size of exclusion zone

The 500-meter exclusion zone that NMFS would establish for most species (Proposed IHAs at 26252) is plainly insufficient to prevent auditory injury. NMFS itself, using a single-shot peak pressure standard, estimates that "high-frequency" cetaceans can experience auditory injury at radial distances of 355 to 1585 meters from a seismic array (*see id.* at 26253); and it estimates, under a cumulative sound exposure standard, that "low-frequency" cetaceans can suffer auditory injury at radial distances of 80 to 4766 meters (*see id.* at 26254). And, of course, these distances fail to account for interspecific variability and other factors, as discussed at section II.A.2.c

[281] For the cited example of consecutive hours, for example, *see* Comments of NRDC, Center for Biological Diversity, Center for Water Advocacy, Clean Ocean Action, Coastal Conservation League, Earthjustice, the Humane Society of the United States, Ocean Conservation Research, Oceana, Southern Environmental Law Center, Surfrider Foundation, and Whale and Dolphin Conservation Society, to Mr. Gary D. Goeke, BOEM, at 31 (July 2, 2012) (criticizing a proposal, in BOEM's PEIS, to allow four hours of continuous work as double the time conventionally allowed in NMFS' vessel-based marine mammal surveys).

[282] *E.g.*, Parsons, E.C.M., et al., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals, *supra*.

[283] Dunlop, R.A., et al., Response of humpback whales (*Megaptera novaeangliae*) to ramp-up of a small experimental air gun array, *supra*.

above. Notwithstanding this injury risk, NMFS never explains why its proposed 500-meter exclusion zone achieves the "least practicable adverse impact." NMFS must consider other exclusion zone distances—including but in no way limited to the buffer zone distance of 1000 meters, the single-shot auditory injury distance of 1585 meters, and the 2000-meter distance that NMFS has said in the past constitutes a point of diminishing returns for mitigation monitoring—and explain how the distance it selects satisfies the MMPA's stringent mitigation standard.

c. Exception for bowriding dolphins

NMFS proposed shut-down requirement includes an exception for bowriding dolphins, i.e., small delphinids that "voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array." Proposed IHAs at 26253. This exception is based on the agency's determination that a shutdown requirement for bowriders "is of known concern regarding practicability for the applicant due to increased shutdowns," and would require source vessels to reshoot the missed track line, increasing the total noise ouput, "without likely commensurate benefit for the animals in question." *Id.* But it is not known why dolphins bowride. Researchers have cautioned, for example, against making longitudinal assumptions about population health based on seemingly benign behavioral responses of dolphins around vessels;[284] others have imputed a stress response to some bowriding behaviors;[285] and bowriding dolphins, for whatever reason, may expose themselves to the risk of auditory injury, which would not be detected by the observer. More analysis is therefore needed of the potential costs and benefits of excluding bowriding dolphins from the exclusion zone requirement.

d. Thermal detection

It is well understood that mitigation measures based on visual observation, such as safety zone maintenance, results in highly limited risk reduction for most species and under most conditions, especially for activities, like seismic surveys, that operate at night and in poor sea states.[286] Thermal detection offers a supplement to visual detection measures and has been demonstrated to outperform observers in number of detected whale blows and ship-whale encounters, due to its ability to continuously monitor a 360° field of view during both daylight and nighttime hours.[287]

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[284] *E.g.*, Bejder, L., Samuels, A., Whitehead, H., Finn, H., and Allen, S., Use and misuse of habituation, sensitization and tolerance in describing wildlife responses to anthropogenic stimuli, *Marine Ecology Progress Series* 395: 177-185 (2009); Bejder, L., Samuels, A., Whitehead, H., Gales, N., Mann, J., Connor, R., Heithaus, M., Watson-Capps, J., Flaherty, C., and Krützen, M., Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance, *Conservation Biology* 20: 1791-1798 (2006).

[285] Pers. comm. from D. Lusseau, Professor, U. of Aberdeen, to M. Jasny, NRDC (Sept. 2010).

[286] *E.g.*, Leaper, R., et al., , A simulation framework to evaluate the efficiency of using visual observers to reduce the risk of injury, *supra*.

