DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XE283

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Geophysical Surveys in the Atlantic Ocean

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; issuance of five incidental harassment authorizations.

SUMMARY: In accordance with the regulations implementing the Marine Mammal Protection Act (MMPA) as amended, notification is hereby given that we have issued incidental harassment authorizations (IHA) to five separate applicants to incidentally harass marine mammals during geophysical survey activities in the Atlantic Ocean.

DATES: These authorizations are effective for one year from the date of effectiveness.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

Electronic copies of the applications and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.* In case of problems accessing these documents, please call the contact listed above.

Background

Section 101(a)(5)(D) of the MMPA (16 U.S.C. 1361 *et seq.*) directs the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specific geographic region if certain findings are made and notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The MMPA states that the term ''take'' means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Summary of Requests

In 2014, the Bureau of Ocean Energy Management (BOEM) produced a Programmatic Environmental Impact Statement (PEIS) to evaluate potential significant environmental effects of geological and geophysical (G&G) activities on the Mid- and South Atlantic Outer Continental Shelf (OCS), pursuant to requirements of the National Environmental Policy Act (NEPA). BOEM's PEIS and associated Record of Decision are available online at: *www.boem.gov/Atlantic-G-G-PEIS/.* G&G activities include geophysical surveys in support of hydrocarbon exploration, as are planned by the five IHA applicants discussed herein.

In 2014–15, we received multiple separate requests for authorization for take of marine mammals incidental to geophysical surveys in support of hydrocarbon exploration in the Atlantic Ocean. The applicants are companies that provide services, such as geophysical data acquisition, to the oil and gas industry. Upon review of these requests, we submitted questions, comments, and requests for additional information to the individual applicant companies. As a result of these interactions, the applicant companies provided revised versions of the applications that we determined were adequate and complete. Adequate and complete applications were received from ION GeoVentures (ION) on June 24, 2015, Spectrum Geo Inc. (Spectrum) on July 6, 2015, and from TGS–NOPEC Geophysical Company (TGS) on July 21, 2015.

We subsequently posted these applications for public review and sought public input (80 FR 45195; July 29, 2015). The comments and information received during this public review period informed development of the proposed IHAs (82 FR 26244; June 6, 2017), and all letters received are available online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.* Following conclusion of this opportunity for public review, we received revised applications from Spectrum on September 18, 2015, and from TGS on February 10, 2016. We received additional information from ION on February 29, 2016. We also received adequate and complete applications from two additional applicants: WesternGeco, LLC (Western) on February 17, 2016, and CGG on May 26, 2016. Full details regarding these timelines were described in our **Federal Register** Notice of Proposed IHAs (82 FR 26244; June 6, 2017).

On June 26, 2018, Spectrum notified NMFS of a modification to their survey plan. Spectrum's letter and related information is available online, as is their preceding adequate and complete application. The descriptions and analyses contained herein were complete at the time we received notification of the modification. Therefore, we present those descriptions and analyses, including those related to Spectrum's request (as detailed in their 2015 application), intact as originally developed. However, we provide detail regarding Spectrum's modified survey plan, our evaluation of the modification to the specified activity, and our finding that the determinations made in regard to Spectrum's previously proposed specified activity remain appropriate and valid in a standalone section entitled ''Spectrum Survey Plan Modification'' at the end of this notice.

All issued authorizations are valid for the statutory maximum of one year. All applicants plan to conduct two-dimensional (2D) marine seismic surveys using airgun arrays. Generally speaking, these surveys may occur within the U.S. Exclusive Economic Zone (EEZ) (*i.e.,* to 200 nautical miles (nmi)) from Delaware to approximately Cape Canaveral, Florida, and corresponding with BOEM's Mid- and South Atlantic OCS planning areas, as well as additional waters out to 350 nmi from shore. Please see the applications for specific details of survey design. The use of airgun arrays is expected to produce underwater sound at levels that have the potential to result in harassment of marine mammals. Multiple cetacean species with the expected potential to be present during all or a portion of the planned surveys are described below.

Because the specified activity, specific geographic region, and planned dates of activity are substantially similar for the five separate requests for authorization, we have determined it appropriate to provide a joint notice for issuance of the five authorizations. However, while we provide relevant information together, we consider the potential impacts of the specified activities independently and make determinations specific to each request for authorization, as required by the MMPA.

Description of the Specified Activities

In this section, we provide a generalized discussion that is broadly applicable to all five requests for authorization, with project-specific portions indicated.

Overview

The five applicants plan to conduct deep penetration seismic surveys using airgun arrays as an acoustic source. Seismic surveys are one method of obtaining geophysical data used to characterize the subsurface structure, in this case in support of hydrocarbon exploration. The planned surveys are 2D surveys, designed to acquire data over large areas in order to screen for potential hydrocarbon prospectivity. To contrast, three-dimensional surveys may use similar acoustic sources but are designed to cover smaller areas with greater resolution (*e.g.,* with closer survey line spacing). A deep penetration survey uses an acoustic source suited to provide data on geological formations that may be thousands of meters (m) beneath the seafloor, as compared with a survey that may be intended to evaluate shallow subsurface formations or the seafloor itself (*e.g.,* for hazards).

An airgun is a device used to emit acoustic energy pulses into the seafloor, and generally consists of a steel cylinder that is charged with high-pressure air. The firing pressure of an array is typically 2,000 pounds per square inch (psi). Release of the compressed air into the water column generates a signal that reflects (or refracts) off of the seafloor and/or subsurface layers having acoustic impedance contrast. When fired, a brief (~0.1 second (s)) pulse of sound is emitted by all airguns nearly simultaneously. The airguns do not fire during the intervening periods, with the array typically fired on a fixed distance (or shot point) interval. This interval may vary depending on survey objectives, but a typical interval for a 2D survey in relatively deep water might be 25 m (approximately every 10 s, depending on vessel speed). Vessel speed when towing gear is typically 4–5 knots (kn). The return signal is recorded by a listening device and later analyzed with computer interpretation and mapping systems used to depict the subsurface. In this case, towed streamers contain hydrophones that would record the return signal.

Individual airguns are available in different volumetric sizes, and for deep penetration seismic surveys are towed in arrays (*i.e.,* a certain number of airguns of varying sizes in a certain arrangement) designed according to a given company's method of data acquisition, seismic target, and data processing capabilities. A typical large airgun array, as was considered in BOEM's PEIS (BOEM, 2014a), may have a total volume of approximately 5,400 cubic inches (in^3). The notional array modeled by BOEM consists of 18 airguns in three identical strings of six airguns each, with individual airguns ranging in volume from 105–660 in^3. Sound levels for airgun arrays are typically modeled or measured at some distance from the source and a nominal source level then back-calculated. Because these arrays constitute a distributed acoustic source rather than a single point source (*i.e.,* the "source" is actually comprised of multiple sources with some pre-determined spatial arrangement), the highest sound levels measurable at any location in the water will be less than the nominal source level. A common analogy is to an array of light bulbs; at sufficient distance the array will appear to be a single point source of light but individual sources, each with less intensity than that of the whole, may be discerned at closer distances. In addition, the effective source level for sound propagating in near-horizontal directions (*i.e.,* directions likely to impact most marine mammals in the vicinity of an array) is likely to be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array. The horizontal propagation of sound is reduced by noise cancellation effects created when sound from neighboring airguns on the same horizontal plane partially cancel each other out.

Survey protocols generally involve a predetermined set of survey, or track, lines. The seismic acquisition vessel (source vessel) will travel down a linear track for some distance until a line of data is acquired, then turn and acquire data on a different track. In addition to the line over which data acquisition is desired, full-power operation may include run-in and run-out. Run-in is approximately 1 kilometer (km) of full-power source operation before starting a new line to ensure equipment is functioning properly, and run-out is additional full-power operation beyond the conclusion of a trackline (typically half the distance of the acquisition streamer behind the source vessel) to ensure that all data along the trackline are collected by the streamer. Line turns typically require two to three hours due to the long, trailing streamers (approximately 10 km). Spacing and length of tracks vary by survey. Survey operations often involve the source vessel, supported by a chase vessel. Chase vessels typically support the source vessel by protecting the hydrophone streamer from damage (*e.g.,* from other vessels) and otherwise lending logistical support (*e.g.,* returning to port for fuel, supplies, or any necessary personnel transfers). Chase vessels do not deploy acoustic sources for data acquisition purposes; the only potential effects of the chase vessels are those associated with normal vessel operations.

Dates and Duration

All issued IHAs are valid for the statutory maximum of one year from the date of effectiveness. The IHAs are effective upon written notification from the applicant to NMFS, but not beginning later than one year from the date of issuance or extending beyond two years from the date of issuance. However, the expected temporal extent of survey activity varies by company and may be subject to unpredictability due to inclement weather days, equipment maintenance and/or repair, transit to and from ports to survey locations, and other contingencies. Spectrum originally planned a 6-month data acquisition program (February through July), consisting of an expected 165 days of seismic operations. This plan has been modified and now consists of an estimated 108 days of operations. Please see "Spectrum Survey Plan Modification" for further information. TGS plans a full year data acquisition program, with an estimated 308 days of seismic operations. ION plans a six-month data acquisition program (July through December), with an estimated 70 days of seismic data collection. Western plans a full year data acquisition program, with an estimated 208 days of seismic operations. CGG plans a six-month data acquisition program (July through

December), with an estimated 155 days of seismic operations. Seismic operations typically occur 24 hours per day.

Specific Geographic Region

The planned survey activities would occur off the Atlantic coast of the United States, within BOEM's Mid-Atlantic and South Atlantic OCS planning areas (*i.e.,* from Delaware to Cape Canaveral, FL), and out to 350 nmi (648 km) (see Figure 1, reproduced from BOEM, 2014a). The seaward limit of the region is based on the maximum constraint line for the extended continental shelf (ECS) under the United Nations Convention on the Law of the Sea. Until such time as an ECS is established by the United States, the region between the U.S. EEZ boundary and the ECS maximum constraint line (*i.e.,* 200–350 nmi from shore) is part of the global commons, and BOEM determined it appropriate to include this area within the area of interest for geophysical survey activity.

The specific survey areas differ within this region; please see maps provided in the individual applications (Spectrum: Figure 1; Western: Figures 1–1 to 1–4; TGS: Figures 1–1 to 1–4; ION: Figure 1; CGG: Figure 3) (however, please see ''Spectrum Survey Plan Modification'' for further information). The specific geographic region has not changed compared with what was described in our Notice of Proposed IHAs (82 FR 26244; June 6, 2017), nor has substantive new information regarding the region become available. Therefore, we do not reprint that discussion here; for additional detail regarding the specific geographic region, please see our Notice of Proposed IHAs.

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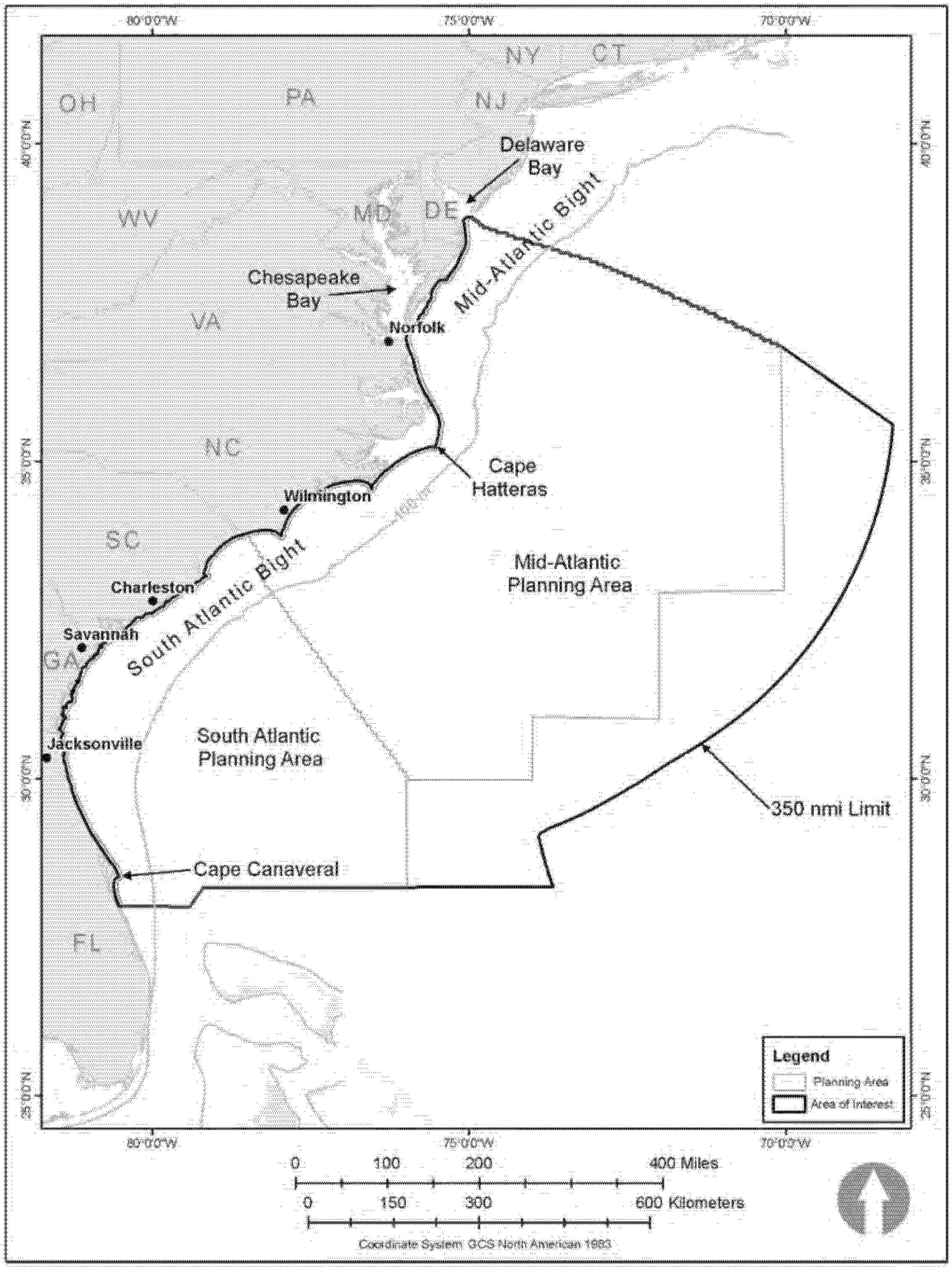

Figure 1. Specific Geographic Region.

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Detailed Description of Activities

Survey descriptions, as summarized from specific applications, are provided here. Please see Table 1 for a summary of airgun array characteristics. With the exception of Spectrum, the planned surveys have not changed from those described in our Notice of Proposed IHAs (82 FR 26244; June 6, 2017) Please see ''Spectrum Survey Plan Modification'' for further information. For full detail, please see the individual IHA applications and our Notice of Proposed IHAs. Note that all applicants expect there to be limited additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard. Therefore, there could be some small amount of use of the acoustic source not accounted for in the total estimated line-km for each survey; however, this activity is difficult to quantify in advance and would represent an insignificant increase in effort.

ION—ION's survey is planned to occur from Delaware to northern Florida (~38.5° N to ~27.9° N) (see Figure 1 of ION's application), and consists of ~13,062 km of survey line. The acoustic source planned for deployment is a 36-airgun array with a total volume of 6,420 in^3. The array would consist of airguns ranging in volume from 40 in^3 to 380 in^3. The airguns would be configured as four identical linear arrays or ''strings'' (see Figure 3 of ION's application). The four airgun strings would be towed at 10-m depth, and would fire every 50 m or 20–24 s, depending on exact vessel speed. ION provided modeling results for their array, including notional source signatures, 1/3-octave band source levels as a function of azimuth angle, and received sound levels as a function of distance and direction at 16 representative sites in the survey area. For more detail, please see Figures 4–6 and Appendix A of ION's application.

Spectrum—Spectrum's survey was originally planned to occur from Delaware to northern Florida (see Figure 1 of Spectrum's application), consisting of ~21,635 km of survey line. This plan has been modified and now consists of ~13,766 km of operations. Please see ''Spectrum Survey Plan Modification'' for further information). The acoustic source planned for deployment is a 32-airgun array with a total volume of 4,920 in^3. The array would consist of airguns ranging in volume from 50 in^3 to 250 in^3. The airguns would be configured as four subarrays, each with eight to ten airguns (see Figure 2 in Appendix A of Spectrum's application). The four airgun strings would be towed at 6 to 10-m depth, and would fire every 25 m or 10 s, depending on exact vessel speed. Spectrum provided modeling results for their array, including notional source signatures, 1/3-octave band source levels as a function of azimuth angle, and received sound levels as a function of distance and direction at 16 representative sites in the survey area. For more detail, please see Appendix A of Spectrum's application.

As stated above, Spectrum notified NMFS on June 26, 2018, of a modification to their survey plan. Please see ''Spectrum Survey Plan Modification'' for further information.

TGS—TGS's survey is planned to occur from Delaware to northern Florida (see Figure 1–1 of TGS's application), and consists of ~58,300 km of survey line. The survey plan consists of two contiguous survey grids with differently spaced lines (see Figures 1–1 to 1–4 of TGS's application), and would involve use of two source vessels operating independently of one another at a minimum of 100 km separation distance. The acoustic sources planned for deployment are 40-airgun arrays with a total volume of 4,808 in^3. The array would consist of airguns ranging in volume from 22 in^3 to 250 in^3. The airguns would be configured as four identical strings (see Figure 3 in Appendix B of TGS's application). The four airgun strings would be towed at 7-m depth, and would fire every 25 m or 10 s, depending on exact vessel speed. More detail regarding TGS's acoustic source and modeling related to TGS's application is provided in Appendix B of TGS's application.

Western—Western's survey is planned to occur from Maryland to northern Florida (see Figure 1–1 of Western's application), and consists of ~27,330 km of survey line. The survey plan consists of a survey grid with differently spaced lines (see Figures 1–1 to 1–4 of Western's application). The acoustic source planned for deployment is a 24-airgun array with a total volume of 5,085 in^3. The airguns would be configured as three identical strings. The three airgun strings would be towed at 10-m depth, and would fire every 37.5 m (approximately every 16 s, depending on vessel speed). More detail regarding Western's acoustic source and modeling related to Western's application is provided in Appendix B of Western's application.

CGG—CGG's survey is planned to occur from Virginia to Georgia (see Figure 3 of CGG's application), and consists of ~28,670 km of survey line. The acoustic source planned for deployment is a 36-airgun array with a total volume of 5,400 in^3. The array would consist of airguns ranging in volume from 40 in^3 to 380 in^3. The airguns would be configured as four identical strings (see Figure 2 of CGG's application). The four airgun strings would be towed at 7-m depth, and would fire every 25 m or 10 s, depending on exact vessel speed. More detail regarding CGG's acoustic source and modeling related to CGG's application is provided in CGG's application.

TABLE 1—SURVEY AND AIRGUN ARRAY CHARACTERISTICS

Company	Total planned survey km	Total volume (in^3)	Number of guns	Number of strings	Nominal source output (downward) [1]			Shot interval (m)	Tow depth (m)
					0–pk	pk–pk	rms		
ION	13,062	6,420	36	4	257	263	[4] 247	50	10
Spectrum	13,766	4,920	32	4	266	272	243	25	6–10
TGS	58,300	4,808	40	4	255	(3)	240	25	7
Western	27,330	5,085	24	3	(3)	262	235	37.5	10
CGG	28,670	5,400	36	4	(3)	259	[3 4] 243	25	7
BOEM [2]	n/a	5,400	18	3	247	(3)	233	n/a	6.5

[1] See ''Description of Active Acoustic Sound Sources,'' later in this document, for discussion of these concepts.
[2] Notional array characteristics modeled and source characterization outputs from BOEM's PEIS (2014a) provided for comparison.
[3] Values not given; however, SPL (pk–pk) is usually considered to be approximately 6 dB higher than SPL (0–pk) (Greene, 1997).
[4] Value decreased from modeled 0–pk value by minimum 10 dB (Greene, 1997).

Comments and Responses

We published a Notice of Proposed IHAs in the **Federal Register** on June 6, 2017 (82 FR 26244), beginning a 30-day comment period. In that notice, we requested public input on the requests for authorization described therein, our analyses, the proposed authorizations, and any other aspect of the Notice of Proposed IHAs for the five separate specified geophysical survey activities, and requested that interested persons submit relevant information, suggestions, and comments. We further specified that, in accordance with the requirements of the MMPA, we would only consider comments that were relevant to marine mammal species that occur in U.S. waters of the Mid- and South Atlantic and the potential effects of the specified geophysical survey activities on those species and their habitat. We also noted that comments indicating general support for or opposition to hydrocarbon exploration or any comments relating to hydrocarbon development (*e.g.,* leasing, drilling) were not relevant to the proposed actions and would not be considered. We requested that comments indicate whether they were general to all of the proposed authorizations or specific to one or more of the five separate proposed authorizations, and that comments should be supported by data or literature citations as appropriate. Following requests to extend the public comment period, we determined it appropriate to do so by an additional 15 days (82 FR 31048; July 5, 2017). Including the 15-day extension, the public comment period concluded on July 21, 2017. Comments received after the close of the comment period were not considered.

During the 45-day comment period, we received 117,294 total comment letters. Of this total, we determined that approximately 3,196 comment letters represented unique submissions, including 73 letters from various organizations or individuals acting in an official capacity (*e.g.,* non-governmental organizations, representatives and members of the oil and gas industry, state and local government, members of Congress, members of academia) and 3,103 unique submissions from private citizens. We note that the 73 letters represent approximately 330 organizations or individuals, as many letters included multiple co-signers. The remaining approximately 114,118 comment letters followed one of 20 different generic template formats, in which respondents provided comments that were identical or substantively the same. We consider each of the 20 different templates to represent a single unique submission that is included in the value cited above (3,196). Separately, we received 15 petitions, with a total of 99,423 signatures. Of these, one petition (595 signatures) expressed support for issuance of the proposed IHAs, while the remainder expressed opposition to issuance of the proposed IHAs or, more generally, to oil and gas exploration and/or development in the U.S. Atlantic Ocean.

NMFS has reviewed all public comments received on the proposed issuance of the five IHAs. All relevant comments and our responses are described below. Comments indicating general support for or opposition to hydrocarbon exploration but not containing relevant recommendations or information are not addressed here. Similarly, any comments relating to hydrocarbon development (*e.g.,* leasing, drilling)—including numerous comments received that expressed concern regarding the risks of oil spills or of potential future industrialization on the U.S. Atlantic coast—are not relevant to the proposed actions and therefore were not considered and are not addressed here. We also provide no response to specific comments that addressed species or statutes not relevant to our proposed actions under section 101(a)(5)(D) of the MMPA (*e.g.,* comments related to sea turtles), nor do we respond to comments more appropriately directed at BOEM pursuant to their authority under the Outer Continental Shelf Lands Act (OCSLA) to permit the planned activities. For those comments germane to the proposed IHAs, we outline our comment responses by major categories. Recurring comments are noted below as having been submitted by ''several'' or ''many'' commenters to avoid repetition. The 73 letters from various organizations or individuals acting in an official capacity, and representatives of each of the 20 form letter templates, are available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.* Remaining comments are part of our administrative record for these actions but are not available online.

General Comments

A large majority of commenters, including all of those following one of the 20 templates, expressed general opposition towards geophysical airgun surveys in the U.S. Atlantic Ocean. We reiterate here that NMFS's proposed actions concern only the authorization of marine mammal take incidental to the planned surveys—jurisdiction concerning decisions to allow the surveys rests solely with BOEM, pursuant to their authority under the OCSLA. Further, NMFS does not have discretion regarding issuance of requested incidental take authorizations pursuant to the MMPA, assuming (1) the total taking associated with a specified activity will have a negligible impact on the affected species or stock(s); (2) the total taking associated with a specified activity will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (not relevant here); (3) the total taking associated with a specified activity is small numbers of marine mammals of any species or stock; and (4) appropriate mitigation, monitoring, and reporting of such takings are set forth, including mitigation measures sufficient to meet the standard of least practicable adverse impact on the affected species or stocks. A large volume of the comments received request that NMFS not issue any of the IHAs and/or express disdain for NMFS's proposal to issue the requested IHAs, but without providing information relevant to NMFS's decisions. These comments appear to indicate a lack of understanding of the MMPA's requirement that NMFS shall issue requested authorizations when the above listed conditions are met; therefore, these comments were not considered.

In general, commenters described the close linkages between their local and state economies to a healthy ocean, contending that the planned surveys could have substantial impacts on, for example, commercial and recreational fishing, wildlife viewing, outdoor recreation, and businesses dependent on these activities. Commenters suggested that NMFS should undertake analyses unrelated to the proposed actions (*i.e.,* issuance of requested IHAs), such as a cost-benefit analysis of hydrocarbon exploration and development compared to the economic benefits of coastal tourism and healthy fisheries. Many commenters also noted that over 120 municipalities and cities and 1,200 elected officials on the Atlantic coast have passed resolutions or otherwise formally opposed hydrocarbon exploration and/or development in the region. We also received comments expressing general opposition to oil and gas exploration activity from the Business Alliance for Protecting the Atlantic Coast, which stated that the comments were submitted on behalf of 41,000 businesses and 500,000 commercial fishing families. While NMFS recognizes the overwhelming opposition expressed by the public to oil and gas exploration and/or development in the U.S. Atlantic Ocean that it has received, we remain appropriately focused on consideration of the best available scientific information in support of our analyses pursuant to the MMPA, specific to the five IHAs considered herein.

Multiple commenters focused on specific, rather than general, issues that are not germane to our consideration of requested action under the MMPA. For example, the Northwest Atlantic Marine Alliance (NAMA) and other groups provided comments related to potential impacts on commercial fisheries, and the New Jersey Council of Diving Clubs expressed concern regarding potential impacts of the planned surveys on recreational divers. Recommendations were provided concerning mitigating potential impacts. We reiterate that NMFS's proposed action—the issuance of IHAs authorizing incidental take of marine mammals—necessarily results in impacts only to marine mammals and marine mammal habitat. Effects of the surveys more broadly are the purview of BOEM, which has jurisdiction under OCSLA for permitting the actual surveys, as opposed to authorizing take of marine mammals incidental to a permitted survey. Therefore, we do not address comments such as these.

Multiple groups stated that NMFS should consider impacts and protection for other species in the action area, such as Atlantic sturgeon, other fish species, invertebrates, plankton, and sea turtles. Some of these comments specifically referenced the importance of the area offshore Cape Hatteras as home to a diverse assemblage of non-marine mammal species, including sharks, turtles, seabirds, and other fish species. The NAMA provided comments relating to Essential Fish Habitat (EFH) (as designated pursuant to the Magnuson Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Pub. L. 104–267)), including concerns regarding effects to EFH resulting from the planned surveys. Because NMFS's proposed action is limited to the authorization of marine mammal take incidental to the planned surveys, effects of the surveys on aspects of the marine environment other than marine mammals and their habitat are not relevant to NMFS's analyses under the MMPA. Pursuant to guidance from NMFS's Office of Habitat Conservation concerning EFH and MMPA incidental take authorizations, we have determined that the issuance of these IHAs will not result in adverse impacts to EFH, and further, that issuance of these IHAs does not require separate consultation per section 305(B)(2) of the MSA. We do not further address potential impacts to EFH.

The MMPA does require that we evaluate potential effects to marine mammal habitat, which includes prey species (*e.g.,* zooplankton, fish, squid). However, consideration of potential effects to taxa other than marine mammals and their prey, or consideration of effects to potential prey species in a context other than the import of such effects on marine mammals, is not relevant to our action under the MMPA. We have appropriately considered effects to marine mammal habitat. Separately, BOEM evaluated effects to all relevant aspects of the human environment (including marine mammals and other taxa) through the analysis presented in their PEIS (available online at: *www.boem.gov/Atlantic-G-G-PEIS/*), and effects to all potentially affected species that are listed under the Endangered Species Act (ESA) and any critical habitat designated for those species were addressed through consultation between BOEM and NMFS pursuant to section 7 of the ESA. That Biological Opinion, which evaluated both BOEM's (issuing permits for the five surveys) and NMFS's (issuing IHAs associated with the five permitted surveys) proposed actions, is available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.* We do not further address taxa other than marine mammals and marine mammal prey.

Marine Mammal Impacts

Comment: Many commenters expressed concern regarding the perceived lack of information regarding the affected marine mammal stocks and the impacts of the surveys on marine mammal individuals and populations and their habitat (direct and indirect; short- and long-term).

Response: NMFS acknowledges that, while there is a growing body of literature on the affected marine mammal stocks and regarding the impacts of noise on individual marine mammals, data gaps do remain, particularly with regard to potential population-level impacts and cumulative impacts. However, NMFS must use the best available scientific information in analyses supporting its determinations pursuant to the MMPA, and has done so here. While NMFS does not take lightly the potential effects of surveys on marine mammal populations, these surveys, with the robust suite of required mitigation and monitoring, are expected to have a negligible impact on the affected species and stocks.

Comment: Many commenters expressed general concern regarding impacts to both individual marine mammals and potential population-level harm, including impacts to important behaviors and chronic stress stemming from acoustic disturbance. More specifically, this included: Potential displacement from preferred feeding, breeding, and migratory habitats, which could lead to long-term and large-scale habitat avoidance or abandonment; impacts to mating, vocalizing, and other key marine mammal behaviors; communication interference between cow-calf pairs, which could lead to stranding increases and juvenile deaths; hearing loss hindering recruitment and marine mammals' ability to locate mates and find food.

Response: NMFS has carefully reviewed the best available scientific information in assessing impacts to marine mammals, and recognizes that the surveys have the potential to impact marine mammals through threshold shifts, behavioral effects, stress responses, and auditory masking. However, NMFS has determined that the nature of such potentially transitory exposure—any given location will be exposed to survey noise only relatively briefly and infrequently—means that the potential significance of the authorized taking, including potential long-term avoidance, is limited. NMFS has also prescribed a robust suite of mitigation measures, such as time-area restrictions and extended distance shutdowns for certain species, that are expected to further reduce the duration and intensity of acoustic exposure, while limiting the potential severity of any possible behavioral disruption.

Comment: Many commenters described impacts to ''millions of marine mammals,'' expressing concern that NMFS would allow such a level of impacts, or stating concern that NMFS would allow killing of marine mammals. Similarly, many commenters refer to taking or killing ''138,000 marine mammals.''

Response: Many of these comments were written with reference to the acoustic exposure analysis provided in BOEM's PEIS, which is not directly related to the specific surveys that are the subject of NMFS's analysis. In fact, the more specific figure commonly cited (*i.e.,* 138,000) represents the number of incidents of Level A harassment estimated by BOEM in their analysis using now-outdated guidance (*i.e.,* 180-dB root mean square (rms) with no consideration of frequency sensitivity) that the best available science indicates does not reflect when Level A harassment should be expected to occur. Certain non-governmental organizations have incorrectly suggested the information represents animals killed. In addition, BOEM's programmatic analysis was based on a vastly greater amount of survey activity occurring per year over a period of nine years, versus the five surveys considered herein. Regardless, NMFS cannot issue the authorizations unless the total taking expected to occur as a result of each specified activity is determined to result in a negligible impact to the affected species or stocks. The best available science indicates that Level B harassment, or disruption of behavioral patterns, is likely to occur, and that a limited amount of auditory injury, or permanent threshold shift (PTS) (Level A harassment) may occur for a few species. No mortality is expected to occur as a result of the planned surveys, and there is no scientific evidence indicating that any marine mammal could experience mortality as a direct result of noise from geophysical survey activity. Authorization of mortality may not occur via IHAs, and such authorization was neither requested nor proposed. Finally, we emphasize that an estimate of take numbers alone is not sufficient to assess impacts to a marine mammal population. Take numbers must be viewed contextually with other factors, as explained in the ''Negligible Impact Analyses and Determinations'' section of this Notice.

Comment: Several commenters referenced studies showing that noise from airgun surveys can travel great distances underwater, leading to concern that the surveys would impact marine mammals throughout the specific geographic region at all times. Some commenters then suggested that this would result in there being no available habitat for displaced animals to escape to.

Response: NMFS acknowledges that relatively loud, low-frequency noise (as is produced by airgun arrays) has the potential to propagate across large distances. However, propagation and received sound levels are highly variable based on many biological and environmental factors. For example, while one commonly cited study (Nieukirk *et al.,* 2012) described detection of airgun sounds almost 4,000 km from the acoustic source, the sensors were located within the deep sound channel (SOFAR), where low-frequency signals may travel great distances due to the advantageous propagation environment. While sounds within this channel are unlikely to be heard by most marine mammals due to the depth of the SOFAR channel—which is dependent primarily on temperature and water pressure and therefore variable with latitude—it is arguable whether sounds that travel such distances may be heard by whales as a result of refraction to shallower depths (Nieukirk *et al.,* 2012; McDonald *et al.,* 1995). Regardless, while the extreme propagation distances cited in some comments may not be realistic in terms of effects on mysticetes, we acknowledge that contraction of effective communication space for whales that vocalize and hear at frequencies overlapping those emitted by airgun arrays can occur at distances on the order of tens to hundreds of kilometers. However, attenuation to levels below the behavioral harassment criterion (*i.e.,* 160 dB rms) will likely always occur over much shorter distances and, therefore, we do not agree with the contention that essentially the entire specific geographic region would be ensonified to a degree that marine mammals would find it unsuitable habitat. Rather, it is likely that displacement would occur within a much smaller region in the vicinity of the acoustic source (*e.g.,* within 5–10 km of the source, depending on season and location). Overall, the specific geographic region and marine mammal use of the area is sufficiently large that, although displacement may occur, the region offers enough habitat for marine mammals to seek temporary viable habitat elsewhere, if necessary. Many of the affected species occupy a wide portion of the region, and it is expected that individuals of these species can reasonably find temporary foraging grounds or other suitable habitat areas consistent with their natural use of the region. Further, although the planned surveys would cover large portions of the U.S. Mid- and South Atlantic, they will only be transitory in any given area. Therefore, NMFS does not expect displacement to occur frequently or for long durations. Importantly, for species that show high site fidelity to a particular area (*e.g.,* pilot whales around Cape Hatteras) or to bathymetric features (*e.g.,* sperm whales and beaked whales), NMFS has required additional time-area restrictions to reasonably minimize these impacts.

Comment: The Bald Head Island Association commented that many bottlenose dolphin populations are depleted, and risks from the surveys are too great.

Response: NMFS acknowledges that coastal bottlenose dolphin stocks are depleted under the MMPA, and we described the 2013–2015 Unusual Mortality Event affecting these stocks in our Notice of Proposed IHAs. NMFS is requiring a year-round closure to all survey activity out to 30 km offshore, including a 20-km distance beyond which encountered dolphins would generally be expected to be of the offshore stock and a 10-km buffer distance that is expected to encompass all received sound levels exceeding the 160-dB rms Level B harassment criterion. In consideration of this mitigation requirement, NMFS believes that impacts to coastal bottlenose dolphins will be minimal.

Comment: The New York State Department of Environmental Conservation expressed concern about impacts from the surveys to animals in the New York Bight, noting that even though the surveys would not be occurring in the vicinity of New York Bight many of the same animals that use the New York Bight for certain life history strategies would also be found in certain times of year in the specific geographic region.

Response: Although unrelated to our analyses and necessary findings pursuant to the MMPA, we note that in requesting the opportunity to conduct review of the proposed surveys pursuant to the Coastal Zone Management Act, New York did not demonstrate that the surveys would have reasonably foreseeable effects on New York's coastal uses or resources. Therefore, New York's request was denied. However, we acknowledge that some of the same animals that may occur in the New York Bight could also occur at other times of year within the survey region and, therefore, be affected by the specified activities. However, as detailed elsewhere in this document, we have found for each specified activity and each potentially affected species or stock that the taking would have a negligible impact.

Comment: The Natural Resources Defense Council (NRDC) submitted comments on behalf of itself and over thirty other organizations, including the Center for Biological Diversity, Defenders of Wildlife, Earthjustice, The Humane Society of the United States, Sierra Club, *et al.* Hereafter, we refer to this collective letter as ''NRDC.'' NRDC and other commenters assert that the surveys will drive marine mammals into shipping lanes, thereby increasing their risk of ship strike.

Response: As an initial matter, we address overall themes in NRDC's 85-page comment letter. In addition to mischaracterizing the literature, likely impacts to marine mammals, and NMFS's analyses in multiple places—which we attempt to correct throughout our responses—the letter repeatedly makes use of undefended or off-point assertions (*e.g.,* that NMFS's findings are ''arbitrary and capricious'' and ''non-conservative''). While we have attempted to clarify and correct individual mischaracterizations in our specific responses to comments, we broadly address the issue here. NRDC's 16 assertions that NMFS's analyses and/or conclusions are ''arbitrary and capricious'' or just ''arbitrary'' are unfounded. Similarly, NRDC claims that NMFS's approaches or decisions are ''non-conservative,'' or should be more ''conservative,'' at least 15 times, with no indication of what standard they are seeking to attain. While NRDC may disagree with the issuance of the IHAs or the underlying activities themselves, we believe the administrative record for these IHAs amply demonstrates that NMFS used the best available science during our administrative process to inform our analyses and satisfy the standards under section 101(a)(5)(D).

With regard to this specific comment, the surveys are largely not occurring in or near any shipping lanes, as they will occur a minimum of 30 km offshore. NMFS is not aware of any scientific information suggesting that the surveys would drive marine mammals into shipping lanes, and disagrees that this would be a reasonably anticipated effect of the specified activities.

Comment: Comments submitted jointly by Oceana and the International Fund for Animal Welfare (hereafter, ''Oceana'') and, separately, by Sea Shepherd Legal discuss particular concerns regarding potential impacts to large whales. The comments cite studies showing modified singing behavior and habitat avoidance among fin whales in response to airguns; that sperm whales in the Gulf of Mexico have shown decreased buzz rates around airguns; that singing among humpback whales declined in response to airgun noise; etc.

Response: NMFS reviewed all cited studies in making its determinations for both the proposed and final IHAs, and agrees that there are multiple studies documenting changes in behavior and/or communication amongst large whales in response to airgun noise, sometimes at significant distance. Changes in vocalization associated with exposure to airgun surveys within migratory and non-migratory contexts have been observed (*e.g.,* Castellote *et al.,* 2012; Blackwell *et al.,* 2013; Cerchio *et al.,* 2014). The potential for anthropogenic sound to have impacts over large spatial scales is not surprising for species with large communication spaces, like mysticetes (*e.g.,* Clark *et al.,* 2009); however, not every change in a vocalization would necessarily rise to the level of a take, much less have meaningful consequences to the individual or for the affected population. As noted previously, the planned surveys are expected to be transient and would not result in any sustained impacts to such behaviors for baleen whales. We also acknowledge that exposure to noise from airguns may impact sperm whale foraging behavior (Miller *et al.,* 2009). However, our required mitigation—including time-area restrictions designed to protect certain habitat expected to be of importance for foraging sperm whales, in addition to standard shutdown requirements expected to minimize the severity and duration of any disturbance—when considered in context of the transient nature of the impacts possible for these surveys lead us to conclude that effects to large whales will be no greater than a negligible impact and will be mitigated to the level of least practicable adverse impact.

Comment: Several industry commenters stated, in summary, that there is no scientific evidence that geophysical survey activities have caused adverse consequences to marine mammal stocks or populations, and that there are no known instances of injury to individual marine mammals as a result of such surveys, stating that similar surveys have been occurring for years without significant impacts. One stated that surveys have been ongoing in the Gulf of Mexico for years and have not resulted in any negative impacts to marine mammals, including reducing fitness in individuals or populations. Referring to other regions, the commenters stated that bowhead whale numbers have increased in the Arctic despite survey activity. CGG noted that there is no ''empirical evidence'' of surveys causing injury or mortality to marine mammals, and that previous surveys resulted in less take than authorized. Another group added that BOEM has spent $50 million on protected species and noise research over four decades with no evidence of adverse effects.

Response: Disruption of behavioral patterns (*i.e.,* Level B harassment) has been documented numerous times for marine mammals in the presence of airguns (in the form of avoidance of areas, notable changes in vocalization or movement patterns, or other shifts in important behaviors; see ''Potential Effects of the Specified Activity on Marine Mammals and Their Habitat''). Further, lack of evidence for a proposition does not prove it is false. In this case, there is growing scientific evidence demonstrating the connections between sub-lethal effects, such as behavioral disturbance, and population-level effects on marine mammals (*e.g.,* Lusseau and Bedjer, 2007; New *et al.,* 2014). Disruptions of important behaviors, in certain contexts and scales, have been shown to have energetic effects that can translate to reduced survivorship or reproductive rates of individuals (*e.g.,* feeding is interrupted, so growth, survivorship, or ability to bring young to term is compromised), which in turn can adversely affect populations depending on their health, abundance, and growth trends.

Based on the available evidence, a responsible analysis of potential impacts of airgun noise on marine mammal individuals and populations cannot assume that such effects cannot occur. In reality, conclusive statements regarding population-level consequences of acoustic stressors cannot be made due to insufficient investigation, as such studies are exceedingly difficult to carry out and no appropriate study and reference populations have yet been established. For example, a recent report from the National Academy of Sciences noted that, while a commonly-cited statement from the National Research Council (''[n]o scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal population'') remains true, it is largely because such impacts are very difficult to demonstrate (NRC, 2005; NAS, 2017). Population-level effects are inherently difficult to assess because of high variability, migrations, and multiple factors affecting the populations. However, NMFS has carefully considered the available evidence in determining the most appropriate suite of mitigation measures and in making the necessary determinations (see ''Negligible Impact Analyses and Determinations'').

Comment: NRDC states that NMFS must consider that behavioral disturbance can amount to Level A harassment, or to serious injury or mortality, if it interferes with essential life functions through secondary effects, stating that displacement from migration paths can result in heightened risk of ship strike or predation, especially for right whales. In a similar vein, Oceana expressed concern about the presence of additional ships in the Atlantic, risking serious injury to marine mammals from ship strike or entanglement. Relatedly, NRDC noted that NMFS's conclusion that ship strikes will not occur indicates an assumption that required ship-strike avoidance procedures will be effective. NRDC disagrees that the ship-strike avoidance measures will be effective.

Response: NMFS acknowledges that sufficient disruption of behavioral patterns could theoretically, likely in connection with other stressors, result in a reduction in fitness and ultimately injury or mortality. However, such an outcome could likely result only from repeated disruption of important behaviors at critical junctures, or sustained displacement from important habitat with no associated compensatory ability. No such outcome is expected as a result of these surveys, which will be transient in any given area within the large overall region, and which avoid some of the most important habitat. Effects such as those suggested by NRDC would not be expected for right whales, as the surveys are required to avoid migratory pathways (80 km from coast), or achieve comparable protection provided through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore (see ''Mitigation'' for more information).

Although the primary stressor to marine mammals from the specified activities is acoustic exposure to the sound source, NMFS takes seriously the risk of vessel strike and has prescribed measures sufficient to avoid the potential for ship strike to the extent practicable. NMFS has required these measures despite a very low likelihood of vessel strike; vessels associated with the surveys will add a discountable amount of vessel traffic to the specific geographic region (*i.e.,* each survey will operate with roughly 2–3 vessels) and, furthermore, vessels towing survey gear travel at very slow speeds (*i.e.,* roughly 4–5 kn).

NMFS's required vessel strike avoidance protocol is expected to further minimize any potential interactions between marine mammals and survey vessels. Please see ''Vessel Strike Avoidance'' for a full description of requirements, which include: Vessels must maintain a 10 kn speed restriction when in North Atlantic right whale critical habitat, Seasonal Management Areas, or Dynamic Management Areas; vessel operators and crews must maintain a vigilant watch for all marine mammals and must take necessary actions to avoid striking a marine mammal; vessels must reduce speeds to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel; and vessels must maintain minimum separation distances.

Comment: NRDC stated that NMFS did not properly consider potential impacts of masking to marine mammals. For example, NRDC notes that NMFS addresses masking in the general consequences discussion of its negligible impact analysis, but disagrees with NMFS's conclusion that consequences are appropriately categorized as ''medium'' rather than ''high'' for mysticetes, citing the distances at which vocal modifications to distant sounds have been detected in low-frequency cetaceans and newly-described low-level communication calls between humpback whales and their calves, which they suggest have dire implications for right whales. NRDC also states that NMFS incorrectly thinks masking is co-extensive with the modeled 160-dB rms behavioral harassment zones, and suggests that NMFS should take a modeling approach to better assess potential masking. Relatedly, another commenter stated a belief that NMFS assumes that there is no potential for masking during the interpulse interval, when in fact there is noise during that period due to multipath arrivals.

Response: NMFS disagrees that the potential impacts of masking were not properly considered. NMFS acknowledges our understanding of the literature NRDC cites regarding the greater sensitivity of low-frequency cetaceans to airgun survey noise via the designation of these effects as ''medium,'' but fundamentally, the masking effects to any one individual whale from one survey operating far offshore are expected to be minimal. Masking is referred to as a chronic effect because one of the key harmful components of masking is its duration—the fact that an animal would have reduced ability to hear or interpret critical cues becomes much more likely to cause a problem the longer it is occurring. Also, inherent in the concept of masking is the fact that the potential for the effect is only present during the times that the animal and the source are in close enough proximity for the effect to occur (and further this time period would need to coincide with a time that the animal was utilizing sounds at the masked frequency) and, as our analysis (both quantitative and qualitative components) indicates, because of the relative movement of whales and vessels, we do not expect these exposures with the potential for masking to be of a long duration within a given day. Further, because of the relatively low density of mysticetes, the time-area restrictions, and large area over which the vessels travel, we do not expect any individual whales to be exposed to potentially masking levels from these surveys more than a few days in a year.

NMFS recognizes that masking may occur beyond the 160-dB zone and, further, that the primary concern is when numerous sources, many of which may be at distances beyond their 160-dB isopleth, contribute to higher background noise levels over extended time periods and significant portions of an individual's acoustic habitat. However, as noted above, any masking effects of these single surveys operating far offshore (with no expectation that any of the five would be in close enough proximity to one another to contemporaneously expose animals to noise from multiple source vessels) are expected to be limited and brief, if present. Further, we recognize the presence of multipath arrivals, especially the farther the receiver is from the ship, but given the reduced received levels at distance, combined with the short duration of potential masking and the lower likelihood of extensive additional contributors to background noise this far offshore and within these short exposure periods, we believe that the incremental addition of the seismic vessel is unlikely to result in more than minor and short-term masking effects, likely occurring to some small number of the same individuals captured in the estimate of behavioral harassment.

In regard to some of the specific examples NRDC raised, we acknowledge that vocal modifications of low-frequency cetaceans in response to distant sound sources have been detected. However, as discussed elsewhere in this Notice, not every behavioral change or minor vocal modification rises to the level of a take or has any potential to adversely impact marine mammal fitness, and NRDC has not demonstrated why it believes the short duration exposures that low-frequency cetaceans might be exposed to a few times a year from a survey should constitute a ''high'' versus ''medium'' consequence in NMFS's assessment framework.

Similarly, NMFS is also aware of the Videsen *et al.* (2017) paper reporting the lower-level communication calls between humpback mother-calf pairs and noting the increased risk of cow-calf separation with increases in background noise. We first note that only neonates were tagged and measured in this study (*i.e.,* circumstances could change with older calves). Further, while vocalizations between these pairs are comparatively lower level than between adults, the cow and neonate calf are in regular close proximity (as evidenced by the extent of measured sound generated by rubbing in this study), which means that the received levels for cow-calf communication are higher than they would be if the animals were separated by the distance typical between adults—in other words, it is unclear whether these lower-level, but close proximity, communications are comparatively more susceptible to masking. Assuming that right whale cow-calf pairs use the same lower-level communication calls, we first note that across all five surveys, modeled results estimate that 19 right whales may intercept with the tracklines of the surveys such that they are potentially taken and, further, as described in the ''Negligible Impact Analyses and Determinations'' section and based on available demographic information, it should be expected that no more than four exposures could be of adult females with calves (not specifically neonates). Again, when this very low likelihood of encountering cow-calf pairs is combined with the fact that any individuals (or cow-calf pairs) would not be expected to be exposed on more than a couple/few days in a year, NRDC has not demonstrated how the consequences of these activities would be ''catastrophic,'' for right whales, and we believe our analysis supports a ''medium'' consequence rating.

Last, in response to the suggestion that we utilize a model, such as the model NMFS used for assessing similar potential impacts in the Gulf of Mexico, to assess impacts to communication space from the surveys evaluated here—it is neither necessary nor an appropriate use of those tools. As noted above, the combination of the modeled take estimates, along with a qualitative evaluation of the temporal and spatial footprint of the activities within the large action area and dispersed marine mammal distributions, makes it clear that masking effects, if any, would be highly limited for these activities. In the Gulf of Mexico, NMFS used the referenced model in the context of a five-year rule to programmatically assess the chronic impacts of an entire seismic program in a mature and active hydrocarbon-producing region, with a significantly greater amount of effort than is contemplated in these five surveys, overlaid in an area with already otherwise high ambient noise. Use of the model is comparatively expensive and time-consuming, and produces a relatively gross-scale comparison of predicted annual averages (or other duration) of accumulated sound energy (which can also be interpreted in the context of the communication space of any species). This sort of analysis can be helpful in understanding relative chronic effects when higher and longer-term overall levels of activity and impacts are being evaluated across areas with notably variable levels of activities and/or ambient noise, and can potentially inform decisions regarding time-area mitigation. Here, however, any impacts to communication space from any individual survey are expected to be minimal; in addition to being unnecessary, the lack of granularity in the suggested model (which is appropriate at larger and denser scales of impacts, and which can be improved with improvement of the available input data) is such that its application to these activities would not produce useful information.

Comment: The South Carolina Environmental Law Project, on behalf of the Business Alliance for Protecting the Atlantic Coast, commented that chronic stress is possible from the specified activities and that likely stress effects would be exacerbated due to their contention that avoidance is impossible.

Response: As described in our Notice of Proposed IHAs, NMFS recognizes that stress from acoustic exposure is one potential impact of these surveys, and that chronic stress can have fitness, reproductive, etc. impacts at the population-level scale. However, we believe the possibility for chronic stress is low given the transitory and intermittent nature of the sound source (*i.e.,* acoustic exposure in specific areas will not be long lasting). The potential for chronic stress was evaluated in making the determinations presented in NMFS's negligible impact analyses.

Comment: An individual stated that NMFS did not account for long-term impacts to species, writing that it is impossible to accurately account for impacts without looking at the effects of sound disturbance on energy balance (*e.g.,* when disturbance results in additional time spent traveling and/or foraging in less optimal habitats, the result may be a negative energy balance). The commenter stated further that this negative energy balance could have effects both individually and cumulatively for a population, and that the cumulative effect of behavioral disturbance could be equivalent to a certain amount of lethal takes.

Response: NMFS acknowledges that the concerns raised are theoretically possible, but in this case, with limited duration of individual surveys or of overlap of multiple surveys, and modeled take estimates suggesting that individuals would rarely be impacted by any given survey more than a few days in a year, frequent and long-term displacement is not expected. Therefore, NMFS does not anticipate behavioral disruptions sufficient to negatively impact individual energy balances, much less to a degree where long-term effects resulting in impacts to recruitment or survival would occur. For example, while the available evidence indicates sensitivity to disruption of foraging efficiency for sperm whales exposed to airgun noise (Miller *et al.,* 2009), a recent bioenergetic modeling exercise showed that infrequent, minor disruptions in foraging—as are expected in this case—are unlikely to be fatal (Farmer *et al.,* 2018). The authors conclude that foraging disruptions would have to be relatively frequent to lead to terminal starvation, but continual minor disruptions can cause substantial reductions in available reserves. Given the temporary, infrequent nature of exposure likely to result from the planned surveys, in conjunction with the planned mitigation, which includes effort restrictions in areas expected to be of importance for sperm whale foraging, it is unlikely that either continual minor disruptions or less frequent, but more severe disruptions would occur.

Comment: One individual cited Schnitzler *et al.* (2017) in stating that the varied anatomy of individual sperm whale ears indicates that ''tolerable'' sound levels may not be the same for different animals.

Response: NMFS acknowledges that actual individual responses to noise exposure will vary based on a variety of factors, including individual anatomy but more likely because of individual context and experience. However, sufficient scientific information does not exist to assess differential impacts to specific individuals. Therefore, NMFS uses generic acoustic thresholds in order to predict potential responses to noise exposure. However, NMFS has required a sufficiently robust suite of mitigation measures to provide reasonable certainty of general reduction of takes and of intensity and/or duration of acoustic exposures for individual sperm whales.

Comment: The Bald Head Island Association noted that many marine mammals have washed up on their beaches in recent years, including a beaked whale and juvenile dolphin after offshore airgun surveys. Sea Shepherd Legal claimed that NMFS did not adequately address the potential for stranding events, noting several studies that they claim link strandings with airgun surveys. They also noted that NMFS did not acknowledge a January 2017 mass stranding of false killer whales when considering impacts to species.