[287] Burkhardt, E. Kindermann, L., Zitterbart, D., and Boebel, O., Detection and tracking of whales using a shipborne, 360° thermal-imaging system, *in* Popper, A.N., and Hawkins, A. (eds.), *The Effects of Noise on Aquatic Life* (2012); Peckham, J., O'Young, S.D., and Jacobs, J.T., Comparison of medium and long wave infrared imaging for ocean based sensing, *Journal of Ocean Technology* 10: 113-128 (2015); Zitterbart D.P., Kindermann, L., Burkhardt, E., and Boebel, O., Automatic round-the-clock detection of whales for mitigation from underwater noise impacts, *PLoS ONE* 8: e71217 (2013).

In addition, aerial-mounted infrared cameras have proven able to detect thermal "trails" up to 300 m behind humpback whales, formed by the thermal mixing of the stratified water that persists for up to 2 minutes.[288] The development of automated whale-blow detection systems for infrared video[289] indicates that this technology can feasibly be used for real-time whale detection and mitigation. Given the multiple potential benefits of employing thermal detection as a mitigation tool, NMFS should consider its application as a supplement to visual monitoring. Other detection platforms and devices, such as drones and gliders, should also be considered.[290]

6. NMFS fails to consider mitigation to reduce ship-strike risk throughout right whale habitat.

NMFS' conclusion that "[n]o incidental take resulting from ship strike is anticipated" depends in substantial part on its prescribed ship-strike avoidance procedure, which the agency believes "eliminates any foreseeable risk of ship strikes." Proposed IHAs at 26280. Its monitoring procedures complement the already slow, 4- to 5-knot operational speeds assumed by seismic vessels, which renders "both the possibility of striking a marine mammal and the possibility of a strike resulting in serious injury or mortality... discountable." *Id.* Yet while seismic vessels towing large airgun arrays and 3-kilometer-long streamers necessarily move at slow speeds, vessels supporting the seismic operation are not similarly constrained and can (and typically do) travel rapidly, creating a dangerous but mitigable risk of lethal collision.

Support vessels, like all vessels associated with the proposed surveys, are required by NMFS to observe a seasonal 10-knot speed restriction within Dynamic Management Areas and Seasonal Management Areas for right whales, and within right whale critical habitat off the southeast coast. *Id.* at 26267.[291] Unless a Dynamic Management Area is established, however, this restriction does not generally apply to the waters between Seasonal Management Areas that NMFS has expressly included within its designated time-area closure for right whales; nor does it apply to areas further offshore, where passive acoustic monitoring indicates right whales occur (*see* section II.A.2.h above), nor in Seasonal Management Areas or critical habitat outside the seasonal restriction.

There is no special biological relevance to Seasonal Management Areas. They do not demarcate waters where right whales occur with greater frequency, but, rather, target waters where the great

[288] Churnside, J., Ostrovsky, L., and Veenstra, T., Thermal footprints of whales, *Oceanography* 22: 206-209 (2009).

[289] Santhaseelan, V., and Asari, V.K., Automated whale blow detection in infrared video, *in* Zhou, J. (ed.), *Computer Vision and Pattern Recognition in Environmental Informatics* 58-78 (2015); Zitterbart, D.P., et al., Automatic round-the-clock detection of whales, *supra*.

[290] Other available platforms, such as acoustic gliders, can improve monitoring of marine mammals ahead of the seismic vessel, and should also be considered by NMFS as a real-time monitoring measure. *See*, *e.g.*, Baumgartner, M.F., Fratantoni, D.M., Hurst, T.P., Brown, M.W., Cole, T.V.N., van Parijs, S.M., and Johnson, M., Real-time reporting of baleen whale passive acoustic detections from ocean gliders, *Journal of the Acoustical Society of America* 134: 1814-1823 (2013).

[291] On the benefits of a 10-knot speed reduction rule, *see* 73 Fed. Reg. 60173 (Oct. 10, 2008); 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(1): 144-156 (2007).

mass of commercial ships regulated by the agency's ship-speed rule (*see* 73 Fed. Reg. 60173 (Oct. 10, 2008) and 78 Fed. Reg. 72726 (Dec. 9, 2013)) are most likely to occur—a consideration that has no import where project-specific mitigation is concerned. NMFS should consider extending its all-vessel 10-knot speed restriction to other right whale habitat, including the time-area closure area it has proposed and the right whale BIA that the agency has separately defined, and to periods outside the winter calving season.