Response: Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series (*e.g.,* Geraci *et al.,* 1999). However, the cause or causes of most strandings are unknown (*e.g.,* Best, 1982). Stranding events are known to occasionally happen as a result of sound exposure, *e.g.,* Southall *et al.,* 2006, 2013; Jepson *et al.,* 2013; Wright *et al.,* 2013, with stranding thought to occur subsequent to the exposure, as a result of non-auditory physiological effects or injuries, which theoretically might occur as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction). However, such events are typically associated with use of military tactical sonar, which has very different characteristics than airgun noise.

NMFS is unaware of any information linking possible strandings on Bald Head Island, or in any other location on the East Coast, with offshore airgun survey activity, and does not expect the planned surveys to have any potential to result in stranding events or the type of injuries or effects that could lead to stranding events, given the required mitigation and operational protocols. In support of its position, Sea Shepherd Legal cites two review articles (Gordon *et al.,* 2003; Compton *et al.,* 2008) that make general statements regarding the potential effects of airgun noise and/or review best practices in mitigation—NMFS reviewed these papers and discussed them in our Notice of Proposed IHAs. Sea Shepherd also cites a third document (Engel *et al.,* 2004) questioning whether such surveys may be responsible for coincident strandings of humpback whales in Brazil in 2002, and notes NMFS's discussion of a 2002 beaked whale stranding event that was contemporaneous with and reasonably associated spatially with an airgun survey in the Gulf of California. However, unlike for strandings associated with use of military sonar, no conclusive causal link was made, and these observations remain based on spatial and/or temporal coincidence. NMFS here acknowledges the 2017 stranding of false killer whales in Florida referenced by Sea Shepherd Legal, for which no cause was found.

However, as a precaution NMFS has modified its reporting requirements to include protocols relating to minimization of additional harm to live-stranded (or milling) marine mammals. Addition of these protocols does not imply any change to our determination that stranding events are unlikely, nor does it imply that a stranding event that does occur is necessarily the result of the specified activities. However, we recognize that regardless of the cause of a stranding event, it is appropriate to take action in certain circumstances to avoid additional harm. Please see ''Monitoring and Reporting'' for more information.

Marine Mammal Impacts—Habitat

Comment: Many commenters expressed concern regarding potential impacts to marine mammal prey and/or food webs from the planned surveys. NRDC specifically provided numerous citations in claiming that the surveys could impact marine mammal prey through the following: (1) Cause severe physical injury and mortality; (2) damage hearing and sensory abilities of fish and marine invertebrates; (3) impede development of early life history stages; (4) induce stress that physically damages marine invertebrates and compromises fish health; (5) cause startle and alarm responses that interrupt vital behaviors; (6) alter predator avoidance behavior that may reduce probability of survival; (7) affect catchability of prey species; (8) mask important biological sounds essential to survival; (9) reduce reproductive success, potentially jeopardizing long-term sustainability of fish populations; (10) interrupt feeding behaviors and induce other species-specific effects that may increase risk of starvation, reduce reproduction, and alter community structure; and (11) compromise orientation of fish larvae with potential ecosystem-level effects. Additionally, many commenters cited a recent publication by McCauley *et al.* (2017) as evidence that the surveys could potentially impact zooplankton and consequently marine mammal food webs.

In contrast, the International Association of Geophysical Contractors, American Petroleum Institute, and National Ocean Industries Association (hereafter, ''the Associations'') stated that McCauley *et al.* (2017) ''purports to demonstrate, but fails to prove, that seismic survey air sources negatively impact zooplankton.'' The Associations cite small sample size, variability in the baseline and experimental data, and the ''large number of speculative conclusions that appear to be inconsistent with the data collected over a two-day period'' in stating that the research ''creates no reasonable implication regarding the potential effects of seismic surveys on marine mammals.''

Response: NMFS strongly disagrees with NRDC's contention that we ignored effects to prey species; in fact, we considered relevant literature (including that cited by NRDC) in finding that the most likely impact of survey activity to prey species such as fish and invertebrates would be temporary avoidance of an area, with a rapid return to recruitment, distribution, and behavior anticipated. While there is a lack of specific scientific information to allow an assessment of the duration, intensity, or distribution of effects to prey in specific locations at specific times and in response to specific surveys, NMFS's review of the available information does not indicate that such effects could be significant enough to impact marine mammal prey to the extent that marine mammal fitness would be affected. A more detailed discussion is provided in ''Potential Effects of the Specified Activities on Marine Mammals and Their Habitat.''

In summary, fish react to sounds which are especially strong and/or intermittent low-frequency sounds, and behavioral responses such as flight or avoidance are the most likely effects. However, the reaction of fish to airguns depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. While we agree that some studies have demonstrated that airgun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017), other studies have shown no or slight reaction to airgun sounds (*e.g.,* Pena *et al.,* 2013; Wardle *et al.,* 2001; Jorgenson and Gyselman, 2009; Cott *et al.,* 2012). Most commonly, though, the impacts of noise on fish are temporary. Investigators reported significant, short-term declines in commercial fishing catch rate of gadid fishes during and for up to five days after survey operations, but the catch rate subsequently returned to normal (Engas *et al.,* 1996; Engas and Lokkeborg, 2002); other studies have reported similar findings (Hassel *et al.,* 2004).

As discussed by NRDC, however, even temporary effects to fish distribution patterns can impact their ability to carry out important life-history functions. SPLs of sufficient strength have been known to cause injury to fish and fish mortality and, in some studies, fish auditory systems have been damaged by airgun noise (McCauley *et al.,* 2003; Popper *et al.,* 2005; Song *et al.,* 2008). However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen *et al.* (2012b) showed that a TTS of 4–6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long—both of which are conditions unlikely to occur during these surveys, which will be transient in any given location and likely result in brief, infrequent noise exposure to prey species in any given area. For these surveys, the sound source is constantly moving, and most fish would likely avoid the sound source prior to receiving sound of sufficient intensity to cause physiological or anatomical damage. In addition, ramp-up may allow certain fish species the opportunity to move further away from the sound source.

Available data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect airgun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014). Similar to fish, however, the transient nature of the surveys leads to an expectation that effects will be largely limited to behavioral reactions and would occur as a result of brief, infrequent exposures.

With regard to potential impacts on zooplankton, McCauley *et al.* (2017) found that exposure to airgun noise resulted in significant depletion for more than half the taxa present and that there were two to three times more dead zooplankton after airgun exposure compared with controls for all taxa, within 1 km of the airguns. However, the authors also stated that in order to have significant impacts on *r*-selected species such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned, and it is possible that the findings reflect avoidance by zooplankton rather than mortality (McCauley *et al.,* 2017). In addition, the results of this study are inconsistent with a large body of research that generally finds limited spatial and temporal impacts to zooplankton as a result of exposure to airgun noise (*e.g.,* Dalen and Knutsen, 1987; Payne, 2004; Stanley *et al.,* 2011).

A modeling exercise was conducted as a follow-up to the McCauley *et al.* (2017) study (as recommended by McCauley *et al.* (2017)), in order to assess the potential for impacts on ocean ecosystem dynamics and zooplankton population dynamics (Richardson *et al.,* 2017). Richardson *et al.* (2017) found that for copepods with a short life cycle in a high-energy environment, a full-scale airgun survey would impact copepod abundance up to three days following the end of the survey, suggesting that effects such as those found by McCauley *et al.* (2017) would not be expected to be detectable downstream of the survey areas, either spatially or temporally. However, these findings are relevant for zooplankton with rapid reproductive cycles in areas where there is a high natural replenishment rate resulting from new water masses moving in, and the findings may not apply in lower-energy environments or for zooplankton with longer life-cycles. In fact, the study found that by turning off the current, as may reflect lower-energy environments, the time to recovery for the modelled population extended from several days to several weeks.

However, while potential impacts to zooplankton are of obvious concern with regard to their follow-on effects for higher-order predators, the survey area is not an important area for feeding for taxa that feed directly on zooplankton, *i.e.,* mysticetes. In the absence of further validation of the McCauley *et al.* (2017) findings, if we assume a worst-case likelihood of severe impacts to zooplankton within approximately 1 km of the acoustic source, the large spatial scale and expected wide dispersal of survey vessels does not lead us to expect any meaningful follow-on effects to the prey base for odontocete predators. While the large scale of effect observed by McCauley *et al.* (2017) may be of concern, especially in a more temperate environment, NMFS concludes that these findings indicate a need for more study, particularly where repeated noise exposure is expected—a condition unlikely to occur in relation to these planned surveys. We do not offer further comment with regard to the specific criticisms of the Associations, other than to say that their dismissal of the study seems to reflect an unsubstantiated opinion.

Overall, prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects. Mortality from decompression injuries is possible in close proximity to a sound, but only limited data on mortality in response to airgun noise exposure are available (Hawkins *et al.,* 2014). The most likely impacts for most prey species in a given area would be temporary avoidance of the area. The surveys are expected to move through an area relatively quickly, limiting exposure to multiple impulsive sounds. In all cases, sound levels would return to ambient once a survey ends and the noise source is shut down and, when exposure to sound ends, behavioral and/or physiological responses are expected to end relatively quickly (McCauley *et al.,* 2000b). The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. While the potential for disruption of spawning aggregations or schools of important prey species can be meaningful on a local scale, the mobile and temporary nature of the surveys and the likelihood of temporary avoidance behavior suggest that impacts would be minor.

Comment: A group of scientists (C.W. Clark, S.D. Kraus, D.P. Nowacek, A.J. Read, M. Rekdahl, A.N. Rice, H. Rosenbaum, and R.S. Schick) submitted a collective comment letter. Hereafter, we refer to this letter as ''Nowacek *et al.*'' Nowacek *et al.* and NRDC stated that it is inappropriate to conclude that these surveys will not impact marine mammal acoustic habitat, since the production of airgun noise is known to increase ambient noise, thereby negatively impacting habitat. NRDC further states that NMFS has failed to adequately account for impacts to acoustic habitat. In support of their statements, Nowacek *et al.* submitted the results of a sound field modeling exercise in which they considered energy produced from seven shots of a 40-element array at 6 m depth (other important source details were not provided) across one-third-octave bands spanning the 71–224 Hz frequency range. Resulting sound fields were concatenated at 1-s resolution for two different water depths (50 and 200 m) (commenters submitted animations associated with this exercise; these are available upon request and are part of our administrative record for these actions). They wrote that these animations highlight the dynamic nature of the marine environment, especially the low-frequency sound field, and the large area over which sound levels are increased above ambient levels but below current regulatory harassment thresholds. The commenters then correctly note that consideration of likely takes is limited to just a portion of the area over which airgun noise extends into the marine environment. Nowacek *et al.* also recommended that NMFS produce a quantitative methodology for assessing the region's acoustic environment, the proportional contributions from each of the natural and anthropogenic noise inputs, and create mechanisms to mitigate these lower-level noise exposures.

Response: The commenters' claims that NMFS concluded that there ''would be no impact to the quality of the acoustic habitat'' or suggested that ''there is no basis for acoustic habitat impacts'' are erroneous. NMFS made no such statements, but rather acknowledged in our Notice of Proposed IHAs that it was likely that there would be impacts to acoustic habitat, particularly for low-frequency cetaceans. In fact, we explicitly considered this likelihood in our preliminary negligible impact analyses, finding that ''consequence'' of the surveys should be considered as higher for mysticete whales than for other species for this reason.

NMFS addressed potential effects to habitat, including acoustic habitat, and acknowledges that the surveys will increase noise levels in the vicinity of operating source vessels. However, following consideration of the available information, NMFS concludes that these impacts will not significantly affect ambient noise levels or acoustic communication space over long time periods, especially in the context of any given exposed individual. As described previously, exploratory surveys such as these cover a large area but would be transient rather than focused in a given location over time and therefore would not be considered as contributing meaningfully to chronic effects in any given location. Given these conclusions, a separate quantitative analysis of potential impacts to acoustic habitat, as is suggested by Nowacek *et al.,* is not warranted. In contrast, we did develop and perform such analysis for a different assessment of much more extensive geophysical survey activity (see Appendix K in BOEM, 2017) to be conducted over a period of ten years, versus the limited amount of survey activity to be conducted over a period of one year here.

We acknowledge and appreciate the commenters' scientific expertise, but there are relevant statutory and regulatory requirements that inform NMFS in the scope of analysis relevant to a finding of negligible impact. Please see also our response to a previous comment above, in which NRDC makes similar charges regarding the impacts of masking. Finally, regarding terminology used in the comments (*i.e.,* ''primary constituent elements''), the discussion in this document pertains specifically to the MMPA and not components related to critical habitat designated under the ESA.

Comment: The Sierra Club Marine Group noted that Cape Hatteras has a very unique morphology, and that these features support upwelling that supports significant biodiversity, including beaked whales. The commenters stated that impacts to this habitat provide a compelling reason to deny the IHAs.

Response: As described in our Notice of Proposed IHAs, NMFS concurs that Cape Hatteras provides important habitat for a diverse assemblage of species, particularly for species such as sperm whales, beaked whales, pilot whales, and other species that show high site fidelity to the area. Accordingly, NMFS has designed a time-area restriction encompassing the area referenced in the comment that precludes survey effort within the area for a three-month period (January to March; Stanistreet *et al.,* 2018); the restriction is defined specifically to benefit beaked whales, sperm whales, and pilot whales, with the specific timing intended as the most appropriate for sperm whales. We also require mitigation to reduce the intensity and duration of exposure for these species—particularly for acoustically sensitive species, such as beaked whales, for which shutdown is required at an extended distance of 1.5 km. Separately, NMFS has required year-round closures of similar high-relief habitats further offshore that are predicted to host relatively high densities of beaked whales. In addition, the North Atlantic right whale closure will protect portions of the area referenced by the commenters, as it extends out to 90 km from the coastline (*i.e.,* 80 km plus a 10 km buffer, see ''Mitigation'') and is in effect from November through April (or comparable protection provided through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore), whereas the seasonal restriction off of Cape Hatteras is in effect from January through March. NMFS believes these restrictions provide a high degree of protection to these species and the habitat they utilize around Cape Hatteras, while meeting the MMPA's least practicable adverse impact standard. When the contextual factor addressing required mitigation is considered, the outcome is a negligible impact to affected species.

Comment: An individual states that the surveys have the potential to impair the Chesapeake Bay, and that such impairment would have wider ecological and economic repercussions beyond the scope of impacting marine mammals. Similarly, one group mentioned that impacts from the surveys could ripple into smaller bays and inlets elsewhere along the East Coast, and impact species long after surveys are complete.

Response: NMFS's action is authorizing the taking of marine mammals pursuant to section 101(a)(5)(D); therefore, impacts of the survey on aspects of the environment other than marine mammals and their habitat are not relevant to NMFS's analysis conducted pursuant to the MMPA. However, the authorization of marine mammal take incidental to the planned surveys would not impact marine mammals of the Chesapeake Bay or of other coastal bays and estuaries. Surveys may not operate closer than 30 km to shore at any time.

North Atlantic Right Whale

Comment: Many commenters expressed concern regarding the North Atlantic right whale and potential impacts of the specified activities, given their declining population size, an ongoing Unusual Mortality Event (UME), declining calf production, and annual exceedances of the calculated potential biological removal value (see ''Description of Marine Mammals in the Area of the Specified Activities—North Atlantic Right Whale'' for further discussion of these issues). Some commenters noted additional concern regarding potential survey overlap with biologically important areas. Others highlighted concerns regarding increased risk of ship strike and/or entanglement with survey vessels, in addition to the potential for acoustic and behavioral effects.

Response: NMFS appreciates the concerns expressed by commenters regarding right whales. As an agency, NMFS is working to address the numerous issues facing right whales, including continued work to reduce deaths due to ship strike and entanglement in fishing gear and ongoing investigation of the UME, as well as other measures to investigate and address the status of the species. The best available scientific information shows that the majority of right whale sightings in the southeast occur in right whale calving areas from roughly November through April, with individual right whales migrating to and from these areas through mid-Atlantic shelf waters. Because of these concerns regarding right whales, NMFS is requiring closure of these areas (out to 90 km from shore) to survey activity from November 1 to April 30 (or that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore). This measure is expected to largely avoid disruption of behavioral patterns for right whales and to minimize overall acoustic exposures. Therefore, NMFS believes that this restriction provides for migratory passage to and from calving grounds as well as avoiding impacts to the whales while on the grounds. In addition, NMFS re-evaluated potential right whale takes using the best available scientific information (*i.e.,* Roberts *et al.,* 2017) and in consideration of the revised time-area restriction. The result of this analysis shows that takes of right whales will be minimal.

Comment: NRDC and, separately, Nowacek *et al.* state that airgun surveys have been linked to significant reductions in the probability of calf survival in western Pacific gray whales (another endangered baleen whale population), claiming that these findings indicate that similar surveys off the southeastern U.S will have significant negative effects on the whales that occur anywhere in the region.

Response: Commenters cite a preliminary report (Cooke *et al.,* 2015) that documented a reduction in calf survival that they suggested may be related to disruption of foraging from airgun survey activity and pile driving in Russia due to presumed avoidance of foraging areas. However, a more recent analysis (Cooke *et al.,* 2017) invalidated these findings, showing that this was a sampling effect, as those calves that were assumed dead in the 2015 study have since been observed alive elsewhere. The new study found no significant annual variation in calf survival. Johnson *et al.* (2007) had previously reported that foraging gray whales exposed to airgun sounds during surveys in Russia did not experience any biologically significant or population-level effects.

Comment: J.J. Roberts and P.N. Halpin of the Duke University Marine Geospatial Ecology Lab (hereafter, ''MGEL'') provided two comments related to right whales. First, the commenters stated, in summary, that the time-area restriction included in our Notice of Proposed IHAs for the specific purpose of avoiding impacts to the North Atlantic right whale would not be sufficient to achieve its stated purpose. The commenters noted multiple lines of scientific evidence that right whales occur beyond the area defined in the Notice of Proposed IHAs (*i.e.,* a 20-nmi coastal strip, superseded by either critical habitat or seasonal management areas, and buffered by a distance of 10 km; this equates roughly to a 47-km coastal strip). The commenters also reiterated concern regarding an error associated with the right whale take estimates for two applicants (TGS and Western). Finally, the commenters noted that they were developing updated density models for the right whale; these revised models more than double the survey effort utilized by the models in the region south of Cape Hatteras, while additional new data boost coverage in non-summer seasons. As stated by the commenters, collectively these data allow for a notable upgrade in right whale density model performance in the regions and seasons addressed here. The commenters noted that, while the revised models have not been through formal peer review, they utilize the same methodology as the Roberts *et al.* (2016) publication, which has been peer reviewed.

Response: We agree with these comments, and addressed them through use of the revised North Atlantic right whale models (Roberts *et al.,* 2017) in developing new exposure estimates for all five applicant companies. Importantly, in agreement with the statements of the commenters and with the outputs of the revised models, we revised the time-area restriction by increasing the standoff distance from shore to 90 km (*i.e.,* 80 km plus a 10 km buffer) (or requiring that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore). As stated by MGEL and other commenters, Norris *et al.* (2014) reported acoustic detections of right whales in the southeast beyond the previous 47 km limit, while Foley *et al.* (2011) documented a right whale birth beyond the previous limit. The right whale model produced by Roberts *et al.* (2016) explicitly included distance from shore as a predictor in the model; right whale densities significantly above zero were predicted beyond the proposed 47 km limit. The revised model retains distance from shore as a predictor and, in the region north of Cape Fear, indicates that right whale density peaks at about 50 km offshore during the winter and is moderate to about 80 km from shore, beyond which limit density is predicted as dropping off rapidly. Please see ''Estimated Take—North Atlantic Right Whale'' and ''Mitigation'' for additional discussion.

Comment: Nowacek *et al.* commented that NMFS should perform a quantitative evaluation of right whale health and reproductive rates, including mortality and sublethal effects of entanglement. They noted that tools such as the Population Consequences of Disturbance (PCOD) model could be used to perform such an analysis. However, Nowacek *et al.* provided their own modeling example, including a health assessment of five North Atlantic right whales, which they described in their comment letter. Nowacek *et al.*'s analysis showed that a small decrement in health that could be linked to stress caused by chronic noise exposure can result in negative consequences for individual right whales.

Response: NMFS appreciates the attention given to this issue by the commenters, and finds the analysis provided in their letter useful. As noted by many commenters, the primary threats to the right whale remain ship strike and entanglement in fishing gear. However, NMFS considered this analysis and its conclusions in its determination to revisit the acoustic exposure analysis conducted for right whales and in reconsidering the most appropriate habitat-based mitigation requirements related to right whales. Following these new analyses, NMFS finds that predicted takes of right whales have been substantially reduced and that potential impacts to the right whale have been reduced to the level of least practicable adverse impact. While it is likely not possible to completely avoid acoustic exposures of North Atlantic right whales, NMFS finds that such exposures will be minimized and that, importantly, the impact of acoustic exposures will be minimized by avoiding entirely the habitat expected to be important for right whales for calving and migratory behavior (or that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore). In the event that right whales are encountered outside these areas, the expanded shutdown requirement will minimize the severity and/or duration of acoustic exposures. Finally, while exposures of right whales at levels below those expected to result in disruption of behavioral patterns but above the level of ambient noise may occur, NMFS does not consider such potential exposures as likely to constitute ''chronic noise exposure,'' as a result of the relatively brief duration of any given survey in any particular location; therefore, it is unlikely that the specified activities could result in impacts such as those assessed through the analysis of Nowacek *et al.*

Comment: One commenter described the relationship between noise and stress shown by Rolland *et al.* (2012) for right whales, stating that the planned surveys could increase stress in right whales.

Response: While NMFS concurs that the findings of Rolland *et al.* (2012) indicate a connection between noise exposure and stress in right whales, the number of vessels associated with the surveys is unlikely to contribute to significant additive vessel traffic and associated vessel noise as compared with vessel activity already occurring in the region. Rolland *et al.* (2012)

measured vessel density in an area with much more concentrated activity (*i.e.,* shipping lanes in the Bay of Fundy) than what would occur in the activity area. While noise from the surveys, whether due to use of the airgun arrays or from the vessels themselves, may cause stress responses in exposed animals, NMFS finds it unlikely that such responses will significantly impact individual whales as chronic noise exposure is not expected.

Comment: Several groups commented on additional data NMFS should have considered in assessing impacts to North Atlantic right whales. For example, the Marine Mammal Commission (MMC) recommended that we consult with NMFS's Northeast Fisheries Science Center regarding results of their most recent acoustic analysis, which they contend may provide insight on occurrence of right whales at different distances from shore. Similarly, Nowacek *et al.* recommended that NMFS should consider more recent data from the Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys or right whale surveys in the southeast curated by the North Atlantic Right Whale Consortium. NRDC stated that NMFS must use additional data sources in calculating right whale densities, noting that recent passive acoustic studies have detected whales further offshore and with broader seasonality than previously expected.

Response: NMFS agrees with these comments, and has considered these various sources of newer data, including by revising acoustic exposure estimates for right whales by using the latest density models for right whales (Roberts *et al.,* 2017). These revised models incorporate the southeast U.S. right whale survey data as well as the AMAPPS data. While the revised model does not directly incorporate acoustic data—we note that NRDC offers no suggestions as to how this might be accomplished—it was validated through comparison with passive acoustic monitoring data (Davis *et al.,* 2017). While this validation work does suggest that the revised model may underestimate right whale presence in certain locations or seasons—for example, acoustic data indicate that the model may underestimate the presence of whales relatively far from shore during the winter in the region north of Cape Hatteras—we developed an extended right whale closure (out to 90 km from shore) (or we require that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore) in an effort to reasonably encompass the likelihood of increased whale presence at greater distances from shore than have previously been expected.

Comment: Sea Shepherd Legal stated that NMFS ignored the ''Cetacean & Sound Mapping platform (''CetSound'')'' when discussing biologically important areas for North Atlantic right whales.

Response: Though NMFS did not give specific reference to ''CetSound'' in our Notice of Proposed IHAs, we did in fact incorporate and consider information available through NOAA's CetSound website (*cetsound.noaa.gov*), including information relating to BIAs, as discussed by LaBrecque *et al.* (2015).

Cumulative Impacts and Related Issues

Comment: Many commenters expressed concern regarding ''cumulative,'' ''aggregate'' and ''synergistic'' impacts. Commenters stated that NMFS did not adequately address cumulative or aggregate impacts from the five surveys, which are planned to occur within the same broad geographic region and which could overlap temporally. Some commenters referenced the large amount of survey effort described in BOEM's PEIS, erroneously ascribing the potential cumulative impacts associated with that level of effort—associated with nine years of surveys in support of an active oil and gas program in the Atlantic—to the significantly smaller amount of activity contemplated in our five separate proposed IHAs. Commenters urged the agency to review cumulative impacts using a risk-averse approach, considering such impacts in the context of effects to both species and ecosystems, as well as across time and geographic extent. As discussed in a previous comment response, some commenters cited studies demonstrating potential long-range propagation of airgun signals as reason for additional consideration of cumulative impacts. Similarly, some commenters claimed a need to consider takes in the aggregate and to consider potential takes from other sources. Nowacek *et al.* specified that NMFS should assess aggregate impacts in addition to cumulative impacts, highlighting available tools to do so. One commenter suggested that a cumulative noise management plan should be developed. Commenters such as Nowacek *et al.* decry our independent consideration of the effects of each individual specified activity under the MMPA as ''completely without basis in science or logic.'' Similarly, NRDC claims that failing to consider the total impact of all five surveys in the negligible impact assessment does not satisfy NMFS's legal obligations and is ''contrary to common sense and principles of sound science.'' NRDC also states that NMFS's negligible impact determination underestimates impacts to marine mammal species and populations because it fails to consider the effects of other anticipated activities on the same marine mammal populations. Finally, some commenters acknowledged that the MMPA does not require consideration of cumulative impacts but stated that NMFS must do so in this case given the unprecedented scale of these surveys in the Atlantic.

Response: Cumulative impacts (also referred to as cumulative effects) is a term that appears in the context of NEPA and the ESA, but it is defined differently in those different contexts. Neither the MMPA nor NMFS's codified implementing regulations address consideration of other unrelated activities and their impacts on populations. However, the preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989) states in response to comments that the impacts from other past and ongoing anthropogenic activities are to be incorporated into the negligible impact analysis via their impacts on the environmental baseline. Consistent with that direction, NMFS here has factored into its negligible impact analyses the impacts of other past and ongoing anthropogenic activities via their impacts on the baseline (*e.g.,* as reflected in the density/distribution and status of the species, population size and growth rate, and other relevant stressors (such as incidental mortality in commercial fisheries)). In addition, the context aspect of our assessment framework also considers these factors. See the ''Negligible Impact Analyses and Determinations'' section of this notice.