7. NMFS does not fulfill the MMPA's requirement to prescribe mitigation achieving the "least practicable adverse impact" to marine mammal habitat.

NMFS does not separately consider mitigation aimed at reducing impacts to marine mammal habitat, as the MMPA requires.

Under the Act, NMFS is required to prescribe "means of effecting the least practicable impact on such species or stock *and its habitat*, paying particular attention to rookeries, mating grounds, and areas of similar significance." 16 U.S.C. §§ 1371(a)(5)(A)(ii), (D)(vi) (emphasis added). Agencies are required to "give effect, if possible, to every word Congress used." *Reiter v. Sonotone Corp.*, 442 U.S. 330, 339 (1979); *accord United States v. Menasche*, 348 U.S. 528, 538-39 (1955). The plain language of the Act therefore requires NMFS to show that it reduced habitat impacts to the least practicable level—yet it does not do so.

It is possible that the agency's proposed time-area closures would reduce impacts on some marine mammal prey species and on acoustic habitat, but those closures are aimed at mitigating effects on particular marine mammal populations, a different objective. NMFS must prescribe mitigation resulting in the "least practicable adverse impact" on marine mammal habitat.

8. NMFS fails to prescribe requirements sufficient to monitor and report takings of marine mammals.

In issuing incidental take authorizations, NMFS must prescribe "requirements pertaining to the monitoring and reporting of such taking." 16 U.S.C. § 1371(a)(5)(A)(i)(II)(bb), (D)(ii)(III). Such monitoring and reporting, according to NMFS' implementing regulations, must result in "increased knowledge of the species, [and] the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities," and applicants are also required to suggest means of "coordinating" such efforts "with other schemes already applicable to persons conducting [the activity]." 50 C.F.R. § 216.104(13). For MMPA and related compliance in the Gulf of Mexico, BOEM is developing an adaptive management program, which, beyond "the standard" safety zone monitoring and reporting requirements, may include "visual or acoustic observation of animals, new or ongoing research and data analysis, in situ measurements of sound sources or other potential impact-producing factors, or any other number of activities aimed at understanding the coincidence of marine mammals and G&G activities in space and time, as well as the impacts that may occur from this overlap."[292]

[292] BOEM, Gulf of Mexico OCS Proposed Geological and Geophysical Activities, Western, Central, and Eastern Planning Areas: Draft Programmatic Environmental Impact Statement, *supra*, at 1-14. *See also* Kearnes and West,

Unfortunately, NMFS has neither prescribed anything similar in the Atlantic, nor set any requirements sufficient to meet the objectives described in its implementing regulations. *See* 50 C.F.R. § 216.104(13). Instead, the agency has prescribed monitoring aimed primarily at detecting marine mammals within the 1-kilometer exclusion and buffer zone (Proposed IHAs at 26252)—a scale of observation that is disconnected from the mechanisms of harm driving the population-specific "magnitude" and "consequences" factors in NMFS' preliminary impact analyses. BOEM's Atlantic Marine Assessment Program for Protected Species, known as "AMAPPS," may provide some of the necessary information,[293] but that discretionary program does not alleviate NMFS' responsibility to prescribe monitoring and reporting meeting the statute's objectives. 16 U.S.C. § 1371(a)(5)(A)(i)(II)(bb), (D)(ii)(III). Meaningful monitoring and reporting is all the more critical given the threat this activity poses to the endangered, declining right whale, the limited knowledge of population abundance and trends,[294] and the ongoing activity expected by BOEM.

We offer the following considerations, adapted from our comments on BOEM's Gulf of Mexico adaptive management plan,[295] to inform a monitoring and reporting plan for the Atlantic:

(1) The monitoring program should be hypothesis-driven to the greatest extent possible;

(2) The program should provide focused research effort for populations of special concern, such as North Atlantic right whales, beaked whales, and sperm whales;

(3) The program should include regular distribution and abundance surveys;

(4) The program should include research on the most pertinent topics related to the industry's noise impacts on the region's marine mammals, including research on masking and impacts on acoustic habitat, research on chronic stress, analysis of the population consequences of cumulative impacts, and data acquisition on the potential impacts of new seismic technology; and

(5) The program should provide meaningful public participation, transparency, and data accessibility regardless of what funding structure is employed.

NMFS must not authorize any incidental take for seismic surveys in the Atlantic without establishing a monitoring and reporting plan and incorporating it into the take authorizations.

Synthesis report: Stakeholder webinars to inform development of a monitoring plan for marine mammals in the Gulf of Mexico (2015) (report prepared for BOEM).

[293] *See* Desray Reeb, BOEM, Atlantic Marine Assessment Program for Protected Species (AMAPPS) (2013) (presentation at the OCS Scientific Committee meeting of May 2013).

[294] *See*, *e.g.*, 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).

[295] Letter from NRDC, Center for Biological Diversity, Earthjustice, Gulf Restoration Network, Sierra Club, and Whale and Dolphin Conservation, to Jennifer Laliberté, BOEM (Jan. 5, 2015).

D. The proposed activities have the potential to kill and seriously injure marine mammals and therefore cannot be authorized under the IHA provisions of the MMPA.

The regulatory history of the 1994 Amendments makes clear that where there is a potential for serious injury or mortality, the applicant should request a take authorization rather than use the expedited IHA process:

> For the purpose of incidental harassment authorizations, NMFS proposes to limit the use of those authorizations for harassment involving the "potential to injure" to only incidental harassment that may involve non-serious injury. Serious injury for marine mammals, such as permanent hearing or eyesight loss, or severe trauma, could lead fairly quickly to the animal's death. NMFS does not believe that Congress intended to allow "incidental harassment" takings to include injuries that are likely to result in mortality, even where such incidental harassment involves only small numbers of marine mammals. Therefore, if the review of an application for incidental harassment indicates that there is a potential for serious injury or death, NMFS proposes that it would either (1) determine that the potential for serious injury can be negated through mitigation requirements that could be required under the authorization or (2) deny the incidental harassment authorization and require the applicant to petition for a regulated small take authorization under 50 CFR 228.5."

60 Fed. Reg. 28379, 28380-81 (May 31, 1995).

In this case, the potential for serious injury and mortality is evident. Significantly, as NMFS itself acknowledges (Proposed IHAs at 26254), the noise produced by seismic surveys can induce mother-calf separation in large whales. A recent study found that humpback whale mothers and calves communicate in extremely weak tonal sounds and grunts, likely as a predator-avoidance behavior.[296] These sounds, essential to the calves' survival, would likely be overwhelmed by the noise produced by seismic, particularly over the large expanses of ocean where, as described above, seismic noise would spread across the inter-pulse interval. Other baleen whale species, including the endangered North Atlantic right whale, depend on similar calls to maintain mother-calf contact and are similarly vulnerable.[297]

Seismic surveys also increase the risk of stranding-induced mortality, a risk that is heightened where, as here, the sound source would at times be moving towards shore.[298] And, while beaked whales stranded in close association with seismic surveys were not specifically analyzed for the

[296] Videsen, S.K.A., et al., High suckling rates and acoustic crypsis of humpback whale neonates, *supra*.

[297] *See* Nowacek, D.P. Seismic surveys: Potential impacts and ideas for mitigation, monitoring and management, Presentation at the Marine Mammal Commission 2015 Annual Meeting (2015).

[298] Brownell, Jr., R.L., et al., Hunting cetaceans with sound: A worldwide review, *supra*; Hildebrand, J., Impacts of anthropogenic sound, *supra*; Castellote, M., and Llorens, C., Review of the effects of offshore seismic surveys in cetaceans: Are mass strandings a possibility? *in* Popper, A.N., and Hawkins, A. (eds.), *The Effects of Noise on Aquatic Life II*, at 133-43 (2016).

DCS-like pathologies that have been documented in other noise-related stranding events,[299] any noise that induces a flight response in those species has the potential to cause severe behaviorally-mediated injury.[300] Such injury is well associated in human and experimental animal studies with mortality and with "a more protracted syndrome leading to death."[301]

Finally, as discussed at sections II.A.2.d and II.C.6 above, the conditions that NMFS has prescribed for seismic airgun vessels do not eliminate the potential for ship-strike, and consequent serious injury or mortality, by support vessels. Given the reasonable potential for mortality and serious injury, NMFS cannot authorize the surveys under the IHA provisions of the MMPA and must deny the pending applications.