Our 1989 final rule for the MMPA implementing regulations also addressed public comments regarding cumulative effects from future, unrelated activities. There we stated that such effects are not considered in making findings under section 101(a)(5) concerning negligible impact. We indicated that NMFS would consider cumulative effects that are reasonably foreseeable when preparing a NEPA analysis; and also that reasonably foreseeable cumulative effects would be considered under section 7 of the ESA for ESA-listed species.

In this case, we deem each of these IHAs a future, unrelated activity relative to the others. Although these IHAs are all for surveys that will be conducted for a similar purpose, they are unrelated in the sense that they are discrete actions under section 101(a)(5)(D), issued to discrete applicants.

Here, we recognize the potential for cumulative impacts, and that the aggregate impacts of the five surveys will be greater than the impacts of any given survey. The direct aggregate impacts of multiple surveys were addressed through the associated NEPA analyses: In BOEM's PEIS, which addressed the impacts of a significantly greater amount of survey activity that may be permitted by BOEM, and which NMFS adopted as the basis for its Record of Decision; as well as in NMFS's tiered Environmental Assessment, which supported a Finding of No Significant Impact (FONSI) for the issuance of the five IHAs here.

In our FONSI, NMFS's assessment was focused on whether the predicted level of take from the five surveys, when considered in context, would have a meaningful biological consequence at a species or population level. NMFS, therefore, assessed and integrated other contextual factors (*e.g.,* species' life history and biology, distribution, abundance, and status of the stock; mitigation and monitoring; characteristics of the surveys and sound sources) in determining the overall impact of issuance of the five IHAs on the human environment. Key considerations included the nature of the surveys and the required mitigation. In all cases, it is expected that sound levels will return to previous ambient levels once the acoustic source moves a certain distance from the area, or the surveys cease, and it is unlikely that the surveys will all occur at the same time in the same places, as the area within which the surveys will occur is very large and some will occur for less than six months. In other words, we would not expect the duration of a sound source to be greater than moderate and intermittent in any given area. Surveys have been excluded from portions of the total area deemed to result in the greatest benefit to marine mammals. These restrictions will not only reduce the overall numbers of take but, more importantly, will eliminate or minimize impacts to marine mammals in the areas most important to them for feeding, breeding, and other important functions. Therefore, these measures are expected to meaningfully reduce the severity of the takes that do occur by limiting impacts that could reduce reproductive success or survivorship.

In summary, NMFS finds that when the required mitigation and monitoring is considered in combination with the large spatial extent over which the activities are spread across for comparatively short durations (less than one year), the potential impacts are both temporary and relatively minor. Therefore, NMFS does not expect aggregate impacts from the five surveys to marine mammals to affect rates of recruitment or survival, either alone or in combination with other past, present, or ongoing activities. The cumulative impacts of these surveys (*i.e.,* the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions) were addressed as required through the NEPA documents cited above and, as noted, supported a FONSI for the five IHAs. These documents, as well as the relevant Stock Assessment Reports, are part of NMFS's Administrative Record for this action, and provided the decision-maker with information regarding other activities in the action area that affect marine mammals, an analysis of cumulative impacts, and other information relevant to the determinations made under the MMPA.

Separately, cumulative effects were analyzed as required through NMFS's required intra-agency consultation under section 7 of the ESA, which concluded that NMFS's action of issuing the five IHAs was not likely to jeopardize the continued existence of listed marine mammals and was not likely to adversely affect any designated critical habitat.

We note that section 101(a)(5)(D) of the MMPA requires NMFS to make a determination that the take incidental to a ''specified activity'' will have a negligible impact on the affected species or stocks of marine mammals, and will not result in an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses. We believe the ''specified activity'' for which incidental take coverage is being sought under section 101(a)(5)(D) is appropriately defined and described by the IHA applicant, just as with applications submitted for section 101(a)(5)(A) incidental take regulations. Here there are five specified activities, with a separate applicant for each. NMFS must make the necessary findings for each specified activity.

Comment: Several commenters discussed a recent report from the National Academy of Sciences concerning cumulative impacts to marine mammals (''Approaches to Understanding the Cumulative Effects of Stressors on Marine Mammals''; NAS, 2017), suggesting that NMFS should have reviewed this report in addressing cumulative impacts.

Response: NMFS acknowledges the importance of this new report, which was not available at the time of writing for our Notice of Proposed IHAs. We reviewed this report and considered its findings in relation to our considerations pursuant to NEPA as well as with regard to its general findings for marine mammals. Behavioral disturbance or stress may reduce fitness for individual animals and/or may exacerbate existing declines in reproductive health and survivorship. For example, stressors such as noise and pollutants can induce responses involving the neuroendocrine system, which controls reactions to stress and regulates many body processes (NAS, 2017). As an example, Romano *et al.* (2004) found that upon exposure to noise from a seismic watergun, bottlenose dolphins had elevated levels of a stress-related hormone and, correspondingly, a decrease in immune cells. Population-level impacts related to energetic effects or other impacts of noise are difficult to determine, but the addition of other stressors can add considerable complexity due to the potential for interaction between the stressors or their effects (NAS, 2017). When a population is at risk NAS (2017) recommends identifying those stressors that may feasibly be mitigated. In this case, we have done so by prescribing a comprehensive suite of mitigation measures that both specifically tailors real-time detection and mitigation requirements to the species most sensitive to noise from airguns or to additional stressors in general (due to overall vulnerability of the stock), and includes habitat-based mitigation that restricts survey effort in the areas and times expected to be most important for the species at greatest risk of more severe impacts from the specified activities (or requires comparable protection via other methods).

Acoustic Thresholds

Comment: NRDC and several other commenters criticized NMFS's use of the 160-dB rms Level B harassment threshold, stating that the threshold is based on outdated information and that current research shows that behavioral impacts can occur at levels below the threshold. Criticism of our use of this threshold also focused on its nature as a step function, *i.e.,* it assumes animals don't respond to received noise levels below the threshold but always do respond at higher received levels. Several organizations also suggest that reliance on this threshold results in consistent underestimation of impacts. Commenters urged the agency to provide additional technical acoustic guidance regarding thresholds for behavioral harassment and stated that no determinations regarding the proposed IHAs can be made until such new guidance has been developed. NRDC specifically stated that NMFS should employ specific thresholds for which species-specific data are available, and then create generalized thresholds for other species, and that the thresholds should be expressed as linear risk functions where appropriate to account for intraspecific and contextual variability. NRDC and others suggested that NMFS must revise the threshold as suggested in Nowacek *et al.* (2015), which recommended a dose function centered on 140 dB rms. TGS suggested that NMFS should re-evaluate take estimates using the approach described in Wood *et al.* (2012).

Response: NMFS acknowledges that the 160-dB rms step-function approach is simplistic, and that an approach reflecting a more complex probabilistic function may more effectively represent the known variation in responses at different levels due to differences in the receivers, the context of the exposure, and other factors. Certain commenters suggested that our use of the 160-dB threshold implies that we do not recognize the science indicating that animals may react in ways constituting behavioral harassment when exposed to lower received levels. However, we do recognize the potential for Level B harassment at exposures to received levels below 160 dB rms, in addition to the potential that animals exposed to received levels above 160 dB rms will not respond in ways constituting behavioral harassment. These comments appear to evidence a misconception regarding the concept of the 160-dB threshold. While it is correct that in practice it works as a step-function, *i.e.,* animals exposed to received levels above the threshold are considered to be ''taken'' and those exposed to levels below the threshold are not, it is in fact intended as a sort of mid-point of likely behavioral responses (which are extremely complex depending on many factors including species, noise source, individual experience, and behavioral context). What this means is that, conceptually, the function recognizes that some animals exposed to levels below the threshold will in fact react in ways that are appropriately considered take, while others that are exposed to levels above the threshold will not. Use of the 160-dB threshold allows for a simplistic quantitative estimate of take, while we can qualitatively address the variation in responses across different received levels in our discussion and analysis.

NRDC consistently cites reports of changes in vocalization, typically for baleen whales, as evidence in support of a lower threshold than the 160-dB threshold currently in use. A mere reaction to noise exposure does not, however, mean that a take by Level B harassment, as defined by the MMPA, has occurred. For a take to occur requires that an act have ''the potential to disturb by causing disruption of behavioral patterns,'' not simply result in a detectable change in motion or vocalization. Even a moderate cessation or modification of vocalization might not appropriately be considered as being of sufficient severity to result in take (Ellison *et al.,* 2012). NRDC claims these reactions result in biological consequences indicating that the reaction was indeed a take but does not provide a well-supported link between the reported reactions at lower received levels and the claimed consequences. In addition, NRDC fails to discuss documented instances of marine mammal exposure to received levels greater than 160 dB that did not elicit any response. Just a few examples are presented here:

- Malme *et al.* (1985) conducted a study consisting of playback using a stationary or moving single airgun and humpback whales. No clear overall signs of avoidance of the area were recorded for feeding/resting humpback whales exposed to received levels up to 172 dB. Although startle responses were observed when the airgun was first turned on, likely due to the novelty of the sound, increasing received levels did not result in increasing probability of avoidance. In three instances, whales actually approached the airgun.
- Malme *et al.* (1988) conducted a controlled exposure experiment involving a moving single airgun and gray whales. From this study, the authors predicted a 0.5 probability that whales would stop feeding and move away from the area when received levels reached 173 dB and a 0.1 probability of feeding interruption at a received level of 163 dB. However, whale responses were highly variable, with some whales remaining feeding with received levels as high as 176 dB.
- McCauley *et al.* (1998, 2000a, 2000b) report observations associated with an actual seismic survey (array volume 2,678 in ^{3}) and controlled approaches of humpback whales with a single airgun. When exposed to the actual seismic survey, avoidance maneuvers for some whales began at a range of 5–8 km from the vessel; however, in three trials whales at a range beyond 5 km showed no discernible effects on movement patterns. In addition, some male humpback whales were attracted to the single airgun (maximum received level of 179 dB). Overall, McCauley *et al.* (2000a) found no gross disruption of humpback whale movements in the region of the source vessel, based on encounter rates.
- Malme *et al.* (1983, 1984) conducted playback experiments with gray whales involving a single airgun and a full array (2,000–4,000 in ^{3}). For playback of the array, it was estimated that probability of avoidance during migration (including moving inshore and offshore to avoid the area or to pass the noise source at a greater distance then would normally occur) was 0.1 at 164 dB; 0.5 at 170 dB; and 0.9 at levels greater than 180 dB.

These examples are related only to baleen whales, for which NRDC provides examples of vocalization changes in response to noise exposure. Although associated received levels are not available, a substantial body of evidence indicates that delphinids are significantly more tolerant of exposure to airgun noise. Based on review of monitoring reports from many years of airgun surveys, many delphinids approach acoustic source vessels with no apparent discomfort or obvious behavioral change (Barkaszi *et al.,* 2012; Stone, 2015a). Behavioral observations of gray whales during an airgun survey monitored whale movements and respirations pre-, during-, and post-seismic survey (Gailey *et al.,* 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and, after considering natural variation, none of the response variables were significantly associated with survey or vessel sounds.

Overall, we reiterate the lack of scientific consensus regarding what criteria might be more appropriate. Defining sound levels that disrupt behavioral patterns is difficult because responses depend on the context in which the animal receives the sound, including an animal's behavioral mode when it hears sounds (*e.g.,* feeding, resting, or migrating), prior experience, and biological factors (*e.g.,* age and sex). Other contextual factors, such as signal characteristics, distance from the source, and signal to noise ratio, may also help determine response to a given received level of sound. Therefore, levels at which responses occur are not necessarily consistent and can be difficult to predict (Southall *et al.,* 2007; Ellison *et al.,* 2012; Bain and Williams, 2006).

There is currently no agreement on these complex issues, and NMFS followed the practice at the time of submission and review of these applications in assessing the likelihood of disruption of behavioral patterns by using the 160-dB threshold. This threshold has remained in use in part because of the practical need to use a relatively simple threshold based on available information that is both predictable and measurable for most activities. We note that the seminal review presented by Southall *et al.* (2007) did not suggest any specific new criteria due to lack of convergence in the data. NMFS is currently evaluating available information towards development of guidance for assessing the effects of anthropogenic sound on marine mammal behavior. However, undertaking a process to derive defensible exposure-response relationships is complex (*e.g.,* NMFS previously attempted such an approach, but is currently re-evaluating the approach based on input collected during peer review of NMFS (2016)). A recent systematic review by Gomez *et al.* (2016) was unable to derive criteria expressing these types of exposure-response relationships based on currently available data.

NRDC consistently cites Nowacek *et al.* (2015) in public comments, suggesting that this paper is indicative of a scientific consensus that NMFS is missing or ignoring. We note first that while NRDC refers to this paper as a ''study'' (implying that it presents new scientific data or the results of new analyses of existing scientific data), the paper in fact makes policy recommendations rather than presenting any new science. The more substantive reviews presented by Southall *et al.* (2007) and Gomez *et al.* (2016) were unable to present any firm recommendations, as noted above. Other than suggesting a 50 percent midpoint for a probabilistic function, Nowacek *et al.* (2015) offer minimal detail on how their recommended probabilistic function should be derived/implemented or exactly how this midpoint value (*i.e.,* 140 dB rms) was derived (*i.e.,* what studies support this point). In contrast with elements of a behavioral harassment function that NRDC indicates as important in their comments, Nowacek *et al.* (2015) does not make distinctions between any species or species groups and provide no quantitative recommendations for acknowledging that behavioral responses can vary by species group and/or behavioral context. In summary, little substantive support is provided by Nowacek *et al.* (2015) for the proposal favored by NRDC and it is treated in that paper as a vague recommendation with minimal support offered only in a one-page supplementary document rather than well-supported scientific consensus, as the commenter suggests.

NMFS disagrees that establishing species-specific thresholds is practical (*i.e.,* this approach would make assessments unnecessarily onerous by creating numerous thresholds to evaluate). Additionally, there is scientific evidence that grouping thresholds by broad source category (Gomez *et al.,* 2016) or taxonomic group (NMFS, 2018) is supportable. NMFS currently uses data/thresholds from surrogate species/groups to represent those species/groups where data are not available.

Overall, while we agree that there may be methods of assessing likely behavioral response to acoustic stimuli that better capture the variation and context-dependency of those responses than the simple step-function used here, there is no agreement on what that method should be or how more complicated methods may be implemented by applicants. NMFS is committed to continuing its work in developing updated guidance with regard to acoustic thresholds, but pending additional consideration and process is reliant upon an established threshold that is reasonably reflective of available science.

In support of exploring new methods for quantitatively predicting behavioral harassment, we note NMFS's recently published proposed incidental take regulations for geophysical surveys in the Gulf of Mexico (83 FR 29212; June 22, 2018), which propose using the modeling study first published in BOEM's associated EIS (Appendix D in BOEM, 2017) to estimate take. This study evaluated potential disruption of behavioral patterns that could result from a program of airgun surveys, using both the 160-dB step function and a probabilistic risk function similar to that suggested by Nowacek *et al.* (2015), but with a midpoint set at 160 dB for the majority of species, rather than 140 dB. This function, described in Wood *et al.* (2012), includes for most species a 10 percent probability of behavioral harassment at 140 dB, with subsequent steps of 50 percent at 160 dB and 90 percent at 180 dB. Of note, use of this generic function resulted in lower numbers of estimated takes than did use of the 160-dB step function. Therefore, while use of the probabilistic risk function may allow for more specific quantitative consideration of contextual issues and variation in individual responses, our use of the 160-dB step function is conservative in that the number of resulting takes is higher. NMFS will continue to explore quantitative refinement of the behavioral harassment threshold where there is available information to support methodologies that better reflect the variation in individual responses. However, the current threshold allows for an appropriate, and often conservative, enumeration of predicted takes by Level B harassment, which support robust negligible impact and small numbers analyses.

Comment: Nowacek *et al.* stated that use of the 160-dB threshold would be specifically problematic for beaked whales, as these species demonstrate behavioral response at levels below 160 dB rms and occupy certain areas of the specific geographic region in high densities.

Response: Please see our previous comment response regarding use of the 160-dB threshold for behavioral harassment. With regard to the expected significance of takes by harassment specifically for beaked whales, we acknowledge that beaked whales are documented as being a particularly behaviorally sensitive species in response to noise exposure. This information is considered in our negligible impact analyses (''Negligible Impact Analyses and Determinations'') and informed our evaluation of the mitigation necessary to satisfy the least practicable adverse impact standard (''Mitigation''). We require implementation of three year-round closures of submarine canyon areas expected to provide important habitat for beaked whales, a seasonal closure of the area off of Cape Hatteras cited by the commenters, and have required expanded shutdown requirements for beaked whales. Additionally, regarding the specific levels at which they are behaviorally harassed by exposure to noise from airguns, we note that there are no data on beaked whale responses to airgun noise, and their hearing sensitivity in the frequency range of signals produced by airguns is notably lower than their sensitivity in the frequency range of the sonar sources for which data is available indicating that they have responded at lower levels (in other words, noise from an airgun must be louder than a sonar pulse for them to hear it as the same level).

Comment: NRDC and others stated that if NMFS does not revise existing behavioral harassment thresholds, it should use the acoustic threshold for continuous noise (*i.e.,* 120 dB rms) rather than the threshold for intermittent sound sources (*i.e.,* 160 dB rms). NRDC contends that, as a result of reverberation and multipath arrivals, the impulsive signal produced by airguns is more similar to a continuous noise at greater distances from the source and, therefore, use of the 120-dB ''continuous'' noise threshold is more appropriate than the 160-dB threshold for intermittent sound sources.

Response: NMFS acknowledges that as airgun shots travel through the environment, pulse duration increases because of reverberation and multipath propagation. However, we disagree that the 120-dB rms threshold for continuous noise—which was based on behavioral responses of baleen whales to drilling (Malme *et al.,* 1984; Richardson *et al.,* 1990)—is more appropriate than the intermittent noise threshold of 160-dB rms for evaluating potential behavioral harassment resulting from airgun noise. The 160-dB threshold was derived from data for mother-calf pairs of migrating gray whales (Malme *et al.,* 1983, 1984) and bowhead whales (Richardson *et al.,* 1985, 1986) behaviorally responding when exposed specifically to noise from airguns. The Richardson *et al.* (1985, 1986) studies included controlled approaches with a full-scale airgun array firing at 7.5 km from the animals. Thus, behavioral responses observed in these studies account for changes in the pulse duration associated with propagation.

In addition, there is a prevalent misconception in comments from NRDC and others regarding Level B harassment, as defined by the MMPA. NRDC cites multiple observations of behavioral reactions or of changes in vocal behavior in making statements supporting their overall recommendation that behavioral harassment thresholds be lower. However, these observations do not necessarily constitute evidence of disruption of behavioral patterns (Level B harassment) rather than simple reactions to often distant noise, which may provoke a reaction when discernable above ambient noise levels.

For example, changes in mysticete vocalization associated with exposure to airgun surveys within migratory and non-migratory contexts have been observed (*e.g.,* Castellote *et al.,* 2012; Blackwell *et al.,* 2013; Cerchio *et al.,* 2014). The potential for these changes to occur over large spatial scales is not surprising for species with large communication spaces, like mysticetes (*e.g.,* Clark *et al.,* 2009), although not every change in a vocalization would necessarily rise to the level of a take.

Comment: NRDC claims that NMFS misapplies the MMPA's statutory definition of harassment by adopting a probability standard other than ''potential'' in setting thresholds for auditory injury, stating that a take estimate based on ''potential'' should either count take from the lowest exposure level at which hearing loss can occur or establish a probability function that accounts for variability in the acoustic sensitivity of individual marine mammals. Instead, NRDC states that NMFS derived auditory injury thresholds from average exposure levels at which tested marine mammals experience hearing loss, which discounts instances of hearing loss at lower levels of exposure. The comment goes on to state that for purposes of take estimation, thresholds based on mean or median values will lead to roughly half of an exposed cohort experiencing the impacts that the threshold is designed to avoid, at levels that are considered ''safe,'' therefore resulting in substantial underestimates of auditory injury. NRDC makes similar statements with regard to the 160-dB threshold for Level B harassment.

Response: The technical guidance's (NMFS, 2018) onset thresholds for temporary threshold shift (TTS) for non-impulsive sounds encompass more than 90 percent of available TTS data (*i.e.,* for mid-frequency cetaceans, only two data points are below the onset threshold, with maximum point only 2 dB below), and in some situations 100 percent of TTS data (*e.g.,* high-frequency cetaceans; although this group is data-limited). Thus, the technical guidance thresholds provide realistic predictions, based on currently available data, of noise-induced hearing loss in marine mammals. For impulsive sounds, data are limited to two studies, and NMFS directly adopted the TTS onset levels from these two studies for the applicable hearing groups.

Our **Federal Register** notice announcing the availability of the original technical guidance (81 FR 51694; August 4, 2016; NMFS, 2016), indicated that onset of auditory injury (PTS) equates to Level A harassment under the MMPA. We explained in that notice that because the acoustic thresholds for PTS conservatively predict the onset of PTS, they are inclusive of the ''potential'' language contained in the definition of Level A harassment. See 81 FR 51697, 51721.

Regarding Level B harassment, based on the language and structure of the definition of Level B harassment, we interpret the concept of ''potential to disturb'' as embedded in the assessment of the behavioral response that results from an act of pursuit, torment, or annoyance (collectively referred to hereafter as an ''annoyance''). The definition refers to a ''potential to disturb'' by causing disruption of behavioral patterns. Thus, an analysis that indicates a disruption in behavioral patterns establishes the ''potential to disturb.'' A separate analysis of ''potential to disturb'' is not needed. In the context of an authorization such as this, our analysis is forward-looking. The inquiry is whether we would reasonably expect a disruption of behavioral patterns; if so, we would conclude a potential to disturb and therefore expect Level B harassment. We addressed NRDC's concerns regarding the scientific support for the Level B harassment threshold in a previous comment response.

Comment: The Center for Regulatory Effectiveness (CRE) does not agree with NMFS's use of the technical acoustic guidance (NMFS, 2016, 2018) for purposes of evaluating potential auditory injury. CRE claims that (1) NMFS's use of the guidance conflicts with Executive Order 13795 (''Implementing an America-First Offshore Energy Strategy''); (2) the guidance violates the Office of Management and Budget's (OMB) Peer Review Bulletin and Guidance Document Bulletin and implementing Memoranda; (3) violates Information Quality Act (IQA) guidelines; and (4) violates Executive Orders 12866 (''Regulatory Planning and Review'') and 13771 (''Reducing Regulation and Controlling Regulatory Costs''). Regarding the IQA, CRE states that NMFS does not have an OMB-approved Information Collection Request (ICR) associated with the guidance, and is therefore violating the IQA. The CRE also claims that NMFS's use of the guidance violates the MMPA requirement that all mitigation requirements be practicable, as the guidance supposedly requires monitoring and reporting requirements and other mitigation requirements that are impossible to comply with.

Response: NMFS disagrees that use of the technical guidance results in any of the claims listed by CRE. First, the use of the technical guidance does not conflict with Executive Order 13795. Section 10 of the Executive Order called for a review of the technical guidance (NMFS, 2016) as follows: ''The Secretary of Commerce shall review for consistency with the policy set forth in Section 2 of this order and, after consultation with the appropriate Federal agencies, take all steps permitted by law to rescind or revise that guidance, if appropriate.'' To assist the Secretary in the review of the technical guidance, NMFS solicited public comment via a 45-day public comment period (82 FR 24950; May 31, 2017) and hosted an interagency consultation meeting with representatives from ten federal agencies (September 25, 2017). NMFS provided a summary of comments and recommendations received during this review to the Secretary, and per the Secretary's approval, issued a revised version of the technical guidance in June 2018 (83 FR 28824; NMFS, 2018).

Second, NMFS did comply with the OMB Peer Review Bulletin and IQA Guidelines in development of the technical guidance. The technical guidance was classified as a Highly Influential Scientific Assessment and, as such, underwent three independent peer reviews, at three different stages in its development, including a follow-up to one of the peer reviews, prior to its dissemination by NMFS. In addition, there were three separate public comment periods. Responses to public comments were provided in a previous **Federal Register** notice (81 FR 51694; August 4, 2016). Detailed information on the peer reviews and public comment periods conducted during development of the guidance are included as an appendix to the guidance, and are detailed online at: *www.cio.noaa.gov/services_programs/prplans/ID43.html.*

Furthermore, the technical guidance is not significant for purposes of Executive Orders 12866 or 13771 or OMB's Bulletin entitled, ''Agency Good Guidance Practices'' for significant guidance documents. 72 FR 3432 (January 25, 2007). Nevertheless, the technical guidance follows the practices and includes disclaimer language suggested by the OMB Bulletin to communicate effectively to the public about the legal effect of the guidance. Finally, with regard to the claim that NMFS's use of the technical guidance violates the MMPA requirement that all mitigation requirements be practicable, as the guidance supposedly requires monitoring and reporting requirements and other mitigation requirements that are impossible to comply with, we reiterate that mitigation and monitoring requirements associated with an MMPA authorization or ESA consultation or permit are independent management decisions made in accordance with statutory and regulatory standards in the context of a proposed activity and comprehensive effects analysis and are beyond the scope of the technical guidance. The technical guidance does not mandate mitigation or monitoring. Finally, there is no collection of information requirement associated with the technical guidance, so no ICR is required.

Comment: Several groups raised concerns regarding use of the technical acoustic guidance (NMFS, 2016, 2018), claiming that the guidance is not based on the best available science and underestimates potential auditory injury. NRDC specifically cited many supposed issues with the guidance, including adoption of ''erroneous'' models, broad extrapolation from a small number of individuals, and disregarding ''non-linear accumulation of uncertainty.'' NRDC suggests that NMFS retain the historical 180-dB rms Level A harassment threshold as a ''conservative upper bound'' or conduct a ''sensitivity analysis'' to ''understand the potential magnitude'' of the supposed errors. Oceana stated that NMFS should not make a decision about the proposed IHAs while the technical guidance is under review.

Response: The original 2016 technical guidance and revised 2018 guidance is a compilation, interpretation, and synthesis of the scientific literature that provides the best available information regarding the effects of anthropogenic sound on marine mammals' hearing. The technical guidance was classified as a Highly Influential Scientific Assessment and, as such, underwent three independent peer reviews, at three different stages in its development, including a follow-up to one of the peer reviews, prior to its dissemination by NMFS. In addition, there were three separate public comment periods, during which time we received and responded to similar comments on the guidance (81 FR 51694), and more recent public and interagency review under Executive Order 13795. While new information may help to improve the guidance in the future, and NMFS will review the available literature to determine when revisions are appropriate, the final guidance reflects the best available science and all information received through peer review and public comment. Given the systematic development of the guidance, which was also reviewed multiple times by both independent peer reviewers and the public, NRDC's use of the phrase ''arbitrary and capricious'' is unreasonable.

The guidance updates the historical 180-dB rms injury threshold, which was based on professional judgement (*i.e.,* no data were available on the effects of noise on marine mammal hearing at the time this original threshold was derived). NMFS does not believe the use of the technical guidance provides erroneous results. The 180-dB rms threshold is plainly outdated, as the best available science indicates that rms SPL is not even an appropriate metric by which to gauge potential auditory injury (whereas the scientific debate regarding behavioral harassment thresholds is not about the proper metric but rather the proper level or levels and how these may vary in different contexts). NRDC's advice to return to use of the 180-dB threshold is inconsistent with its criticism of the 160-dB rms criterion for Level B harassment. However, as we said in responding to comments criticizing the Level B harassment criterion, development of an updated threshold(s) is complicated by the myriad contextual and other factors that must be considered and evaluated in reaching appropriate updated criteria. See our response to comment on the Level B harassment threshold.

Sound Field Modeling

Comment: The MMC noted differences in the estimated Level B harassment radii provided in ION and Spectrum's applications, noting that since the largest discrepancies were observed at shallow water sites, it is likely that geoacoustic properties were responsible. Although both ION and Spectrum used sediment data from cores collected during the Ocean Drilling Program, the data was based on samples from different sites and potentially different assumptions as to sediment attenuation. The MMC provided related recommendations: (1) NMFS should determine whether ION's or Spectrum's estimated zones are the most appropriate and require that both companies use the same set of zones; (2) NMFS should require each of the five companies to conduct sound source verification (SSV) in waters less than 100 m and use that data to inform and adjust the extent of Level B harassment zones as necessary; and (3) NMFS should determine the appropriate baseline geoacoustic model for the region in concert with BOEM, ION, and Spectrum, and then require this in future IHAs for similar activities in the region.

Response: NMFS appreciates the MMC's attention to this matter, but disagrees that it is necessarily appropriate to require use of the same data or approaches to modeling sound fields when there is not clearly a ''most appropriate'' approach. Sound field modeling for both ION and Spectrum was conducted by experts in the field. We appropriately approved both applicants' applications as adequate and complete, determining that both used appropriate data inputs and acceptable modeling approaches. Subsequently, both applications were made available for public review in order to better inform NMFS's preparation of proposed IHAs; no such concerns were raised. Importantly, we recognize that there is no model or approach that is always the most appropriate and that there may be multiple approaches that may be considered acceptable. Having determined that both applicants used appropriate data and acceptable modeling approaches, it would be inappropriate to require one to change their approach to conform to the other because of differences in the results. Given our confidence in the data inputs and modeling approaches used, we find that a requirement to conduct SSV studies is not warranted, despite discrepancies in modeling results. As is appropriate, NMFS would consider the appropriateness of data inputs and modeling approaches for any future applications but, in keeping with our response here, will not necessarily enforce use of one dataset or modeling approach when others may be considered as equally representative of the best available scientific data and techniques.

Comment: One individual suggested that, because the representative airgun array used in BOEM's sound field modeling was characterized as having a source level lower than that of arrays planned for use by the applicants, use of BOEM's sound field modeling could lead to an underestimate of takes.

Response: Numerous factors combine in the sound field modeling provided by BOEM to result ultimately in estimates of sound fields at different locations. BOEM's modeling was performed to be reasonably representative of the types of sources that would be used in future surveys, recognizing that actual sources may vary somewhat from what was considered in the sound field modeling. We disagree that these minor differences would have meaningful impacts on the ultimate result of the exposure estimation process, and find that the modeling provided by BOEM was reasonably representative of what would occur during actual surveys and, therefore, acceptable to use for informing the take estimates for these surveys.

Comment: One individual stated that NMFS does not fully consider the implications of different weather phenomena in acoustic propagation, and that in failing to account for variations in ocean and weather conditions, the average estimates of propagation and take are biased downward. The same individual also claimed that NMFS did not adequately consider ocean floor sediment composition in modeling expected sound fields, and states again that this would likely result in higher numbers of take.

Response: While NMFS acknowledges that discrete weather phenomena could result in propagation being more or less efficient than anticipated under a seasonal average scenario (*i.e.,* one element of propagation modeling is the use of sound velocity profiles that are season-specific within the specific geographic region), the commenter provides no basis for concluding that such phenomena would lead overall to the estimated takes being biased downward. Further, the sound field modeling approaches taken by the applicants (and in BOEM's PEIS) follow state-of-science approaches and are reasonable when considering the need to model propagation year-round and over a wide geographic area. The commenter provides no specific recommendation for how the suggestion should be accomplished. With regard to sediment composition, the applicants' sound field modeling considered sediment characteristics at 15 representative modeling sites throughout the region, and the commenter does not provide any evidence to back the claim that variability in actual sediment composition would result in bias to take estimates in a particular direction or provide any specific recommendation to remedy the perceived flaw.

Comment: Ocean Conservation Research (OCR) noted that NMFS did not consider a secondary transmission path in the mixed layer above the marine thermocline that behaves as a surface duct, stating that, while the propagation in this transmission path is dependent on the wavelength of the source, the angle of incidence, the depth of the mixed layer, and the surface conditions, the attenuation characteristics are more consistent with the cylindrical spreading model. OCR goes on to claim that, assuming cylindrical propagation of surface ducted noise, typical airgun noise would require 13 km to attenuate to a received level of 180 dB rms.

Response: Although OCR is correct to point out that the mechanism of sound propagation is complex in the ocean environment, with the potential formation of a surface duct as a result of the mixed layer above the permanent thermocline, the conclusion derived by OCR that typical airgun noise would require 13 km to attenuate to a received level of 180 dB rms is unsupported.

First, oceanographic conditions in the mid-Atlantic region do not support a persistent surface duct, which usually occurs after a storm or consistently cool and windy weather. A reduction of surface wind velocity and the warming of the surface water will quickly break down a surface duct and cause the downward refraction of a shallow source (*e.g.,* source from an airgun array) due to a negative sound velocity profile above the thermocline.

Second, as stated above, the formation of a surface duct requires strong wind gusts and a high sea state, which are not ideal conditions for conducting a seismic survey given the need to tow a large array of airguns and long streamers. Thus, even if a surface duct is formed, it is very unlikely that a seismic survey would continue under such conditions.

Third—as OCR correctly pointed out—sound propagation in a surface duct is dependent on the wavelength of the source, the angle of incidence, the depth of the mixed layer, and the surface conditions. Among these parameters, the depth of the mixed layer is typically determined by the wind speed and sea state. While relatively low wind speed may support a weak, shallow surface duct, such a duct cannot support propagation of airgun sound, which is predominantly low-frequency. Jensen *et al.* (2011) provide the following equation that determines the cutoff frequency (frequency below which sound will not propagate) given the depth of an isothermal surface layer:

$$f_0 \approx \frac{1500}{0.008D^{3/2}}$$

where f_0 is the cutoff frequency in Hz and D is the depth in meters of an isothermal surface layer. As an example, for a cutoff frequency to be around 100 Hz, the surface duct needs to be at least 150 m deep. In general, shallow ducts (D <50 m) are more common, but they are only effective waveguides for frequencies above 530 Hz, which also suffer high scattering loss due to the rough sea surface under these weather conditions.

Finally, most acoustic rays from an airgun array are emitted at very steep angles to be contained within the surface duct waveguide.

For these reasons, we do not believe surface ducts in the mid-Atlantic region, if they exist, would contribute noticeably to propagation for sound emitted from airguns.

Comment: NRDC stated that NMFS used unrealistic and non-conservative assumptions about spreading loss, bottom composition, and reverberation in its propagation analysis and claimed that the analysis does not represent the best available science. NRDC stated that, for propagation loss, NMFS incorrectly assumed that normal propagation conditions would apply, such as not accounting for surface ducting (and BOEM only assumed moderate surface ducting in 3 of 21 modeled areas). Furthermore, NRDC stated that low-frequency propagation along the seabed can spread in a planar manner, and can propagate with more efficiency than indicated by cylindrical propagation. Finally, NRDC asserted that NMFS cannot accept the assumptions in three applications (CGG, TGS, and WesternGeco) that proposed surveys will cover areas with soft or sandy bottoms. NRDC claims that NOAA's own models indicate that there is a likelihood of coral bottom habitat in the survey area, and many hard-bottom habitat areas were not modeled by BOEM and consequently incorporated by NMFS.

Response: Regarding sound propagation in a surface duct, please refer to the above response to a similar comment from OCR. As stated earlier, oceanographic conditions in the mid-Atlantic region do not support a persistent surface duct, particularly for low-frequency sound propagation. Therefore, the modeling of a moderate surface duct for airgun noise propagation is a conservative measure. Also as stated earlier, frequency and launch angle of the source play a major role in surface ducting. This information is clearly stated by D'Spain *et al.* (2006) with regard to the 2000 beaked whale stranding in the Bahamas, *i.e.,* that the surface duct ''. . . effectively traps mid to high frequency sound radiated by acoustic sources within the duct, such as surface ship sonars . . .'' and that ''[a]t low frequencies, the sound is no longer effectively trapped by the duct because the acoustic wavelength. . . . is too large in comparison to the duct thickness.''

NRDC's statement that ''low-frequency propagation along the seabed can spread in a planar manner . . . can propagate with significantly greater efficiency than cylindrical propagation would indicate'' is incorrect. Any acoustic wave can be approximated for plane wave propagation at sufficiently far range (R) for a region (W) such that $W \leq (\lambda R)^{1/2}$, where λ is the wavelength. This plane wave approximation has no bearing on the efficiency of sound propagation.

Finally, substrate types for propagation modeling are based on grain size, porosity, and shear velocity, etc., and ''coral bottom'' is not one of them. In fact, the roughness of the coral habitat would cause severe bottom loss due to scattering. Based on published literature, bottom types of the region are mostly composed of sand (*e.g.,* Stiles *et al.,* 2007; Kaplan, 2011). Therefore, the use of sand and clay for propagation modeling is appropriate. The acoustic modeling provided by BOEM (2014a) appropriately and reasonably accounts for variability in bottom composition throughout the planned survey area.

Comment: Some groups noted that the different approaches taken to acoustic modeling make it difficult to compare takes. Specifically, TGS, CGG, and Western relied on the acoustic modeling provided in BOEM's PEIS, while ION and Spectrum performed their own modeling. In addition, Spectrum and ION used a restricted suite of sound velocity profiles, matching the seasons when they intend to conduct their planned surveys. The comment letter from Nowacek *et al.* adds an assertion that this difficulty in comparing takes is problematic when NMFS is trying to assess whether the activities impact only small numbers or cause negligible impacts, and state that they ''can find no evidence in the Notice that NMFS took account of these significant problems when attempting to evaluate the impacts of the IHAs.''

Response: As stated in a previous response to an MMC comment, NMFS disagrees that the different approaches taken to sound field modeling constitute a problem at all, much less a significant one. BOEM's PEIS provides a sound analysis of expected sound fields in a variety of propagation conditions, including water depth, bottom type, and season, for a representative airgun array. ION and Spectrum conducted similar sound field modeling, but with the added advantage of modeling the specific array planned for use and limiting use of sound velocity profiles to the time period when the survey is planned to occur. No commenter provided any rational basis for disputing that these methods are appropriate or that they used the best available information and modeling processes. Regardless of differences in the sound field modeling processes, one would not expect that the take estimates are directly comparable, precisely because the surveys are planned for different locations, using different sound sources, and, for some companies, operating at different times of year. We disagree the various modeling approaches cause some problem for conducting appropriate negligible impact and/or small numbers analyses; both of these findings are appropriately made in consideration of a given specified activity. Therefore, comparison of the take numbers across IHAs is not a relevant consideration. We disagree that differences in approaches across the applications are arbitrary. On the contrary, we carefully evaluated each applicant's approaches to take estimation and, while they are indeed different in some respects, each applicant uses accepted approaches. Unlike NRDC, we recognize that there is no model or approach that is always the most appropriate and that there may be multiple approaches that may be considered acceptable. Far from ''parroting'' the applicants' assessments, as NRDC implies, NMFS made substantial changes where necessary, including complete revision of North Atlantic right whale take estimates for all applicants, revision of take estimates for all species using the best available density data (*i.e.,* Roberts *et al.,* 2016) for ION and Spectrum, and revised assessment of potential Level A harassment for all applicants. NMFS strongly disagrees that ''grossly inconsistent'' data or methods were used for any applicant in the analyses described herein.

Comment: One individual noted that it is not apparent how NMFS accounted for high-frequency sounds, which has implications for potential takes by Level A harassment for species that hear better at higher frequencies. The commenter wrote that airguns produce pulses with most energy at low frequencies (around 10 Hz), but that these pulses contain significant energy at frequencies up to more than 100 kHz, claiming that high-frequency hearing specialists can be affected at distances of 70 km or more. The commenter cited Bain and Williams (2006) in support of the latter claim.

Response: In considering the potential impacts of higher-frequency components of airgun noise on marine mammal hearing, one needs to account for energy associated with these higher frequencies and determine what energy is truly ''significant.'' Tolstoy *et al.* (2009) conducted empirical measurements, demonstrating that sound levels (*i.e.,* one-third-octave and spectral density) associated with airguns were at least 20 dB lower at 1 kHz compared to higher levels associated with lower frequencies (below 300 Hz). These levels were even lower at higher frequencies beyond 1 kHz. Thus, even though high-frequency cetaceans may be more susceptible to noise-induced hearing loss at higher frequencies, it does not mean that a source produces a sufficiently loud sound at these higher frequencies to induce a PTS (*i.e.,* auditory injury). For example, Bain and Williams (2006) indicated ''airguns produced energy above ambient levels at all frequencies up to 100 kHz (the highest frequency measured), although the peak frequency was quite low.'' However, a finding that airgun signals contain energy ''above ambient'' and are detectable at frequencies up to 100 kHz does not mean that these levels are high enough to result in auditory injury. The commenter does not describe what is meant by ''significant'' energy, but there is no information to suggest that these higher-frequency noise components are sufficient to cause auditory injury at ranges beyond those described in Table 5.

Furthermore, Bain and Williams (2006) focus on behavioral responses of marine mammals to airgun surveys, rather than on potential impacts on hearing. Harbor porpoises, while considered a high-frequency cetacean in terms of hearing, are also often categorized as a particularly sensitive species behaviorally (*i.e.,* consistently responds at a lower received level than other species; Southall *et al.,* 2007). We agree that harbor porpoises are more likely to avoid loud sound sources, such as airgun arrays, at greater distances. However, this means that these species are even less likely to incur some degree of threshold shift.

Marine Mammal Densities

Comment: The MMC recommended that NMFS require TGS and Western to use the Roberts *et al.* (2016) model, rather than the approach described herein (see ''Estimated Take''). MMC describes several perceived problems with the approach taken by TGS and Western, including that they do not adequately account for availability and detection biases, and that their approach does not use the same habitat-based approach to predicting density. Overall, they state that it does not make sense for applicants to use different density estimates for the same area.

Response: Please see ''Estimated Take'' for a full description of take estimation methodologies used by TGS and Western. First, we note that the applicants did carefully consider the Roberts *et al.* data in addition to other available sources of data. In fact, these two applicants did use the Roberts *et al.* data for a group of nine species, while devising an alternate methodology for a separate group of seven species that did not meet a specific threshold for sightings data recommended by Buckland *et al.* (2001). Further, these applicants did account for bias, correcting densities using general *g*(0) values for aerial and vessel surveys for each species as published in the literature.

As stated below and in our Notice of Proposed IHAs, we determined that their alternative approach (for seven species or species groups) is acceptable. We recognize that there is no model or approach that is always the most appropriate and that there may be multiple approaches that may be considered acceptable. The alternative approach used for seven species actually uses the most recent data, and does so in a way that conforms with recommended methods for deriving density values from sightings data. We do not believe that one or the other approach is non-representative of the best available science and methodologies.

Comment: NRDC criticized NMFS's use of the Roberts *et al.* (2016) model outputs for purposes of deriving abundance estimates, as used in NMFS's small numbers analyses. NRDC states that we should use the NMFS Stock Assessment Report (SAR) abundance estimates for this purpose, while allowing that model-predicted abundance estimates may be used for ''data-deficient'' stocks. NRDC implies that use of model-predicted abundances would overestimate actual abundances, apparently based on the fact that the density models are informed by many years of data rather than only the most recent year of data. Where model-predicted abundance estimates are used, NRDC recommends that we adjust the averaged model outputs to the lower bound of the standard deviation estimated by the model for each grid cell.

Response: The approach recommended by NRDC is plainly inappropriate. Comparing take estimates generated through use of the outputs of a density model to an unrelated abundance estimate provides a meaningless comparison. As explained in our Notice of Proposed IHAs, in most cases we compare the take estimates generated through use of the density outputs to the abundance predicted through use of the model precisely to provide a meaningful comparison of predicted takes to predicted population. To illustrate this, we provide the extreme example of the Gulf of Mexico stock of Clymene dolphin. NMFS's three most recent SAR abundance estimates for this stock have fluctuated between 129 and 17,355 animals, *i.e.,* varying by a maximum factor of more than 100. For most species, such fluctuations across these ''snapshot'' abundance estimates (*i.e.,* that are based on only the most recent year of survey data) reflect interannual variations in dynamic oceanographic characteristics that influence whether animals will be seen when surveying in predetermined locations, rather than any true increase or decline in population abundance. In fact, NMFS's SARs typically caution that trends should not be inferred from multiple such estimates, that differences in temporal abundance estimates are difficult to interpret without an understanding of range-wide stock abundance, and that temporal shifts in abundance or distribution cannot be effectively detected by surveys that only cover portions of a stock's range (*i.e.,* U.S. waters). The corresponding density model for Gulf of Mexico Clymene dolphins predicts a mean abundance of 11,000 dolphins. Therefore, in this example, NRDC would have us compare takes predicted by a model in which 11,000 dolphins are assumed to exist to the most recent (and clearly inaccurate) abundance estimate of 129 dolphins. Our goal in assessing predicted takes is to generate a meaningful comparison, which is accomplished in most cases through use of the model-predicted abundance.

SAR abundance estimates have other issues that compromise their use in creating meaningful comparisons here. As in the example above, use of multiple years of data in developing an abundance estimate minimizes the influence of interannual variation in over- or underestimating actual abundance. Further, SAR abundance estimates are typically underestimates of actual abundance because they do not account for availability bias due to submerged animals—in contrast, Roberts *et al.* (2016) do account for availability bias and perception bias on the probability of sighting an animal—and because they often do not provide adequate coverage of a stock's range. The SAR for the Canadian East Coast stock of minke whales provides an instructive example of the latter. In the 2015 SARs, NMFS presented a best abundance estimate of 20,741 minke whales, reflecting data that provided adequate (but not complete) coverage of the stock's range. In the 2016 SARs, NMFS claims an abundance estimate of 2,591 whales for this same stock (albeit with caveats) simply because the survey data covering the Canadian portion of the range was no longer included in determining the best abundance estimate. We assume that again, based on this comment, NRDC would have us compare the minke whale take estimates to this plainly incomplete abundance estimate.

NRDC appears to claim that the SARs are an appropriate representation of ''actual'' abundance, whereas the Roberts *et al.* (2016) predictions are not. NRDC also appears to claim, without substantiation, that an abundance estimate derived from multiple years of data would typically overestimate actual abundance. However, these estimates are not directly comparable—not because one represents a ''snapshot,'' while one represents multiple years of data, but because one does not correct for one or more known biases against the probability of observing animals during survey effort, while the other does. Because of this important caveat, NMFS's SAR abundance estimates should not be considered ''actual'' abundance more than any other accepted estimate. Therefore, when multiple estimates of a stock's abundance are available, they should be evaluated based on quality, *e.g.,* does the estimate account for relevant biases, does it best cover the stock's range, does it minimize the effect of interannual variability, and, importantly, should provide a meaningful comparison. In summary, NRDC's comment reflects an inaccurate interpretation of the available information, and NMFS strongly disagrees with the recommended approach.

Take Estimates

Comment: The Associations (representing oil and gas industry interests) state that ''NMFS substantially overestimates the number of incidental takes predicted to result'' from the specified activities. The comment goes on to discuss the ''biased modeling that is intentionally designed to overestimate take'' provided in BOEM's 2014 PEIS. Other industry commenters repeat these points verbatim.

Response: The Associations' statement that NMFS has substantially overestimated takes is incorrect. First, in large part the take estimates are those presented by the applicants (although in some cases NMFS has made changes to the presented estimates in accordance with the best available information). Second, two applicants conducted their own independent sound field modeling, which NMFS accepted. In fact, BOEM and these two applicants followed best practices and used the best available information in conducting state-of-the-science sound field modeling. The Associations' complaints include no substantive recommendations for improvement.

NMFS participated in development of the acoustic modeling through its status as a cooperating agency in development of BOEM's PEIS. We strongly disagree with the Associations' characterization of the modeling conducted by BOEM and with the BOEM statements cited by the Associations. While the modeling required that a number of assumptions and choices be made by subject matter experts, some of these are purposely conservative to minimize the likelihood of underestimating the potential impacts on marine mammals represented by a specified level of survey effort. The modeling effort incorporated representative sound sources and projected survey scenarios (both based on the best available information obtained by BOEM), physical and geological oceanographic parameters at multiple locations within U.S. waters of the mid- and south Atlantic and during different seasons, the best available information regarding marine mammal distribution and density, and available information regarding known behavioral patterns of the affected species. Current scientific information and state-of-the-art acoustic propagation and animal movement modeling were used to reasonably estimate potential exposures to noise. NMFS's position is that the results of the modeling effort represent a conservative but reasonable best estimate. These comments provide no reasonable justification as to why the modeling results in overestimates of take, instead seemingly relying on the mistaken notion that real-time mitigation would somehow reduce actual levels of acoustic exposure, and we disagree that ''each of the inputs is purposely developed to be conservative''—indeed, neither the Associations nor BOEM provide any support for the latter statement. Although it may be correct that conservativeness accumulates throughout the analysis, the Associations do not adequately describe the nature of conservativeness associated with model inputs or to what degree (either quantitatively or qualitatively) such conservativeness ''accumulates.''

Comment: One individual stated that NMFS should consider how ''animal behavioral response can condition exposure,'' noting that behavioral responses may result in effects to the potential amount and intensity of take. We believe the commenter is suggesting that the way any specific animal moves through the water column in initial response to the sound can change the manner in which they are subsequently further exposed to the sound.

Response: The commenter seemingly indicated that some species should be expected to dive downwards rather than exhibit lateral avoidance. While we agree that this may occur, we do not agree that this would result in an increase in intensity of take—and such an occurrence could not by definition result in an increase in the absolute amount of take, as the animal in question would already be considered ''taken.'' Given relative motion of the vessel and the animal, there is no evidence to support that avoidance of the noise through downward, rather than lateral, movement would result in a meaningful increase in the duration of exposure, as implied by the commenter.

Comment: The Associations stated that it is unclear whether the take estimates include repeated exposures and that, if so, the estimates do not identify the number of repeated exposures, instead presenting a total number of estimated exposures by species. The Associations state that NMFS must perform additional analysis to identify the actual number of individual marine mammals that may be incidentally taken.

Response: The take estimates presented in our Notice of Proposed IHAs, and those shown in Table 6 of this notice, represent total estimated instances of exposure. We agree with the Associations that an understanding of the numbers of individuals affected by the total estimated instances of exposure is relevant, both for the small numbers analysis (a small numbers analysis is appropriately made on the basis of individuals taken rather than total takes, when such information is available) but also for assessing potential population-level impacts in a negligible impact analysis. We also agree that this information is relevant to these analyses and important to use, when available. In fact, one applicant (TGS) provided an analysis of individuals exposed; following review of public comments and re-evaluation of TGS's application, we considered this information in our small numbers analysis for TGS. However, without such information, an assumption that the total estimated takes represent takes of different individuals is acceptable in that it represents a conservative estimate of the total number of individuals taken made in the absence of sufficient information to differentiate between individuals exposed and instances of exposure, and is also generally a reasonable approach given the large, dispersed spatial scales over which the surveys operate. The MMPA does not require that NMFS undertake any such analysis and, in fact, sufficient information is not typically available to support such an analysis.

Comment: NRDC states that masking results in take of marine mammals, and that NMFS must account for this in its take estimates.

Response: We addressed our consideration of masking in greater detail in a previous response. We acknowledge that masking may impact marine mammals, particularly baleen whales, and particularly when considered in the context of the full suite of regulated and unregulated anthropogenic sound contributions overlaying an animal's acoustic habitat. However, we do not agree that masking effects from the incremental noise contributions of individual activities or sound sources necessarily, or typically, rise to the level of a take. While it is possible that masking from a particular activity may be so intense as to result in take, we have no information suggesting that masking of such intensity and duration would occur as a result of the specified activities. As described in our previous comment response, potential effects of a specified activity must be accounted for in a negligible impact analysis, but not all responses or effects result in take nor are those that do always readily quantified. In this case, while masking is considered in the analysis, we do not believe it will rise to the level of take in the vast majority of exposures. However, specifically in the case of these five surveys, in the unanticipated event that any small number of masking incidents did rise to the level of a take, we would expect them to be accounted for in the quantified exposures above 160 dB. Given the short duration of expected noise exposures, any take by masking in the case of these surveys would be most likely to be incurred by individuals either exposed briefly to notably higher levels or those that are generally in the wider vicinity of the source for comparatively longer times. Both of these situations would be captured in the enumeration of takes by Level B harassment, which is based on exposure at or above 160 dB, which also means the individual necessarily spent a comparatively longer time in the adjacent area ensonified below 160 dB, but in which masking might occur if the exposure was notably longer.

Comment: NRDC, the MMC, and others state that NMFS's Level A harassment exposure analysis contains potentially significant errors. The MMC recommends that NMFS (1) provide company-specific Level A harassment zones for each functional hearing group, and (2) re-estimate the numbers of Level A harassment. NRDC states that, by relying on BOEM's 2014 PEIS, NMFS did not use the best available science, *e.g.,* use of earlier density data (DoN, 2007) rather than Roberts *et al.* (2016). NRDC goes on to cite as an additional flaw of the analysis that ''NMFS assumes that auditory take estimates for high-frequency cetaceans depend on the exposure of those species to single seismic shots . . . even though the weighted auditory injury zone for high-frequency cetaceans extends as far as 1.5 kilometers [. . . .] 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).''