III. NMFS' FAILURE TO COMPLY WITH THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act ("NEPA") is "our basic national charter for protection of the environment." 40 C.F.R. § 1500.1(a); *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1215-16 (9th Cir. 1998). Among its provisions, it requires federal agencies to include an environmental impact statement ("EIS") "in every recommendation or report on . . . major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). The fundamental purpose of an EIS is to compel decision-makers to take a "hard look" at a particular action, both at the environmental impacts it will have and at the alternatives and mitigation measures available to reduce those impacts, before a decision to proceed is made. 40 C.F.R. §§ 1500.1(b), 1502.1; *Balt. Gas & Elec. v. NRDC*, 462 U.S. 87, 97 (1983).

In evaluating the five seismic applications, NMFS indicates its intent to rely on BOEM's 2014 Programmatic EIS to satisfy its own NEPA compliance. *See* Proposed IHAs at 26312. NEPA allows an agency to adopt another agency's EIS only where the document "meets the standards for an adequate statement" under NEPA regulations. 40 C.F.R. § 1506.3(a). Here, NMFS cannot rely on BOEM's deficient EIS to satisfy the former's NEPA obligations when issuing regulations or permits under the MMPA. *See Sierra Club v. U.S. Army Corps of Eng'rs*, 701 F.2d 1011, 1030 (2d Cir. 1983) (holding that permitting agency cannot rely on action agency's

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[299] *See, e.g.*, Hildebrand, J., Impact of anthropogenic sound, *supra.*

[300] See, 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: 446-57 (2005); Wright, A., et al., Do marine mammals experience stress related to anthropogenic noise? *supra*; Hooker, S.K., et al., Deadly diving? Physiological and behavioural management of decompression stress in diving mammals, *supra*. *See also* de Quiros, Y.B., Gonzalez-Diaz, O., Mollerlokken, A., Brubakk, A.O., Hjelde, A., Saavedra, P., and Fernandez, A., Differentiation at autopsy between in vivo gas embolism and putrefaction using gas composition analysis, *International Journal of Legal Medicine* doi: 10.1007/s00414-012-0783-6 (2012); de Quiros, Y.B., Gonzalez-Diaz, O., Arbelo, M., Sierra, E., Sacchini, S., and Fernandez, A., Decompression vs. decomposition: distribution, amount, and gas composition of bubbles in stranded marine mammals, *Frontiers in Physiology* doi: 10.3389/fphys.2012.00177 (2012).

[301] Fernández, A., et al., 'Gas and fat embolic syndrome' involving a mass stranding of beaked whales, *supra*.

inadequate EIS). NMFS must prepare a separate EIS, or, at minimum, a supplemental EIS, before proceeding with the proposed actions.

As many of our organizations detailed in comments on BOEM's draft EIS and final EIS, which are attached to the present comment letter, that document is deficient on its face. As they pertain to NMFS' consideration of impacts on marine mammals, those deficiencies include, but are not limited to:

- A failure to evaluate a full range of reasonable alternatives,
- Applying arbitrary significance criteria in the analysis of alternatives that it does consider,
- A failure to evaluate a full range of reasonable mitigation measures,
- A failure to accurately estimate the amount of take and impact of all the activity covered by the EIS, and
- A failure to consider the cumulative impacts of simultaneous and overlapping seismic surveys.

BOEM's failure in 2014 to incorporate best available scientific evidence into the EIS's analysis of impacts, alternatives, and mitigation options is magnified by the passage of time, as significant new information has emerged over the last three years on a number of pertinent matters—including marine mammal densities in the Atlantic, the conservation status of North Atlantic right whales, the acoustic impacts of seismic surveys on marine mammals and marine mammal acoustic habitat, and the impacts of seismic surveys on prey species.[302]

In addition to these and other basic inadequacies, NMFS also cannot rely on that document for its MMPA decisions because the EIS does not adequately address NMFS' own actions and responsibilities under the MMPA. As explained above, the MMPA requires NMFS to protect and manage marine mammals, and to allow incidental take of marine mammals in limited circumstances, when such take satisfies the statutory "negligible impact," "small numbers," and "least practicable adverse impact" requirements. 16 U.S.C. § 1371(a)(5)(A)(i). In other words, NMFS is charged under the MMPA with prioritizing the protection of species. BOEM, on the other hand, has a mandate under the Outer Continental Shelf Lands Act to manage offshore activities, including oil and gas leasing, renewable energy development, and marine minerals extraction. 43 U.S.C. § 1331 *et seq.* Thus BOEM's EIS is framed around a fundamentally different purpose and need—one that is incongruent with NMFS obligations under the MMPA. *See Conservation Council for Hawaii*, 97 F. Supp. 3d at 1236 (holding that NMFS had violated

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[302] *See, e.g.*, Letter from NRDC, Cape Fear River Watch, Center for Biological Diversity, Clean Ocean Action, Earthjustice, Environmental Defense Fund, Environment North Carolina, North Carolina Coastal Federation, North Carolina Conservation Network, North Carolina League of Conservation Voters, Oceana, Ocean Conservation Research, Sound Rivers, South Carolina Coastal Conservation League, South Carolina Wildlife Federation, Southern Environmental Law Center, and Wildlife Conservation Society, to Gary D. Goeke, BOEM (Oct. 26, 2015) (citing Nowacek et al. 2015 and the density model that would be published as Roberts et al. 2016); and see this comment letter *passim* (numerous cites to significant research post-dating or otherwise not included in the EIS).

the MMPA by simply adopting, without modification, a Navy EIS that reflected a different "purpose and need").

In sum, NMFS has failed to take a "hard look" at the environmental impacts of the proposed seismic surveys, and has not considered a reasonable range of alternatives and mitigation measures. *See* 42 U.S.C. § 4332(2)(C); 40 C.F.R. §§ 1500.1(a), (b), 1502.1; *see also Balt. Gas & Elec. v. NRDC*, 462 U.S. at 97. Final IHAs should not issue until after NMFS completes a proper NEPA analysis, both at a programmatic level and for each individual permit.

IV. NMFS' FAILURE TO COMPLY WITH THE ENDANGERED SPECIES ACT

NMFS must comply with the Endangered Species Act ("ESA") in issuing any final IHA.[303] This includes completing a new Programmatic Biological Opinion, conducting project-specific consultations with BOEM, and undertaking project-specific consultations with itself over the prospective issuance of incidental take authorizations.

More than three years have elapsed since NMFS issued its July 2013 Biological Opinion on Geological and Geophysical Activities in the Mid- and South-Atlantic Planning Areas from 2013 to 2020 ("Programmatic BiOp"). The Programmatic BiOp concluded that the collective take analyzed in BOEM's Programmatic EIS would not jeopardize the continued existence of six threatened and endangered marine mammal species. NMFS therefore authorized a collective level of incidental take for those species through 2020. *See* Programmatic BiOp at 296-97.

On April 10, 2015, several of the signatories to this letter petitioned NMFS and BOEM to: (1) reinitiate formal consultation on the Programmatic BiOp under Section 7 of the ESA, 16 U.S.C. § 1536(a)(2); and (2) withdraw the Programmatic BiOp.[304] The petition detailed new information and activities that undermine NMFS' analysis of the effects of the proposed seismic survey activities on ESA-listed species, including a final critical habitat designation for the Northwest Atlantic Ocean Distinct Population Segment of loggerhead sea turtles, 79 Fed. Reg. 39,856 (July 10, 2014); a proposed rule to expand designated critical habitat for endangered North Atlantic right whales, 80 Fed. Reg. 9,314, 9,343 (Feb. 20, 2015); and the initiation of the U.S. Navy's Atlantic Fleet Training and Testing activities that will results in tens of thousands of instances of take of the same marine mammals and within many of the same areas covered by the seismic survey permit applications.

BOEM notified the petitioners that the agency was discussing the issues raised in the petition with NMFS.[305] It further noted that the Programmatic BiOp did not address the issuance of individual permits "whose potential review under the ESA will be considered individually."[306]

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[303] Several organizations submitted comments on ESA compliance on August 28, 2015 in response to NMFS' Notice of Receipt of Applications for Incidental Harassment Authorization for Geophysical Surveys in the Atlantic Ocean, 80 Fed. Reg. 45,195 (July 29, 2015). A copy of that comment letter is included in the attachments to these comments.

[304] A copy of the petition is included in the attachments to these comments.