Response: As described in ''Estimated Take,'' NMFS revised the approach to assessing potential for auditory injury, and associated authorization of take by Level A harassment. NMFS disagrees that the prior approach for the proposed IHAs contained ''significant errors.'' As stated in our Notice of Proposed IHAs, we used the information available to us and made reasonable corrections to account for applicant-specific information. However, following review of public comments, we determined it appropriate to re-evaluate the analysis and subsequently revised our approach as described in ''Estimated Take.'' This revised approach is simplified in its use of the available information while providing a reasonable assessment of the likely potential for auditory injury, and has the advantage of not relying on the BOEM PEIS results. While the PEIS results remain a reasonable assessment of potential effects from a programmatic perspective, and were based on the best available cetacean density information at the time the analyses were conducted, they do not use the best cetacean density information currently available (Roberts *et al.,* 2016), and also did not recognize that the potential for Level A harassment occurrence for mid-frequency cetaceans is discountable (described in detail in ''Estimated Take''). However, the second portion of NRDC's comment is incorrect: The peak pressure injury zones referred to by NRDC as extending as far as 1.5 km are not weighted for hearing sensitivity, as it is inappropriate to do so for exposure to peak pressure received levels (NMFS, 2018). Applicant-specific zones are shown in Table 5; all zones based on accumulation of energy are very small for high-frequency cetaceans. It is unclear what NRDC's recommendation to ''calculate auditory injury by applying both the peak-pressure threshold and a metric that accounts for exposure to multiple shots'' means, as the former is predominant for high-frequency cetaceans, while zones based on the latter are essentially non-existent. As recommended by the MMC, we have provided company-specific Level A harassment zones for each functional hearing group (see Table 5).

Comment: One individual asserted that NMFS fails to account for variability in group size and distribution of various species, stating that while the best estimate of take may be a fraction of an individual in practice either no individuals will be taken, or one or more groups will be taken. The individual suggested that NMFS should decide whether it may authorize one or more large groups, rather than estimates of a fraction of an individual.

Response: We agree with this comment. Accordingly, and as described in our Notice of Proposed IHAs, we did not propose to authorize take less than the average group size for any species. In fact, our take authorization for a group of species deemed ''rare'' was based entirely on an assumption of one encounter with a group, *i.e.,* we authorize take equating to one average group size.

Comment: NRDC asserts that NMFS fails to account for forms of injury that are reasonably anticipated, stating that permanent hearing loss (*i.e.,* Level A harassment) may occur through mechanisms other than PTS, and that behaviorally-mediated injury may occur as a result of exposure to airgun noise. NRDC states that NMFS must account for these mechanisms in its assessment of potential injury.

Response: NMFS is aware of the work by Kujawa and Liberman (2009), which is cited by NRDC. The authors report that in mice, despite completely reversible threshold shifts that leave cochlear sensory cells intact, there were synaptic level changes and delayed cochlear nerve degeneration. However, the large threshold shifts measured (*i.e.,* maximum 40 dB) that led to the synaptic changes shown in this study are within the range of the large shifts used by Southall *et al.* (2007) and in NMFS's technical guidance to define PTS onset (*i.e.,* 40 dB). It is unknown whether smaller levels of temporary threshold shift (TTS) would lead to similar changes or what may be the long-term implications of irreversible neural degeneration. The effects of sound exposure on the nervous system are complex, and this will be re-examined as more data become available. It is important to note that NMFS's technical guidance incorporated various conservative factors, such as a 6–dB threshold shift to represent TTS onset (*i.e.,* minimum amount of threshold shift that can be differentiated in most experimental conditions); the incorporation of exposures only with measured levels of TTS (*i.e.,* did not incorporate exposures where TTS did not occur); and assumed no potential of recovery between intermittent exposures. NMFS disagrees that consideration of likely PTS is not sufficient to account for reasonably expected incidents of auditory injury.

There is no conclusive evidence that exposure to airgun noise results in behaviorally-mediated forms of injury. Behaviorally-mediated injury (*i.e.,* mass stranding events) has been primarily associated with beaked whales exposed to mid-frequency naval sonar. Tactical sonar and the alerting stimulus used in Nowacek *et al.* (2004) are very different from the noise produced by airguns. One should therefore not expect the same reaction to airgun noise as to these other sources.

Comment: TGS recommends that NMFS (1) recalculate take estimates to account for mitigation; (2) remove take estimates associated with the disallowed use of a mitigation gun; and (3) ensure that we do not double-count takes when considering takes by both Level A and Level B harassment.

Response: We agree with these recommendations and have done as requested; please see ''Estimated Take'' for further detail. We do note that, with regard to accounting for mitigation in calculating take estimates, our analysis involved only an accounting of take avoided for certain species as a result of the implementation of time-area restrictions. We did not attempt to account for the potential efficacy of other mitigation requirements in avoiding take.

Comment: The Florida Department of Environmental Protection (FLDEP) wrote that NMFS needs to be cautious in relying on the efficacy of mitigation measures to estimate take by Level A harassment, particularly with regard to North Atlantic right whales. They noted additional information on the effectiveness of proposed mitigation is necessary.

Response: While we agree with the commenters that caution is warranted in assuming that standard mitigation measures, such as shutdowns, will be effective in avoiding Level A harassment, we note that our estimation of likely take by Level A harassment does not substantively rely on such assumptions. As described in ''Estimated Take,'' auditory injury of mid-frequency cetaceans is highly unlikely, for reasons unrelated to mitigation. In estimating likely Level A harassment of high-frequency cetaceans, we did not consider mitigation at all, as the instantaneous exposures expected to result in auditory injury are amenable to a straightforward quantitative estimate. However, our Level A harassment take estimates for low-frequency cetaceans are based on a more qualitative analysis that does consider the implementation of mitigation, as is appropriate. We do not assume in any case that real-time mitigation would be totally effective in avoiding such instances, but for the theoretical injury zone sizes considered here for low-frequency cetaceans, which are based on the accumulation of energy, it is reasonable to assume that large whales may be observed when close to the vessel. Therefore, shutdown may be implemented and accumulation of energy halted such that actual instances of injury should not be considered likely. Our estimated instances of Level A harassment for low-frequency cetaceans consider the expected frequency of encounter for different species and the expectation that mitigation will be effective in avoiding some instances of Level A harassment, but also the likelihood that for some species that would be encountered most frequently, some instances of Level A harassment are likely unavoidable. Specifically for the right whale, we primarily consider that our required time-area restriction will avoid most acute exposures of the species (or that comparable protection will be achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore) (as shown in the very low numbers of estimated take by Level B harassment, which account for the time-area restriction). Given such a low assumed encounter rate, the likelihood of Level A harassment for the species is correctly considered discountable. Please see our discussion in ''Estimated Take'' for further detail.

Comment: NRDC asserts that NMFS has failed to account for the effects of stress on marine mammals.

Response: As NRDC acknowledges, we addressed the available literature regarding potential impacts of stress resulting from noise exposure in marine mammals. As described in that discussion, stress responses are complicated and may or may not have meaningful impacts on marine mammals. NRDC implies that NMFS must (1) enumerate takes resulting from stress alone and (2) specifically address stress in its negligible impact analyses. The effects of stress are not straightforward, and there is no information available to inform an understanding of whether it is reasonably likely that an animal may experience a stress response upon noise exposure that would not be accounted for in NMFS's enumeration of takes via exposure to noise exceeding 160 dB. NRDC provides no useful information as to how such an analysis might be carried out. With regard to NMFS's negligible impact analyses, we believe that the potential effects of stress are addressed and subsumed within NMFS's considerations of magnitude of effect and likely consequences. Similarly, NRDC provides no justification as to why stress would appropriately be considered separately in these analyses, and no useful recommendation as to how to do so, if appropriate. We believe we have appropriately acknowledged the potential effects of stress, and that these potential effects are accounted for within our overall assessment of potential effects on marine mammals.

Comment: The MMC recommends that NMFS (1) determine whether the specific animat density used by Spectrum is appropriate and (2) depending on the outcome of that assessment, either authorize uncorrected take numbers from Spectrum's application, or re-estimate the numbers of Level B harassment takes using a higher animat density.

Response: We appreciate the MMC's consideration of this issue. Following evaluation of the comment, we confirm that the animat density used by Spectrum is appropriate. As stated by Marine Acoustics, Inc. (MAI)—which has years of experience in the field of acoustic modeling and performed the modeling for Spectrum (as well as ION) according to state-of-the science best practices—the modeled animat density value was determined through a sensitivity analysis that examined the stability of the predicted estimate of exposure levels as a function of animat density. The modeled density was determined to accurately capture the full distributional range of probabilities of exposure for the proposed survey, and is therefore appropriate. In describing the original modeling, MAI stated that in most cases the animat density represented a higher density of animats in the simulation than occurs in the real world. This ''over-population'' allowed the calculation of smoother distribution tails, and in the final analysis all results were normalized back to the actual estimated density for the species or group in question. This remains the case when using the revised density estimates from Roberts *et al.* (2016). We disagree with MMC's contention that the mitigation assumptions used by Spectrum in modeling Level B harassment takes were inappropriate; therefore, we retain the estimates proposed for authorization (as modified using the newer Roberts *et al.* (2016) density values).

Comment: The FLDEP stated that NMFS should account for uncertainty in take estimates, including uncertainty about marine mammal density, sound propagation models, and auditory thresholds, and that these factors should ''all manifest as uncertainty around take estimates and be reported in and considered for IHAs.''

Response: We agree with the commenter that it would be useful to understand the degree of confidence in take estimates through some measure of uncertainty around the estimate, and that uncertainty can accrue through all of the mentioned aspects of the take estimation process. However, we believe that the take estimates are reasonable best estimates. Measuring uncertainty around a take estimate is not something that has been accomplished in the past, and the commenter provides no recommendation as to how they believe this should be done.

Comment: The NAMA stated that an IHA should be revoked if it is found that a take by Level A harassment has occurred.

Response: Level A harassment, which is defined as an act with the potential to injure a marine mammal, may be authorized through an IHA, as we have done here.

Comment: The New York State Department of Environmental Conservation stated that the amount of takes by Level A harassment proposed for humpback whales is considerable when considered in context of the ongoing UME, and that NMFS should give more consideration to this concern.

Response: We have considered the ongoing effects of the humpback whale UME in our evaluation. We also reiterate that Level A harassment refers to injury, and therefore cannot be directly equated to serious injury or mortality, and further that the estimated takes by Level A harassment likely represent only onset of mild PTS. However, separately, we have revised our estimates of Level A harassment for all species (see ''Estimated Take''), resulting in much lower estimates for humpback whales. The revised results of this analysis should obviate the concern expressed here.

Comment: OCR stated that NMFS should consider the potential use of ancillary noise sources (*e.g.,* side-scan or multibeam bottom profiling sonars) in estimating take, and notes that these sources have been associated with marine mammal strandings.

Response: We did consider this potential avenue of acoustic exposure. We understand that, generally, vessel operators plan to use standard navigational echosounders (single beam) operated at relatively high frequencies (>18 kHz). In addition, it is possible that some applicants may use a low-level acoustic pinger to help position their towed gear. It is possible that some marine mammals could detect and react to signals from these sources (although this is less likely for low-frequency cetaceans, and these species would not likely detect signals from these systems if they are operated above 35 kHz). However, the vast majority of the time echosounders would be in use, so would airguns which have much higher source levels and are expected to result in more severe reactions than any associated with echosounders specifically. We would expect that in most cases, any response would be to airguns rather than the echosounder itself. We recognize that there would be limited use of echosounders or pingers while airguns are not active, for example, when vessels are in transit from port to areas where surveys will occur. However, we do not believe this results in meaningful exposure to marine mammals since, given the lower source levels and higher frequencies of echosounders and pingers, animals would need to be very close to the transducer to receive source levels that would produce a behavioral response (Lurton, 2016), much less one that would result in a response of a degree considered to be take.

In extreme circumstances, some echosounders and pingers may also have the potential to cause injury, and in one case evidence indicates such a system likely played a contributing role in a cetacean stranding event. However, injury (or any threshold shift) is even less likely than behavioral responses since animals would need to be even closer to the transducer for these to occur. It is also important to note that the system implicated in the stranding event was a lower-frequency (12–kHz), higher-power deepwater mapping system; typical navigational systems, including those that the applicants here would use, would have lower potential to cause similar responses. Kremser *et al.* (2005) concluded the probability of a cetacean swimming through the area of exposure when such sources emit a pulse is small, as the animal would have to pass at close range and be swimming at speeds similar to the vessel in order to receive multiple pulses that might result in sufficient exposure to cause TTS. This finding is further supported by Boebel *et al.* (2005), who found that even for echosounders with source levels substantially higher than those proposed here, TTS is only possible if animals pass immediately under the transducer. Burkhardt *et al.* (2013) estimated that the risk of injury from echosounders was less than three percent that of vessel strike, which is considered extremely unlikely to occur such that it is discountable. In addition, modeling by Lurton (2016) of multibeam echosounders indicates that the risk of injury from exposure to such sources is negligible.

Navigational echosounders are operated routinely by thousands of vessels around the world, and to our knowledge, strandings have not been correlated with their use. The echosounders and pinger proposed for use differ from sonars used during naval operations, which generally have higher source levels, lower frequencies, a longer pulse duration, and more horizontal orientation than the more downward-directed echosounders. The sound energy received by any individuals exposed to an echosounder during the proposed seismic survey activities would be much lower relative to naval sonars, as would be the duration of exposure. The area of possible influence for the echosounders is also much smaller, consisting of a narrow zone close to and below the source vessels as described previously for TTS and PTS. Because of these differences, we do not expect the proposed echosounders and pinger to contribute to a marine mammal stranding event. In summary, any effects that would be considered as take are so unlikely to occur as a result of exposure from ancillary acoustic sources as to be considered discountable.

Marine Mammal Protection Act—General

Comment: Several groups indicated a belief that NMFS's proposal to issue the five IHAs contradicts Congressional intent behind the MMPA. For example, Clean Ocean Action (COA) stated that issuance of the IHAs would be incompatible with the original intent of the MMPA. Sea Shepherd Legal stated that the legislative history of the MMPA makes clear that the precautionary principle must be applied and bias must favor marine mammals, and opines that NMFS's proposed issuance of the IHAs ''undermines the MMPA's prioritization of conservation.''

Response: NMFS disagrees that these actions contradict any requirement of the MMPA or are contrary to Congressional intent as expressed in relevant provisions of the statute. Neither the MMPA nor NMFS's implementing regulations include references to, or requirements for, the precautionary approach, nor is there a clear, agreed-upon description of what the precautionary approach is or would entail in the context of the MMPA or any specific activity. Nevertheless, the MMPA by nature is inherently protective, including the requirement to mitigate to the lowest level practicable (''least'' practicable adverse impacts, or ''LPAI,'' on species or stocks and their habitat). This requires that NMFS assess measures in light of the LPAI standard. To ensure that we fulfill that requirement, NMFS considers all potential measures (*e.g.,* from recommendations or review of available data) that have the potential to reduce impacts on marine mammal species or stocks, their habitat, or subsistence uses of those stocks, regardless of whether those measures are characterized as ''precautionary.''

Comment: Several groups stated that the duration of the public comment period was inadequate. A group of fourteen U.S. Senators urged NMFS to extend the comment period to at least 150 days (30 for each applicant). They wrote that publishing the notice of proposed IHAs had little notice, a short comment period, and no public hearings, adding that the notice of proposed IHAs addresses two applications that NMFS had not previously made available for public review. Some commenters decried what they perceived as a lack of stakeholder outreach. Multiple groups requested that NMFS hold public hearings in the affected regions about the proposed IHAs and their potential impacts.

Response: NMFS has satisfied the requirements of the MMPA, which requires only that NMFS publish notice of a proposed authorization and request public comment for a period of 30 days. In fact, NMFS exceeded this requirement by extending the public comment period by 15 days, for a total period of 45 days. By publishing a joint notice of the five proposed IHAs rather than five separate concurrent notices, NMFS provided for more efficient public review and comment on these substantially similar actions. Although NMFS acknowledges that these are five separate actions, there is no requirement to provide for consecutive review periods (*i.e.,* five 30-day periods totaling 150 days). Although not required, NMFS in 2015 published a notice of receipt of applications received to afford opportunity for public review and comment. Therefore, NMFS provided an opportunity for review of the applications for 30 days followed by a 45-day review of the proposed IHAs, for a total of 75 days of review—far above what is required by the MMPA. As stated earlier in this document, the additional two applications received following the 2015 review were substantially similar to those offered for review, and we determined that publishing a notice of their receipt would not provide any additional useful information.

Overall, we believe that there has been sufficient opportunity for public engagement with regard to the proposed surveys, through opportunities associated with NMFS's consideration of the requested IHAs under the MMPA and those associated with BOEM's consideration of requested permits under OCSLA (or through other associated statutory requirements). The public, coastal states, and other stakeholders have had substantial opportunity for involvement via processes related to the Coastal Zone Management Act (CZMA), NEPA, OCSLA, and the MMPA. In 2014, BOEM completed their PEIS, with NOAA acting as a cooperating agency in development of the PEIS. During EIS scoping, BOEM offered two separate comment periods and held seven public meetings in coastal states. The draft PEIS was made available for public review and comment for 94 days. Public hearings were held in eight coastal states. Subsequently, the final PEIS was made available for public comment for 90 days prior to BOEM's issuance of a Record of Decision. After completion of the 2014 PEIS, BOEM made all geophysical survey permit requests available for public review and comment for 30 days. With NMFS's participation, BOEM subsequently held eight open house meetings in coastal states for the public to learn more about the proposed surveys and to provide input to the permitting process. In addition, NOAA and BOEM engaged with coastal states as required by the CZMA federal consistency provision.

Comment: NRDC states that the specified activities have the potential to kill and seriously injure marine mammals, and that NMFS cannot therefore authorize the requested incidental take via an IHA. NRDC specifically contends that behavioral disturbance (*i.e.,* Level B harassment) can result in more severe outcomes (*i.e.,* Level A harassment or serious injury or mortality) through secondary effects, and that NMFS must consider this. Similarly, Oceana and other commenters suggest that Level A harassment (*i.e.,* auditory injury) cannot be authorized via an IHA, as it is equivalent to serious injury or mortality. In this same vein, commenters relate Level A harassment to potential biological removal (PBR) levels, a metric used to evaluate the significance of removals from a population (*i.e.,* serious injury or mortality).

Response: We strongly disagree that mortality or serious injury are reasonably anticipated outcomes of these specified activities, and the commenters do not provide compelling evidence to the contrary. Instead, commenters present speculative potentialities, including the contention that behavioral disturbance will lead to heightened risk of strike or predation. Moreover, the specific example given by NRDC—that the migratory path for right whales lies ''in the middle of the'' survey area—is plainly incorrect. The migratory path for right whales lies along the continental shelf (Schick *et al.,* 2009; Whitt *et al.,* 2013; LaBrecque *et al.,* 2015), whereas the survey area extends out to 350 nmi from shore, with most survey effort planned for waters where right whales do not occur (*i.e.,* waters greater than 1,500 m deep; Roberts *et al.,* 2017). More importantly, we require that applicants maintain a minimum standoff distance of 90 km from shore from November through April (or that comparable protection be achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore), encompassing the expected migratory path and season and obviating any concern regarding potential secondary effects on migrating right whales.

Separately, section 101(a)(5)(D) of the MMPA, which governs the issuance of IHAs, indicates that the ''the Secretary shall authorize . . . . taking by harassment [. . . .]'' The definition of ''harassment'' in the MMPA clearly includes both Level A and Level B harassment.

Last, PBR is defined in the MMPA (16 U.S.C. 1362(20)) as ''the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population'' and is a measure to be considered when evaluating the effects of mortality or serious injury on a marine mammal species or stock. Level A harassment is not equivalent to serious injury and does not ''remove'' an individual from a stock. Therefore, it is not appropriate to use the PBR metric to directly evaluate the effects of Level A harassment on a stock in the manner suggested by commenters.

Comment: ION expressed concern regarding proposed IHA language indicating that ''taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation'' of an IHA, requesting that NMFS remove this language. Applicants also expressed concern about not being able to avail themselves of the IHAs while they are effective.

Response: The referenced language is standard text in issued IHAs, which acknowledges that, while unlikely and unexpected, species for which take is not authorized may be observed and unintentionally taken. Absent extenuating circumstances, it is unlikely that such an occurrence would result in the suspension or revocation of an IHA. Rather, in the event that an observation is made of an unusual species for which take is not authorized, we would consider whether it is likely that the take warrants a modification of the IHA in order to include future take authorization for that species, or whether it is more likely that the observation would not occur again. NMFS has also included a provision for an IHA holder to request suspension of the IHA when operations must cease for reasons outside the holder's control, excluding certain circumstances, for a limited period.

Least Practicable Adverse Impact

Comment: NRDC believes NMFS relies on a ''flawed interpretation'' of the least practicable adverse impact standard. They state that NMFS (1) wrongly imports a population-level focus into the standard, contrary to the ''clear'' holding of the Ninth Circuit in *NRDC* v. *Pritzker;* (2) inappropriately ''balances'' or weighs effectiveness against practicability without sufficient analysis, counter to *Pritzker,* using the seasonality of Area #5 and NMFS's core abundance approaches as examples; and (3) must evaluate measures on the basis of practicability (which connotes feasibility), not practicality (which connotes usefulness)—and evaluating on the basis of practicality would be arbitrary and capricious.

Response: We carefully evaluated the Ninth Circuit's opinion in *Pritzker* and believe we have fully addressed the Court's concerns. Our discussion of the least practicable adverse impact standard in the section entitled ''Mitigation'' explains why we believe a population focus is a reasonable interpretation of the standard. With regard to the second point, we disagree that the Ninth Circuit's opinion requires such a mechanical application of the factors that must be considered in assessing mitigation options. Finally, we agree with the commenter that we must evaluate measures on the basis of practicability, and for these IHAS we have done so. Our assessment of measures for practicability looked at appropriate considerations, as demonstrated by our discussion in this Notice. This included cost and impact on operations. We note that although not directly relevant for these IHAs, in the case of a military readiness activity, practicality of implementation is explicitly part of the practicability assessment. Thus, the two concepts are not entirely distinct.

Comment: In determining whether proposed IHAs meet the least practicable adverse impact (LPAI) standard, the MMC recommends that NMFS (1) identify the potential adverse impacts that it has identified and is evaluating; (2) specify what measures might be available to reduce those impacts; and (3) evaluate whether such measures are practicable to implement. The MMC further suggests that NMFS provided ''virtually no analysis to support'' our conclusions.

Response: The MMC identifies a specific manner in which it recommends NMFS consider applicable factors in its least practicable adverse impact analysis, however, NMFS has clearly articulated the agency's interpretation of the LPAI standard and our evaluation framework in the ''Mitigation'' section of this notice. NMFS disagrees that analysis was not provided to support our least practicable adverse impact findings. Specifically, NMFS identifies the adverse impacts that it is considering in the LPAI analysis, and comprehensively evaluates an extensive suite of measures that might be available to reduce those impacts (some of which are adopted and some that are not) both in the context of their expected ability to reduce impacts to marine mammal species or stocks and their habitat, as well as their practicability (see ''Mitigation'' and ''Negligible Impact Analyses and Determinations'' sections).

Comment: TGS recommended that NMFS ''model how many shut-down and delay actions would be expected for a survey'' in evaluating practicability, suggesting that ''animat modeling could be used to accomplish this estimate.''

Response: NMFS is not aware of data sources that would appropriately inform such an analysis, and does not agree that such an analysis is either practical or necessary. Moreover, we believe we have addressed the commenter's concern by removing a number of shutdown measures (in response to other public comments) that we determined were likely ineffective and/or impracticable or otherwise unwarranted, thus minimizing the accumulation of potential for shutdown and delay actions. We also note that seismic operators have successfully and practicably implemented shutdowns in multiple regions, both in the United States and in other countries where seismic mitigation protocols have been prescribed, and that larger shutdown zones have previously been required of operators in the U.S. Arctic as well as for research seismic cruises, without any known practicability issues. We have appropriately accounted for issues related to practicability in our analysis of the appropriate suite of required mitigation measures.

Negligible Impact

Comment: As described briefly in a previous comment and response, NRDC asserts that NMFS should conduct a combined negligible impact analysis for all five specified activities, in consideration of the aggregate take across all five surveys in the same geographical region, over the same period of time, and with ''substantially similar impacts on marine mammals.'' NRDC states that NMFS's failure to do so does not meet our legal obligations under the MMPA and is ''contrary to common sense and principles of sound science.'' Other commenters offer similar comments. NRDC cites to legislative history that indicates ''specified activity'' includes all actions for which ''the anticipated effects will be substantially similar.'' H.R. Rep. No. 97–228 (Sept. 16, 1981), as reprinted in 1981 U.S.C.C.A.N. 1458, 1469. Further, NRDC cites to NMFS's 1989 implementing regulations as further evidence that NMFS must ''evaluate the impacts resulting from all persons conducting the specified activity, not just the impacts from one entity's activities.'' Based on this, NRDC argues that NMFS must make a finding that the authorized activity—which includes all five IHA applications—will have a negligible impact on the affected species or stocks.

Response: We considered five distinct specified activities and, therefore, performed five distinct negligible impact analyses. As we said in a previous response to comment, we believe the ''specified activity'' for which incidental take coverage is being sought under section 101(a)(5)(D) is appropriately defined and described by the applicant. Here there are five specified activities, with a separate applicant for each.

Although NRDC's comment correctly cites the pertinent language from section 101(a)(5)(D) (which was enacted in 1994), it refers to legislative history from 1981 in support of its argument. But that legislative history corresponds to Congress' enactment of the provision for incidental take regulations. Because the IHA provisions were added in 1994, citations from the 1981 legislative history cannot accurately be referenced as statements made ''in enacting this provision.'' More substantively, the sentence from which NRDC quotes was, in our view, for the purpose of instructing the agencies to avoid promulgating incidental take regulations that are overly broad in their scope (''It is the intention of the Committee that [. . .] the specified activity [. . .] be narrowly identified so that the anticipated effects will be substantially similar.''). Similarly, the discussion from NMFS's and the U.S. Fish and Wildlife Service's 1989 implementing regulations (again, before the 1994 enactment of section 101(a)(5)(D)) was in reference to section 101(a)(5)(A), the provision for incidental take regulations. There the focus was on ensuring that the negligible impact evaluation for an incidental take regulation under section 101(a)(5)(A)—*not* incidental harassment authorizations under section 101(a)(5)(D)—included the effects of the total taking by all the entities anticipated to be conducting the activity covered by the incidental take regulation.

We do not mean to suggest that the legislative history for section 101(a)(5)(A) and our implementing regulations that preceded enactment of section 101(a)(5)(D) have no application to that section. We recognize there is considerable overlap between the two provisions. However, there are enough differences that the two provisions should not be casually conflated with one another.

Comment: The Associations state that they concur with NMFS's preliminary determinations of negligible impact on the affected species or stocks. However, their comments go on to claim that the ''magnitude'' and ''impact'' ratings that inform our negligible impact determinations as part of our negligible impact analysis framework are overly conservative, and that they disagree with these aspects of our negligible impact analyses.

Response: We appreciate the Associations' concurrence with our overall determinations. However, we disagree with the statements regarding aspects of our negligible impact analyses, and feel that these statements to some degree reflect a misunderstanding of the framework elements. In support of their assertion, the Associations claim that ''high'' and ''moderate'' magnitude ratings ''have never been observed in the multi-decade history of offshore seismic exploration [. . . .]'' Magnitude ratings reflect only the amount of take that is estimated, as well as the spatial and temporal scale over which the take is expected to occur in relation to what is known regarding a stock's range and seasonal movements; therefore, it is incorrect to reference what has or has not ''been observed'' in disputing the validity of the given magnitude ratings. The Associations also claim that no survey has had more than an ''insignificant'' impact on a marine mammal species or stock, without explaining the meaning that they assign to this term in context of their comments or providing any evidence (as we have stated, lack of evidence of ''significance'' does not constitute evidence of ''insignificance''). As this term bears no relevance to the MMPA's ''negligible impact,'' we cannot comment on the claim. With regard to the Associations' comment that our assigned impact ratings are too high, we again disagree (noting that these ratings are developed using the formula described for our negligible impact framework); however, absent any constructive recommendations relating to the development of the impact ratings or our framework overall, we cannot respond further.

Comment: The MMC recommends that NMFS evaluate the numbers of Level A harassment takes, in concert with the Level B harassment takes, using the negligible impact analysis framework.

Response: This comment appears based on a mistaken assumption that we ''assessed only the proposed Level B harassment takes'' in our negligible impact analyses. It is correct that we did not define quantitative metrics relating to amount of potential take by Level A harassment. However, as we state in the section entitled ''Negligible Impact Analyses and Determinations,'' the authorized taking by Level A harassment is so low as to not warrant such detailed analysis. We addressed the likely impacts of the minimal amount of takes expected by Level A harassment, stating that the expected mild PTS would not likely meaningfully impact the affected high-frequency cetaceans, and may have minor effects on the ability of affected low-frequency cetaceans to hear conspecific calls and/or other environmental cues. For all applicants, the expected effects of Level A harassment on all stocks to which such take may occur is appropriately considered de minimis.

Comment: NRDC claims that NMFS underestimates the ''magnitude'' component of the negligible impact analyses.

Response: NRDC suggests that the negligible impact framework used in our Notice of Proposed IHAs positions a ''de minimis'' amount of take as determinative of an ultimate ''de minimis'' impact rating. Although not stated explicitly by NRDC, we agree that this was inappropriate and have revised this aspect of our negligible impact framework. In effect, the proposed approach meant that a de minimis amount of take, which would necessarily lead to a de minimis magnitude rating, rendered considerations of likely consequences for affected individuals irrelevant. For example, mysticete whales with a de minimis amount of take were automatically assigned an overall de minimis impact rating, as consequences were considered not applicable in cases where a de minimis magnitude rating was assigned. However, the assessed level of potential consequences for individual baleen whales of ''medium''—which is related to inherent vulnerabilities of the taxon and other existing population stressors, and is therefore not dependent on the specific magnitude rating—would still exist, regardless of the amount of take. Under our revised approach, a mysticete whale with a de minimis amount of take is assigned a low impact rating, in light of the medium consequences rating. These changes are described further in the section entitled ''Negligible Impact Analyses and Determinations.''

NRDC asserts that impacts resulting from each of the five separate specified activities on the endangered North Atlantic right whale would be greater than negligible, stating that it is ''inconceivable'' that impacts should be considered anything less than ''high,'' regardless of the expected avoidance of right whales in time and space. We have addressed concerns regarding North Atlantic right whales in greater detail elsewhere in these comment responses. While we acknowledge that there will be some effects to individual right whales, as it is not possible to conduct these activities without the potential for impacts to whales that venture outside of areas where they are expected to occur or that undertake migration at atypical times, impacts to the population are in fact effectively minimized for each of these specified activities. As described later in this document, we have revised our exposure analysis for right whales using the latest and best available scientific information, and have appropriately revised our prescribed mitigation on the basis of that information, as well as public comment, in such a way as to reasonably avoid almost all potential right whale occurrence. We also include real-time mitigation that would minimize the effect of any disturbance on a right whale, in the unexpected event that an individual was encountered in the vicinity of a survey. Accordingly, the impact ratings for mysticetes are at least ''low'' versus ''de minimis'' (as stated above, we agree that the impact rating should likely be greater than de minimis given the inherent vulnerabilities of the species).

NRDC goes on to state that NMFS uses a ''non-conservative'' metric in characterizing the amount of take, and suggests that we should adopt Wood *et al.* (2012)'s more conservative approach for ESA-listed species. NRDC does not explain how this recommendation will better satisfy the statutory requirements of the MMPA. As stated by Wood *et al.* (2012), development of metrics for assessment of the magnitude of effect is considered particularly subjective. Rather than invent new metrics in the absence of any specific rationale or guidance, we retain use of those given by Wood *et al.,* which are produced through expert judgment. We disagree that the more conservative approach applied by Wood *et al.* (2012) for ESA-listed species is appropriate. We believe that the assessment of amount of take is a generic consideration, *i.e.,* that the metrics used to assess this factor are appropriately applied similarly to all species. Contextual factors, such as the status of the species, are applied elsewhere in the analysis, *e.g.,* through consideration of likely consequences to individuals or as a second-order function of the mitigation that is developed in reflection of specific concerns about a given species. NRDC's implication that we did not take account of vulnerable populations in our negligible impact framework is incorrect.

Comment: NRDC asserts that the evaluation of likely consequences to individuals from species other than mysticete whales in our negligible impact analyses is ''problematic.''

Response: Overall, NRDC basically provides a blanket suggestion that for all species impacts should be considered to be higher than we have determined after careful consideration of the available science. NRDC also repeatedly claims that we have provided no rational basis for our findings. While we acknowledge that we bear the responsibility to support our statutory findings, we believe we have satisfied that requirement and, further, NRDC does not provide adequate justification or evidence to support their claims.

For sperm whales, NRDC demands that the likely consequences to individuals be considered ''high'' rather than ''medium,'' as we have done (on the basis of presumed heightened potential for disruption of foraging activity). In so doing, NRDC primarily relies upon Miller *et al.* (2009), as has NMFS in assuming some heightened potential for foraging disruption. However, the evidence provided by the available literature is not nearly as clear as NRDC's comment implies. We agree that the work of Miller *et al.* (2009) indicates that sperm whales in the Gulf of Mexico are susceptible to disruption of foraging behavior upon exposure to relatively moderate sound levels at distances greater than the required general exclusion zone. However, NRDC misstates the results of the study in claiming that a nearly 20 percent loss in foraging success was documented. Rather, the authors report that buzz rates (a proxy for attempts to capture prey) were approximately 20 percent lower, meaning that the appropriate interpretation would be that foraging activity (versus foraging success) was reduced by 20 percent (Jochens *et al.,* 2008). This is an important distinction, as the former implies a cessation of activity—which may include increased resting bouts at the surface—during the relatively brief period that the surveys transit through the whale's foraging area, whereas the latter implies that the whale is continuing to expend energy in the hunt for food, without reward. Moreover, while we do believe that these results support our contention that exposure to survey noise can impact foraging activity, other commenters have interpreted them differently, *e.g.,* by focusing on the finding that exposed whales did not change behavioral state during exposure or show horizontal avoidance (a finding replicated in other studies, *e.g.,* Madsen *et al.,* 2002; Winsor *et al.,* 2017), or that the finding of reduced buzz rates was not a statistically significant result. In referencing Bowles *et al.* (1994), NRDC fails to state that the observed cessation of vocalization was likely in response to a low-frequency tone (dissimilar to airgun signals), though a distant airgun survey was noted as producing signals that were detectable above existing background noise. However, most importantly, we expect that the context of these transitory 2D surveys—as compared with 3D surveys that may occur for a longer duration in a given location, or with repeated survey activity as may occur in an area such as the Gulf of Mexico—means that the potential impacts of the possible reduction in foraging activity (*i.e.,* likely consequences on individuals) is limited. More recently, Farmer *et al.* (2018) developed a stochastic life-stage structured bioenergetic model to evaluate the consequences of reduced foraging efficiency in sperm whales, finding that the ultimate effects on reproductive success and individual fitness are largely dependent on the duration and frequency of disturbance—which are expected to be limited in relation to these specified activities. Thus, we believe our conclusion of ''medium'' likely consequences is appropriate.

With regard to *Kogia* spp., NRDC again suggests that NMFS must increase the level of assumed severity for likely consequences to individuals. While we agree that the literature with regard to kogiid life history is sparse, what literature is available (as cited in our Notice of Proposed IHAs) indicates that these species should be considered as having a reasonable compensatory ability when provoked to temporary avoidance of areas in the vicinity of active surveys. None of NRDC's statements on this topic support their contention that these consequences should be considered as more severe, *i.e.,* the notion that there is little information available regarding stock structure is not related to the likely consequences to individuals of disturbance. NRDC assumes that such temporary avoidance necessarily results in ''displacement from optimal to suboptimal habitat'' without any support. Moreover, it appears that NRDC misapprehends the conceptual underpinnings of our negligible impact analytical framework. The expected degree of disturbance (''take'') is determined in the ''Estimated Take'' section, and then is coupled with an understanding of the spatial and temporal scale of such disturbance relative to the stock range. Only then is this comprehensive magnitude rating combined with the expectation of the likely consequences of the given magnitude of effect to yield an overall impact rating that is then considered with other relevant contextual factors, such as mitigation and stock status, in informing the negligible impact determination (Figure 5). By seemingly conditioning its premise on the acoustically sensitive nature of kogiids, which is incorporated into the take estimates and accounted for in the mitigation requirements, NRDC would have us overly weight this aspect of their life history. Our assigned consequences for *Kogia* spp. is appropriate and based on the limited available literature.

Similarly, for delphinids (for which NRDC also urges a more severe assumption of likely consequence to individuals of the given disturbance), NRDC states that the consequences must be considered higher when the magnitude is high. Again, this is a misapprehension of the framework: The assigned ''consequences'' factor is independent of the magnitude rating, and is designed to account for aspects of a species life history that may make individuals from that species more or less susceptible to a biologically significant degree of impact from a given level of disturbance. NRDC's additional statements regarding delphinids appear to again cherry-pick available literature in support of its preferred position, *e.g.,* NRDC cites reactions of dolphins to Navy training involving explosive detonations (a dissimilar activity) and suggests that spotted dolphins are susceptible to greater disturbance on the basis of Weir (2008), claiming that this paper indicates ''pronounced response of spotted dolphins to operating airguns'' and supposedly heightened sensitivity. We do agree that the available observational data (*e.g.,* Barkaszi *et al.,* 2012; Stone, 2015a) show that, in contrast to common anecdotal statements suggesting that dolphins do not react at all to airgun noise, dolphins overall show increased distances to the noise source or even avoidance when airguns are operating. However, as stated elsewhere, these reactions may not even be appropriately considered as take (*e.g.,* Ellison *et al.,* 2012), much less take to which some meaningful biological significance should be assigned. In fact, Weir (2008) concludes that, while spotted dolphin encounters occurred at a significantly greater distance from the airgun array when the guns were firing, there was no evidence of displacement from the study area, indicating that even for this supposedly more sensitive species, greater likely consequences would not be expected. As indicated by Weir (2008), these responses may be short-term and also occur over relatively short ranges from the source.

NRDC concludes its criticism of this aspect of our negligible impact analyses by demanding that we weight this assessment of likely consequences to individuals more highly in the determination of the overall impact rating. However, this appears to again evidence a misapprehension of our framework and its function. We certainly agree that an activity that is found to take small numbers of marine mammals may not be found to satisfy the negligible impact standard. However, here, as in their criticism of NMFS's approach to the small numbers analysis, NRDC inappropriately conflates the two findings. Here, NRDC seems to confuse a low magnitude of effect with the independent small numbers finding, rather than understand this magnitude factor as an important input to the development of the impact rating. As described in greater detail in our section entitled ''Negligible Impact Analyses and Determinations,'' the impact rating represents the coupling of the magnitude rating and the likely consequences to individuals in order to represent the potential impact to the stock (before considering other contextual factors). Therefore, although the likely consequences to individuals of incidental take may be high, if the magnitude of effect is low, then the impact to the stock will not likely be high. NRDC's example indicates that it prefers that the likely consequences to individuals be determinative of the impact rating, *i.e.,* they state that it is inappropriate for a low magnitude rating and high consequences rating to couple to produce a moderate impact rating. Our development of these rating matrices (Tables 8 and 9) are based on expert review (Wood *et al.,* 2012) and appropriately account for the factors illustrated in Figure 5.

Comment: NRDC claims that the negligible impact analyses are inappropriately reliant upon the prescribed mitigation and, further, that the mitigation will be ineffective.

Response: First, NMFS did not rely solely on the mitigation in order to reach its findings under the negligible impact standard. As is stated in our specific analyses, consideration of the implementation of prescribed mitigation is one factor in the analyses, but is not determinative in any case. In certain circumstances, mitigation is more important in reaching the negligible impact determination, *e.g.,* when mitigation helps to alleviate the likely significance of taking by avoiding or reducing impacts in important areas. Second, while NRDC dismisses the importance of our prescribed mitigation by stating that it is ''unsupported by evidence,'' NRDC offers no support for their conclusions.

For example, with regard to the North Atlantic right whale, consideration of the mitigation in our negligible impact analyses was appropriate. That is, it was appropriate to weigh heavily in our analyses mitigation that would avoid most exposures of right whales to noise at levels that would result in take. We acknowledge that our proposed mitigation for right whales was not sufficient. As described in greater detail in previous comment responses, as well as in the section entitled ''Mitigation,'' we re-evaluated our proposed mitigation in light of the public comments we received and on the basis of the best available information.

NRDC elsewhere stresses the importance of developing appropriate habitat-based mitigation—that is, avoiding impacts in areas of importance for marine mammals—and not relying solely on ''real-time'' mitigation (*e.g.,* shutdowns) that allows impacts in those areas but minimizes the duration and intensity of those impacts. Yet despite our development of time-area measures for those species where the available information supports it, NRDC discounts the benefit of avoiding disturbance of sensitive and/or deep-diving species in areas where they are expected to be resident in greatest numbers. Claims that our prescribed time-area restrictions are ineffective and ''unsubstantiated''—and therefore apparently should not be considered in our negligible impact analyses—are contradicted by NRDC's statements that habitat-based mitigation are necessary (''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.'' (Citing p. 61 of NRDC's letter)). However, our revised time-area restriction for right whales (or requirement that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore) may have alleviated some of the concerns expressed in the comment.

NRDC also misunderstands the degree to which we rely on shutdowns for sensitive or vulnerable species, including right whales and beaked whales, at extended distances. We agree that these measures in and of themselves are not likely to carry substantial benefit, especially for cryptic species such as beaked whales that are unlikely to be observed. The prescribed habitat-based mitigation, *i.e.,* time-area restrictions, is obviously more important in minimizing impacts to these species. However, having determined practicability, we also believe that it makes sense to minimize the duration and intensity of disturbance for these species when they are observed, and so include them in the suite of prescribed measures and discuss them where appropriate. Despite their dismissal of these requirements, we presume NRDC agrees that the duration and intensity of disturbance of sensitive species should be minimized where practicable.

In summary, we have prescribed practicable mitigation that largely eliminates takes of North Atlantic right whales, as indicated by the best available science and further minimizes impacts by mitigating for duration and intensity of exposures. Separately, we have developed mitigation that protects use of some of the most important habitat in the region for other sensitive species. We consider these measures appropriately as mitigating factors in the context part of our negligible impact analyses.

Comment: Oceana asserts that our findings of negligible impact are improper. In so doing, they make points that are substantively responded to elsewhere in these comment responses. In addition, they also make repeated reference to the PBR value, claiming that where harassment takes exceed the PBR value for a stock, NMFS must deny the IHA request for failure to meet the negligible impact standard.

Response: We reiterate that the PBR metric concerns levels of allowable removals from a population, and is not directly related to an assessment of negligible impact for these specified activities, which do not involve any expected potential for serious injury or mortality. As noted previously, PBR is not an appropriate metric with which to evaluate Level B harassment and NMFS has described and used an analytical framework that is appropriate. We appropriately do consider levels of ongoing anthropogenic mortality from other sources, such as commercial fisheries, in relation to calculated PBR values as an important contextual factor in our negligible impact analysis framework, but a direct comparison of takes by harassment to the PBR value is not germane. While it is conceptually possible to link disturbance to potential fitness impacts to individuals over time (*e.g.,* population consequences of disturbance), we have no evidence that is the case here.

Small Numbers

Comment: The MMC and multiple commenters recommend that NMFS provide additional explanation to support its selection of the 30-percent limit on marine mammal taking as meeting the small numbers determination for the proposed authorizations. NRDC states that the interpretation of ''small numbers'' presented by NMFS in our Notice of Proposed IHAs is contrary to the plain meaning and purpose of the MMPA, in part because NMFS did not provide a reasoned basis for the take limit proposed (*i.e.,* 30 percent) (MMC and others similarly recommended that NMFS provide additional explanation to support its selection of the 30-percent limit on marine mammal taking as meeting the small numbers determination for the proposed authorizations). NRDC makes four specific claims. First, NRDC states that 30 percent cannot be considered a ''small number.'' Second, NRDC states that Congress intended that takes be limited to ''infrequent, unavoidable'' occurrences, and that NMFS has not explained why the taking would infrequent or unavoidable. Third, NRDC contends that NMFS should define different small numbers thresholds on the basis of conservation status of individual species. Finally, NRDC believes that NMFS must account for ''additive and adverse synergistic effects'' that may occur due to multiple concurrent surveys in conducting a small numbers analysis.

Response: NMFS agrees that the Notice of Proposed IHAs did not provide adequate reasoning for the 30 percent limit. Please see the ''Small Numbers Analyses'' section of this Notice. However, we disagree with NRDC's arguments on this topic. Although NMFS has struggled to interpret the term ''small numbers'' given the limited legislative history and the lack of a biological underpinning for the concept, we have clarified and better described our approach to small numbers. As discussed in the section entitled ''Small Numbers Analyses,'' we describe that the concept of ''small numbers'' necessarily implies that there would also be quantities of individuals taken that would correspond with ''medium'' and ''large'' numbers. As such, we have established that one-third of the most appropriate population abundance number—as compared with the assumed number of individuals taken—is an appropriate limit with regard to ''small numbers.'' This relative approach is consistent with Congress's statement that ''[small numbers] is not capable of being expressed in absolute numerical limits'' (H.R. Rep. No. 97–228).

NRDC claims that a number may be considered small only if it is ''little or close to zero'' or ''limited in degree.'' While we do not accept that a dictionary definition of the word ''small'' is an acceptable guide for establishment of a reasoned small numbers limit, we also note that NRDC cherry-picks the accepted definitions in support of its favored position. The word ''small'' is also defined by Merriam-Webster Dictionary as ''having comparatively little size,'' which comports with the small numbers interpretation developed by NMFS and offered here. See *www.merriam-webster.com/dictionary/small.* NRDC cherry-picks the relevant language by claiming that Congress intended that the agency limit takes to those that are ''infrequent, unavoidable'' occurrences. The actual Congressional statement is that taking of marine mammals should be ''infrequent, unavoidable, or accidental.'' This language implies that allowable taking may in fact be frequent if it is unavoidable or accidental, both of which are the case, even though, in the case of a large-scale, sound-producing activity in areas where marine mammals are present, the takes are not ''infrequent.''

The argument to establish a small numbers threshold on the basis of stock-specific context is unnecessarily duplicative of the required negligible impact finding, in which relevant biological and contextual factors are considered in conjunction with the amount of take.

Similarly, NRDC's assertion that take from multiple specified activities should be considered in additive fashion when making a small numbers finding is not required by section 101(a)(5)(D) of the MMPA. We are unclear whether the logic presented in this comment suggests only that a single small numbers analysis should be undertaken for the five separate specified activities considered herein, or whether NRDC believes that all ''taking'' to which a given stock may be subject from all ongoing anthropogenic activities should be considered in making a small numbers finding for a given specified activity. Regardless, these suggestions from NRDC are not founded in any relevant requirement of statute or regulation, discussed in relevant legislative history, or supported by relevant case law.

Comment: The MMC recommends that, in developing generally applicable guidance for using a proportional standard to make small numbers determinations, NMFS either use a sliding scale that accounts for the abundance of the species or stock or explain why it believes that a single standard should be applied in all cases. The MMC offers two examples, on either end of a spectrum, in illustrating its point. First, MMC provides the example of a small population of marine mammals, stating that ''taking the entire population may arguably constitute a small number.'' Second, the MMC provides the example of a large population of marine mammals, stating that ''certain types of taking from large populations . . . push the limit of what reasonably may be considered a small number.''

Response: NMFS disagrees that such a ''sliding scale'' is necessary or appropriate. Under the ''one-third'' interpretation offered here, and on which we base our small numbers analyses, take equating to greater than one-third of the assumed individuals in the population would not be considered small numbers, other than in certain extenuating circumstances, such as the brief exposure of a single group of marine mammals (as is authorized herein for each applicant for such species as the killer whale). In both of the MMC's examples, the MMC evidently reverts to an absolute magnitude of the number on the ends of the spectrum, without regard for the amount of individuals taken relative to the size of the population. Historically, such an approach may have served as a meaningful limit on actual removals from a population, prior to the development of the PBR metric, but is not a useful consideration when evaluating takes by Level B harassment from sound exposure. There is no meaningful way to define what should be considered as a ''small'' number on the basis of absolute magnitude, and the MMC offers no such interpretation or justification.

Comment: The Associations provide a discussion of several topics relating to ''small numbers'' and recommend that NMFS's small numbers findings be thoroughly explained in the record for these actions.

Response: We agree that the basis for each finding should be explained. Please see our revised explanation in ''Small Numbers Analyses.''

Comment: Oceana claims that NMFS is in violation of the MMPA's ''small numbers'' requirement for a variety of reasons, including that we authorize takes of the ''critically endangered'' North Atlantic right whale and because we authorize takes of species for which there are no available abundance estimates, and relates the potential biological removal metric to the small numbers finding. Oceana and many other commenters also make reference to a supposed ''Federal court defined'' take limit of 12 percent of the appropriate stock abundance.

Response: The reference to a ''Federal court defined'' take limit of 12 percent for small numbers likely comes from a 2003 district court opinion (*Natural Resources Defense Council* v. *Evans,* 279 F.Supp.2d 1129 (N.D. Cal. 2003)). However, given the particular administrative record and circumstances in that case, including the fact that our small numbers finding for the challenged incidental take rule was based on an invalid regulatory definition of small numbers, we view the district court's opinion regarding 12 percent as *dicta.* Moreover, since that time the Ninth Circuit Court of Appeals has upheld a small numbers finding that was not based on a quantitative calculation. *Center for Biological Diversity* v. *Salazar,* 695 F.3d 893 (9th Cir. 1012). Second, while we agree that there are stocks for which no abundance estimate is presented in NMFS's SARs, there are other available abundance estimates for all impacted stocks. However, more importantly, there is no requirement in the MMPA to authorize take only for stocks with available abundance estimates, or even that a small numbers finding must necessarily be based on a quantitative comparison to stock abundance. We are required only to use the best available scientific information in making a small numbers finding; this information may be quantitative or qualitative, and may relate to relevant stock information other than its overall abundance. Finally, the PBR metric defines a level of removals from a population (*i.e.,* mortality) that would allow that population to remain at its optimum sustainable population level or, if depleted, would not increase the population's time to recovery by more than 10 percent. We reiterate that it is inappropriate to make comparisons between takes by harassment and the PBR value for any stock.

Comment: The MMC recommends that NMFS include both the numbers of Level A and B harassment takes in its analysis of small numbers.

Response: We agree that this is appropriate and have done so. Please see ''Small Numbers Analyses,'' later in this document, for full detail.

Comment: TGS states that NMFS should better explain what it views as the most appropriate abundance estimate for each stock.

Response: Please see our revised discussion of this topic in the section entitled, ''Description of Marine Mammals in the Area of the Specified Activities.''

Comment: Several commenters described problems with NMFS's proposed approach to ensuring that actual take estimates remained below the small numbers threshold proposed in our Notice of Proposed IHAs, *i.e.,* a requirement for monthly interim reporting and a proposed process by which companies would correct observations of marine mammals to obtain an estimate of total takes.

Response: We agree with many of the points raised by commenters. However, we discuss only the fundamental underlying issue here, *i.e.,* our proposed small numbers analyses, which did not fully utilize all the information that was available to refine the number of individuals taken and prompted development of a proposed reporting scheme that was roundly criticized. The small numbers analyses, described in our Notice of Proposed IHAs, resulted in erroneous assessments that enumerated take estimates for some applicants and some species would exceed the proposed small numbers threshold. In order to ensure that the proposed threshold would not be exceeded, we proposed that applicants would submit monthly interim reports, including estimates of actual numbers of takes (proposed to be produced via correction of numbers of observed animals for certain biases using factors described in Carr *et al.* (2011)), such that an authorization could be revoked if actual take exceeded the proposed small numbers threshold. While we believe it is appropriate to correct such observations in order to best understand the actual number of takes (discussed elsewhere in these comment responses), we agree that this proposal was inappropriate, *i.e.,* that NMFS should not issue an incidental take authorization for an activity for which a small numbers threshold is expected to be exceeded. Additionally, such an approach results in a clearly impracticable situation for applicants, who commit substantial expenditure towards conducting a given survey plan, but who then may be allowed to complete only a portion of the plan.

In summary, as a result of our review of public comments, we re-evaluated the relevant available information and produced revised small numbers analyses (see ''Small Numbers Analyses,'' later in this document). The revised small numbers analyses alleviated the need for the proposed take reporting scheme and cap, which were also challenged by multiple applicant and public commenters.

Mitigation, Monitoring, and Reporting

Comment: NRDC states that year-round closure is required in the area off Cape Hatteras. This recommendation was also made by a group of scientists from the University of North Carolina-Wilmington (D.A. Pabst, W.A. McLellan, and A.C. Johnson; hereafter, ''Pabst *et al.*'').