[305] Letter from A. Hopper, Director, Bureau of Ocean Energy Management, to S. Roady, Earthjustice (July 1, 2015).

[306] *Id.*

In October 2015, BOEM announced on its website that it had reinitiated Section 7 consultation with NMFS "in light of … [n]ew information available since the issuance of the G&G Atlantic BiOp" and several ESA listings and proposals, including new or expanded critical habitat designations for loggerhead turtles and the North Atlantic right whale, the listing of the scalloped hammerhead shark, and the proposed listings of humpback whale and four shark species, among other marine animals.[307]

We are concerned that NMFS is moving ahead with these IHAs while the new programmatic consultation is still in process, without having analyzed the comprehensive effects of all proposed seismic activities on listed species and their critical habitat under the Endangered Species Act. NMFS should defer the issuance of any IHA until after reconsultation with BOEM on the entire Atlantic seismic program has been completed.[308]

NMFS cannot address the deficiencies identified in our 2015 petition through separate consultation on individual IHAs. The agency requires a full picture of all relevant impacts on the North Atlantic right whale and other endangered species in order to determine whether the seismic testing activities will collectively avoid jeopardy and, if so, to develop the measures necessary to minimize the combined amount of incidental take. These determinations are appropriately made at the programmatic level, where NMFS considers the cumulative impacts of all the proposed seismic surveys, together with other activities taking place in the same area, and, if it allows the testing to proceed, can set an overall level of allowable take that cannot collectively be exceeded. Deferring this analysis to project-specific consultations risks masking or missing these collective impacts. Indeed, courts have rejected agencies' attempts to "defer [programmatic-level] analysis to future site-specific consultations" for precisely these reasons. *Pac. Coast Fed'n of Fishermen's Ass'ns v. NMFS*, 482 F. Supp. 2d 1248, 1267 (W.D. Wash. 2007).[309]

A completed and valid Programmatic BiOp is also vital to ensuring that individual IHAs do not violate the ESA Section 7 mandates to avoid jeopardy and adverse modification of critical habitat. A project-specific analysis must include, at a minimum, an incidental take statement specifying the number and types of takes expected with rigorous and effective monitoring requirements, and hard triggers for halting airgun surveys.

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[307] *See* BOEM, Atlantic G&G Permitting, available at https://www.boem.gov/Atlantic-G-and-G-Permitting/ (accessed June 21, 2017).

[308] Similarly, NMFS has an obligation, under the Magnuson-Stevens Act, to consult the Mid-Atlantic and South Atlantic Fisheries Management Councils over the proposed activity's adverse impacts on essential fish habitat ("EFH"). 16 U.S.C. § 1855(b)(2). This consultation requirement is all the more important given recent science on the impacts of anthropogenic noise on fish, zooplankton and other fish prey, and acoustic habitat, as described elsewhere in these comments. Given the adverse consequences these impacts may have for marine mammals, we recommend that NMFS complete its EFH consultations before authorizing take under the MMPA.

[309] In *Pacific Coast Federation*, the court rejected the agencies' attempt to defer analysis of the relevant "sideboards" necessary for individual projects to avoid collective harm because those "site-specific § 7 consultations will focus on a smaller area than the entire [plan] and, based on the ESA's definition of cumulative effects, assess only those prior federal projects that have undergone consultation. . . . Deferral, therefore, also necessarily improperly curtails the discussion of cumulative effects." 482 F. Supp. 2d at 1267.

For these reasons and those outlined in the April 2015 petition and August 2015 comment letter, NMFS must complete the ongoing consultation with BOEM and correct the deficiencies in the Programmatic BiOp before it conducts project-specific formal consultations or issues any IHAs for seismic activities. After that process is completed, NMFS must also formally consult on the issuance of each individual IHA to ensure that the site-specific effects and take caused by individual permits do not jeopardize the continued existence of ESA-listed species in the biologically rich waters of the Mid- and South-Atlantic coasts.

CONCLUSION

For all of the above reasons, we strongly urge NMFS to withdraw the proposed authorizations and revise its analysis consistent with the agency's statutory obligations. Thank you for considering these comments.

Very truly yours,

Michael Jasny
Director, Marine Mammal Protection Project
NRDC

Attachments sent under separate cover