Response: In this case, NRDC presents substantial evidence of the year-round importance of this habitat to marine mammals (evidence cited by NMFS in proposing the area as a seasonal closure); we agree that this habitat is of year-round importance. We did not base the development of this area as a seasonal restriction because of some assumption that the area is only important for a portion of the year (though the specific seasonal timing is based on increased density of sperm whales; see ''Mitigation''). Rather, our development of this area as a seasonal restriction was in consideration of practicability under the MMPA's least practicable adverse impact standard. We believe NRDC's comment inappropriately minimizes the element of practicability in a determination of the measures that satisfy the standard. In this case, the area is of critical interest to all applicants—based on the dated historical survey information from the region, this area is considered to potentially be most promising in terms of hydrocarbon reserves. Therefore, an absolute proscription on any given applicant's ability to collect data in this area would be impracticable. In such a case where practicability concerns would preclude inclusion of an otherwise valid measure, the measure must be necessary to a finding of negligible impact (*i.e.,* the negligible impact determination cannot be made and the authorization may not be issued absent the measure) in order to supersede the practicability concerns. While NRDC presents substantial evidence of the importance of this area for the marine mammals that use it, they do not grapple with the practicability question or justify why the closure must be year-round for a negligible impact determination to be made.

We disagree with NRDC's apparent contention that surveys conducted in this region are likely to result in the death of resident beaked whales. As we discussed in our Notice of Proposed IHAs, we recognize the importance of the concepts described in Forney *et al.* (2017), *i.e.,* that for resident animals, it is possible that displacement may lead to effects on foraging efficiency that could impact individual vital rates. However, no evidence is presented that severe acute impacts are a reasonably anticipated outcome for surveys that will pass through such habitat in a matter of days.

We also disagree with NRDC's summary dismissal of the benefit of completely restricting survey activity in the habitat for a portion of the year. The benefit of a restriction targeting resident animals is sensibly scaled to the duration of the restriction and/or the timing of the restriction in relation to reproductive behavior. However, we believe that a full season without acute noise exposure, at minimum, for those animals will provide meaningful benefit, including but not limited to avoidance of the stress responses of concern to NRDC elsewhere in their comments.

Comment: Regarding NMFS's proposed time-area restriction in waters off Cape Hatteras, Pabst *et al.* state that recent data from acoustic monitoring suggest that sperm whales are more abundant in this area during winter.

Response: NMFS's initial proposal was to require implementation of this restriction from July through September, in recognition of the limited available visual survey data. As noted by commenters, visual survey data do suggest that sperm whales are most common in the Cape Hatteras region in summer (Roberts *et al.,* 2016). The commenters go on to note, however, that more recently available acoustic monitoring data indicates that the highest number of sperm whale detections were made in winter when visual survey effort was most limited (Stanistreet *et al.,* 2018). While we disagree with the commenters' larger point, *i.e.,* that the ''Hatteras and North'' restriction should be in effect year-round (addressed in previous comment response), we agree with their interpretation of the data that sperm whales are more abundant in winter. Upon review of this newly available data, we determined it appropriate to revise the timing of this restriction to January through March, as described in ''Mitigation.''

Comment: NRDC, the MMC, and multiple other commenters state that NMFS must expand protection of North Atlantic right whale habitat. Many commenters referred to the spatial aspect of the proposed restriction, though some commenters also referred to the temporal aspect.

Response: We agree with the comments referencing the spatial designation, and we are spatially expanding the seasonal restrictions intended to protect right whale migratory habitat, in addition to reproductive habitat and for general protection of right whales (or requiring that comparable protection is achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore). Our determination in this regard and development of this expanded protection are described in greater detail elsewhere in these comment responses, as well as in the section entitled ''Mitigation.'' However, we disagree that the available evidence supports expansion of this area temporally. Pabst *et al.,* in recommending a temporal expansion, reference an analysis of the composition and distribution of individual right whale sightings archived by the North Atlantic Right Whale Consortium from 1998 through 2015 performed by one of the comment authors. While this analysis (as well as more recent acoustic monitoring data; *e.g.,* Davis *et al.* (2017)) suggests that right whales are present in the area in all months of the year, it also shows that very few occurred outside of the time window and outside of the year-round 30-km coastal restriction. During this period, only five archived sightings occurred outside of the November through April period and outside of 30 km from shore. Further, it would be impracticable to completely close this area to survey activity year-round. As we have acknowledged, it is possible that whales will be present beyond this area, or that whales will be present within this area but at times outside when migration is expected to occur. However, we base the time-area restriction on our best understanding of where and when most whales will be expected to occur.

Comment: Several industry commenters provided comments regarding NMFS's proposed exception to shutdown requirements for certain species of dolphin. The Associations stated that, while they appreciate the exception, it should apply to all dolphin species, regardless of behavior. They add that no shutdowns for dolphins are warranted. CGG also criticized the proposed behavior-based exception, instead suggesting that a power-down requirement be applied as an alternative. CGG favorably stated that such a requirement would ''allow for a tolerable hole in the acquired seismic data and will not require the vessel to immediately terminate the survey line and carry out a six hour circle for infill'' and that use of power-downs rather than shutdowns in these circumstances would result in substantial savings in operating costs. TGS stated simply that NMFS ''should consider clarifying and better addressing bow-riding dolphins'' and also recommended that NMFS clarify and better define how to determine if animals are stationary (in reference to NMFS's proposed behavior-based requirements for dolphins).

Response: Following review of the available information and public comments, NMFS agrees that a general exception to the standard shutdown requirement is warranted for small delphinids, without regard to behavior. We agree with TGS and other commenters that the intended behavior-based exception was poorly defined. However, we do not agree that the available evidence supports certain commenters' assertions that seismic surveys do not have any adverse effects on dolphin species. As discussed in ''Mitigation,'' auditory injury is not expected for dolphins, but the reason for dolphin behavior around vessels (when they are attracted) is not understood and cannot be assumed to be harmless. In fact, the analyses of Barkaszi *et al.* (2012), Stone (2015a), and Stone *et al.* (2017) show that dolphins do avoid working vessels.

That said, the available information does not suggest that such reactions are likely to have meaningful energetic effects to individuals such that the effectiveness of such measures outweighs the practicability concerns raised by commenters, in terms of the operational costs as well as the difficulty of implementation. All variations of a conditional shutdown exception proposed to date (by either NMFS or BOEM) that include exceptions based on animal behavior have been criticized, in part due to the subjective on-the-spot decision-making such schemes would require of PSOs. NMFS finds these criticisms warranted. If the mitigation requirements are not sufficiently clear and objective, the outcome may be differential implementation across surveys as informed by individual PSOs' experience, background, and/or training. Therefore, the removal of such measures for small delphinids is warranted in consideration of the available information regarding the effectiveness of such measures in mitigating impacts to small delphinids and the practicability of such measures.

As noted above, one commenter suggested that a power-down requirement would be practicable (though we note that this alternative was offered against the backdrop of broader claims that no measures should be required). We considered modifying the behavior-based shutdown requirement contained in our proposed IHAs to CGG's suggested general power down requirement. However, following consultation with applicants and with BOEM, we determined that the circumstances of this particular commenter (CGG) with regard to practicability may not be broadly transferable, and that a power down requirement would potentially lead to the need for termination of survey lines and infill of the line where data were not acquired if a power down was performed according to accepted practice, in which the power down condition would last until the dolphin(s) are no longer observed within the exclusion zone. As noted in our Notice of Proposed IHAs, the need to revisit missed track line to reacquire data is likely to result in an overall increase in the total sound energy input to the marine environment and an increase in the total duration over which the survey is active in a given area.

We disagree with comments that no shutdown requirements should apply to any delphinid species, regardless of behavior. Here we refer to ''large delphinids'' and ''small delphinids'' as shorthand for generally deep-diving versus surface-dwelling/bow-riding groups, respectively, although the important distinction is their dive behavior rather than their size. As noted above, industry commenters have asserted that no shutdown requirements are warranted for any species of dolphin, stating that the best available science does not support imposing such requirements. The comments acknowledge that small delphinids are more likely to approach survey vessels than large delphinids, but claim without supporting data that there is no evidence that large delphinids will benefit from a shutdown requirement. In contrast to the typical behaviors of (and observed effects on) the small delphinid species group, the typical deep diving behavior of the relatively rarely occurring large delphinid group of species makes these animals potentially susceptible to interrupted/delayed feeding dives, which can cause energetic losses that accrue to affect fitness. As described in greater detail elsewhere in this Notice, there are ample data illustrating the responses of deeper diving odontocetes (including large delphinids) to loud sound sources (including seismic) to include interrupted foraging dives, as well as avoidance with increased speed and stroke rate, both of which may contribute to energetic costs through lost feeding opportunities and/or increased energy demands. Significant advances in study of the population consequences of disturbance are informing our understanding of how disturbances accrue to effects on individual fitness (reproduction and survival) and ultimately to populations via the use of energetic models, where data are available for a species, and expert elicitation when data are still limited. The link between behavioral disturbance, reduced energy budgets, and impacts on reproduction and survival is clear, as is the value in reducing the probability or severity of these behavioral disturbances where possible. Therefore, we find that there is support for the effectiveness of the standard shutdown requirement as applied to the large delphinid species group.

Further, the claim of industry commenters that shutdowns for these deep-diving species would be impracticable was not accompanied by supporting data. The data available to NMFS demonstrates that this requirement is practicable. For example, Barkaszi *et al.* (2012)'s study of observer data in the Gulf of Mexico from 2002–08 (1,440 bi-weekly reports) shows that large delphinids were sighted on only 1.4% of survey days, and that of these sightings, only 58% were within the 500-meter exclusion zone.

Comment: Many commenters expressed concern regarding the efficacy of the prescribed visual and acoustic monitoring methods, stating that species could go undetected. Some commenters offer specific recommendations for changes to staffing requirements. Finally, some of these commenters state that NMFS should require operators to cease work in low-visibility conditions, because of the difficulty in detecting marine mammals in such conditions.

Response: While we disagree with some specific comments regarding efficacy, we agree with the overall point that there are limitations on what may reasonably be expected of either visual or acoustic monitoring. While visual and acoustic monitoring effectively complement each other, and acoustic monitoring is the most effective monitoring method during periods of impaired visibility, there is no expectation that such methods will detect all marine mammals present. In general, commenters appear to misunderstand what we claim with regard to what such monitoring may reasonably be expected to accomplish and/or the extent to which we rely on assumptions regarding the efficacy of such monitoring in reaching the necessary findings. We appropriately acknowledge these limitations in prescribing these monitoring requirements, while stating why we believe that visual and acoustic monitoring, and the related protocols we have prescribed, are an appropriate part of the suite of mitigation measures necessary to satisfy the MMPA's least practicable adverse impact standard. However, our findings of negligible impact and/or small numbers are in no way conditioned on any presumption of monitoring efficacy. With regard to specific staffing requirements, those prescribed herein are based on typical best practices and on review of all available literature concerning such practices. Commenters do not offer compelling information that their proffered recommendations achieve the appropriate balance between enhancement of monitoring effectiveness and the costs (including both monetary costs as well as costs in terms of berth space), and we retain the requirements originally specified. Finally, any requirement to cease operations during low visibility conditions, including at night, would not only be plainly impracticable, it would also likely result in greater impacts to marine mammals, as such a measure would require operations to continue for roughly twice the time.

Such comments do not align with the principles we laid out in the ''Proposed Mitigation'' section of our Notice of Proposed IHAs, in which we discussed the definitively detrimental effects of increased time on the water and/or increased or unnecessary emission of sound energy into the marine environment, versus the potential and uncertain negative effect of proceeding to most efficiently conclude survey activity by conducting operations even in low visibility conditions.

Comment: NRDC asserts that NMFS does not fulfill the MMPA's requirement to prescribe mitigation achieving the ''least practicable adverse impact'' to marine mammal habitat, and specifically notes that NMFS does not separately consider mitigation aimed at reducing impacts to marine mammal habitat, as the MMPA requires.

Response: We disagree. Our discussion of least practicable adverse impact points out that because habitat value is informed by marine mammal presence and use, in some cases there may be overlap in measures for the species or stock and for use of habitat. Here we have identified time-area restrictions based on a combination of factors that include higher densities and observations of specific important behaviors of the animals themselves, but also clearly reflect preferred habitat. In addition to being delineated based on physical features that drive habitat function (*e.g.,* bathymetric features, among others), the high densities and concentration of certain important behaviors (*e.g.,* feeding) in these particular areas clearly indicates the presence of preferred habitat. Also, NRDC asserts that NMFS must ''separately'' consider measures aimed at marine mammal habitat. The MMPA does not specify that effects to habitat must be mitigated in separate measures, and NMFS has clearly identified measures that provide significant reduction of impacts to both ''marine mammal species and stocks and their habitat,'' as required by the statute. Last, we note that NRDC acknowledges that NMFS's measures would reduce impacts on ''acoustic habitat.''

Comment: The MMC recommended that, if NMFS is to require a time-area restriction to protect spotted dolphins in shelf waters, the restriction should be expanded from June through August to June through September. This recommendation was made on the basis of spotted dolphins likely being most abundant in this area during summer. Similarly, TGS stated that NMFS should better support its determination of seasonality for the proposed restriction.

Response: Following review of public comments, NMFS determined that this proposed time-area restriction was unlikely to be effective in accomplishing its intended purpose, while imposing practicability costs on applicants. As explained in greater detail in the ''Mitigation'' section, we have eliminated this proposed requirement. Therefore, the MMC's recommendation is no longer relevant.

Comment: NRDC states that NMFS must require larger buffer zones around the required time-area restrictions. TGS stated that NMFS should better support its choice of 10 km as a buffer distance.

Response: NRDC provides several reasons why they believe that the required standard 10-km buffer zones are insufficient. NRDC claims several supposed ''erroneous and misplaced assumptions'' in the sound field modeling that informs our standard buffer zone, which we have refuted elsewhere in these comment responses. More substantively, NRDC returns again to its suggestion that a different threshold must be used to represent Level B harassment. We have also addressed this comment elsewhere. Here, we reiterate that BOEM's sound field modeling, which was conducted in accordance with the best available scientific information and methods, and which remains state-of-the-science, indicates that the mean distance (considering 21 different scenarios combining water depth, season, and bottom type) to the 160-dB isopleth would be 6,838 m (range 4,959–9,122 m). Our required 10-km buffer is appropriate in conservatively accounting for the potential for sound exceeding the 160-dB isopleth.

Comment: NRDC stated that in order to adequately develop habitat-based protections for marine mammals, NMFS should, in addition to consideration of Roberts *et al.* (2016) and other relevant information, follow certain guidelines to protect baleen whale stocks and other marine mammals: (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. Although NRDC's recommendation is unclear, we assume that the commenter intends that we designate such areas as year-round closures to survey activity.

Response: NMFS relied on the best available scientific information (*e.g.,* Stock Assessment Reports, Roberts *et al.,* 2016, 2017; numerous study reports from Navy-funded monitoring and research in the specific geographic region) in assessing density, distribution, and other information regarding marine mammal use of habitats in the study area. In addition, NMFS consulted LaBrecque *et al.* (2015), which provides a specific, detailed assessment of known Biologically Important Areas (BIA). Although BIAs are not a regulatory designation, the assessment is intended to provide the best available science to help inform regulatory and management decisions about some, though not all, important cetacean areas. BIAs, which may be region-, species-, and/or time-specific, include reproductive areas, feeding areas, migratory corridors, and areas in which small and resident populations are concentrated. Because the BIA assessment may not include all important cetacean areas, NMFS went beyond this evaluation in conducting a core abundance analysis for all species on the basis of the Roberts *et al.* (2016) cetacean density models (described in detail in our Notice of Proposed IHAs). NMFS then weighed the results of the core abundance analysis for each species in context of the anticipated effects of each specified activity, other stressors impacting the species, and practicability for the applicants in determining the appropriate suite of time-area restrictions (see ''Mitigation''). Outside of these time-area restrictions, NMFS is not aware of any evidence of other habitat areas of particular importance, or of any compelling evidence that the planned time-area restrictions should be modified in any way when benefits to the species and practicability for applicants are considered together.

Regarding NRDC's recommended guidelines, we disagree that these would be appropriate for use in determining habitats for protection in this circumstance. The guidelines come from a white paper (''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions'') written by NMFS scientists for consideration in identifying such areas in relation to mitigation development for the incidental take rule governing the U.S. Navy's Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar activities, which was applicable for much of the world's oceans, including in many so-called data-poor areas. NMFS convened a panel of subject matter experts tasked with helping to identify areas that met our criteria for offshore biologically important areas (OBIAs) for marine mammals relevant to the Navy's use of SURTASS LFA sonar, and the white paper offered guidance on alternate methods for considering data-poor areas, in view of the fact that data on cetacean distribution or density do not exist for many areas of the world's oceans. However, such is not the case for the specific geographic region considered here. In fact, the white paper was specifically developed to provide methods for data-poor areas as an alternative to use of a global habitat model (Kaschner *et al.,* 2006) when such use was determined to result in both errors of omission (exclusion of areas of known habitat) and commission (inclusion of areas that are not known to be habitat). Here, we do not face the same lack of data sufficient to inform the designation of appropriate habitat-based restrictions. As described previously, we made use of advanced habitat-based predictive density models, an existing assessment of BIAs in the region, and a substantial body of data from monitoring and research concerning cetacean distribution and habitat use in sensitive areas of the region. Finally, were we to follow NRDC's apparent recommendation in closing all of the areas covered by the guidelines to survey activity, the resulting mitigation would not be practicable for applicants, as a substantial portion of the planned survey area would not be available.

Comment: NRDC states that NMFS should consider time-area closures for additional species.

Response: We did consider habitat-based protections for species additional to those discussed in the time-area restrictions section of ''Mitigation.'' For all affected species, we evaluated the environmental baseline (*i.e.,* other population-level stressors), the nature and degree of effects likely to be the result of the specified activities, and the information available to support the development of appropriate time-area restrictions. We determined that the available information supported development of the measures for the North Atlantic right whale, sperm whales, beaked whales, and pilot whales. For other species, context does not justify additional protections and/or the available information does not support the designation of any specific area for protection. NRDC suggests that such measures should be developed for the humpback whale, sei whale, fin whale, and blue whale. However, NRDC neither adequately justifies the recommendation, offering only cursory reference to the ongoing humpback whale UME (but not referencing the otherwise strong health of the West Indies DPS) and summarily providing dire conclusions regarding the supposed effects on all baleen whales, notwithstanding that at least two of these species (the sei whale and blue whale) are anticipated as being unlikely to experience any meaningful impacts from the specified activities. We addressed NRDC's recommended use of a 2010 ''white paper'' in the previous comment response; other than this apparent recommendation that nearly the entirety of the survey area (*e.g.,* continental shelf waters and waters 100 km seaward of the continental slope; waters within 100 km of all islands and seamounts that rise within 500 m of the surface; and high productivity regions not included under the previous two guidelines) be declared as a protected area, NRDC offers no useful recommendation as to the designation of protections for these species. Our development of habitat-based protections was conducted appropriately in light of relevant information regarding the environmental baseline, expected effects of the specified activities, and information regarding species use of the planned survey area.

Comment: NRDC states that our development of time-area restrictions was performed inadequately, and Pabst *et al.* also challenged our use of core abundance areas. TGS stated that we should better support our use of the 25 percent core abundance area in determining the time-area restrictions, and that we should better describe our consideration of practicability.

Response: NRDC's primary complaint is that our use of the ''core abundance area'' concept was inadequate, and other commenters appear to believe that the core abundance area was the determining factor in the delineation of restriction areas. These comments misapprehend our use of core abundance areas, as we did not use the core abundance areas to define habitat-based protections. To clarify, these core abundance areas did not define the designated time-area restrictions, but rather informed and supported our definition of the appropriate areas. Further, there is no ''correct'' answer regarding the proportion of core abundance that should inform development of habitat-based protections. In part, our analysis of core abundance areas defined by varying proportions of the population simply helped us to adequately visualize areas within the specific geographic region that would reasonably be expected to protect a substantive portion of the population within a relatively well-defined area. In some cases, this helped to confirm that stable habitat, *i.e.,* habitat defined by bathymetric features rather than dynamic oceanographic characteristics and which would be expected to provide important habitat to certain species, is indeed predicted to host high abundance of these species.

NRDC's comment regarding the sperm whale is illustrative. NRDC refers simply to the 5 percent core abundance area for sperm whales as ''entirely inadequate.'' However, when analyzing multiple different core abundance areas for the species, we find that it is predicted as being broadly distributed over slope waters throughout much of the year, *i.e.,* there is little discrete habitat defined in a way that is suitable for protection through a restriction on effort. Therefore, we did not define the protections on the sole basis of the core abundance area analysis. Rather, the core abundance area analysis helped to highlight that sperm whales should be expected to be present year-round in certain deepwater canyons (which also provide important habitat for beaked whales); the spatial definition of these areas does not in fact align with the predicted core abundance area, but rather with the bathymetric features that provide the conditions that lead to the predictions of high abundance in the first place, as is appropriate. Separately, the 5 percent core abundance area highlighted that, in contrast with the broad slope area over which sperm whales are generally expected to occur, a discrete area off of Cape Hatteras (*i.e.,* ''The Point'') would be expected to provide attractive habitat to sperm whales throughout the year, thus enabling us to include this area, with other areas of importance for the sperm whale and other species, in the conglomerate ''Hatteras and North'' (Area #4).

Our definition of the Hatteras and North area was primarily informed by review of the available literature (as described in our Notice of Proposed IHAs), which shows that, for example, beaked whales are consistently present in particular waters of the shelf break region at all times of year (*e.g.,* McLellan *et al.,* 2018; Stanistreet *et al.,* 2017); relatively high numbers of sperm whales are present off of Cape Hatteras year-round (but particularly in the winter) (Stanistreet *et al.,* 2018); and pilot whales have a strong affinity for the shelf break at Cape Hatteras and waters to the north (*e.g.,* Thorne *et al.,* 2017). These findings provided a strong indication that the area should be afforded some degree of protection in the form of restriction on effort, while the core abundance analysis both supported these findings and provided a more quantitative basis upon which to delineate the specific area.

We also acknowledge the important role that practicability for applicants plays in defining the appropriate suite of mitigation requirements to satisfy the MMPA's least practicable adverse impact standard, including design of habitat-based protections. Where a negligible impact finding is not conditioned upon the implementation of specific mitigation, prescription of mitigation must consider impacts on practicability. As stated above, protection of additional habitat for the sperm whale—given no basis on which to specify targeted protections beyond those included herein—would necessarily involve restricting access to large swaths of the specific geographic region. Based on our understanding of applicant considerations, such significant restrictions would likely lead to an applicant's determination that the survey would not take place, as the return on investment would not justify the expenditure, *i.e.,* a clear-cut case of a fatal practicability issue. In the absence of necessity (*i.e.,* the measure must be prescribed in order to make a finding of negligible impact), it would not be permissible to require such stringent restrictions.

NRDC goes on to cite ''important passive acoustic detections, opportunistic sightings, and other data'' that we have supposedly ignored, and cites the New York Bight (an area outside the specific geographic region) as an area illustrating the supposed failure of the density models to adequately highlight important habitat. NRDC also references biologically important areas; as described later in this document, we reviewed available information regarding BIAs (LaBrecque *et al.,* 2015) and there are no additional identified BIAs in the region.

In summary, and contrary to NRDC's statements, we did not rely exclusively on the core abundance analysis to define restriction areas. While we may have inadvertently overemphasized this important aspect of our process in the description provided in our Notice of Proposed IHAs, we evaluated the available literature to inform our understanding of rough areas suitable for protection (or characteristics that might provide such areas), subsequently refining our analysis through use of core abundance analysis to identify specific areas where features expected to provide important habitat overlap with actual predictions of high abundance and/or to refine the specific boundaries of areas that the literature indicated to be of importance. We appropriately based our definition of time-area restrictions on the available literature as well as on our analysis of core abundance areas.

Comment: ION requests that we reconsider the proposed time-area restrictions, based on a supposed lack of effects to right whales from noise exposure, the lack of evidence for serious injury, death, or stranding of beaked whales due to noise exposure from airgun surveys, and the possibility that deepwater canyon closures could be timed to coincide seasonally with the lowest density of sperm whales.

Response: We refer to the discussions provided in our Notice of Proposed IHAs regarding ''Potential Effects of the Specified Activity on Marine Mammals'' and detailing the rationale and basis for our designation of time-area restrictions in ''Proposed Mitigation.'' We stand by this information as supporting our assumptions regarding likely effects of marine mammals and the need for such time-area restrictions, and regarding the basis upon which we designated specific restrictions. Specifically, we have designated the relatively small deepwater canyon areas as year-round closures due to the likelihood that they provide year-round habitat to beaked whales and possibly sperm whales, while resulting in relatively minor practicability impacts. ION claims that these three deepwater canyon closures would result in ''large gaps in the seismic data acquired,'' but the map provided as Figure 1 in ION's letter does not support this contention, instead showing that only very small portions of several planned survey lines pass through these areas.

Comment: CGG suggests that NMFS should evaluate observational data submitted during the course of the survey and only require time-area restrictions ''if potential significance of behavioral disruption and potential for longer-term avoidance exists as a result of acoustic exposure'' from the survey.

Response: We disagree that this would be the appropriate approach to implementation of required restrictions. We also note that CGG mistakenly states that distribution of some species targeted in our design of restrictions is modeled through use of stratified models, implying that not enough information exists on which to base such restrictions. Our restriction areas target coastal bottlenose dolphins, North Atlantic right whales, beaked whales, sperm whales, and pilot whales, none of which are modeled through stratified models. More importantly, the entire premise of time-area restrictions is that, on the basis of a reasoned consideration of available information regarding the anticipated impacts to the affected species or stocks, their status, use of habitat, and practicability for applicants, restrictions on survey effort to completely or partially avoid sensitive habitat are appropriate. Moreover, it would not be appropriate to allow the surveys to occur in those places, thereby potentially allowing the impacts to sensitive habitat and/or disruption of critical behaviors at important places and/or times, and expect that observational data collected during the survey would adequately indicate that the restriction should in fact be in place.

Comment: The Associations state that right whale dynamic management areas (DMA) should not be used as operational restriction areas, and that areas designated to identify the presence of right whales cannot be used for multiple purposes, *e.g.,* to reduce risk of ship strike and to avoid harassment.

Response: The DMA concept recognizes that aggregations of right whales can occur outside of areas and times where they predictably and consistently occur, and it can be applied in various contexts. The DMA construct is used to help reduce risk of ship strike for right whales in association with NMFS's regulations for vessel speed limits in prescribed ''seasonal management areas'' (73 FR 60173; October 10, 2008; extended by 78 FR 73726; December 9, 2013). In that regard, when a specific aggregation of right whales is sighted, NMFS ''draws'' a temporary zone (*i.e.,* DMA) around the aggregation and alerts mariners. DMAs are in effect for 15 days when designated and automatically expire at the end of the period, but may be extended if whales are re-sighted in the same area.

The DMA concept also was used between 2002 and 2009 to protect unexpected aggregations of right whales that met an appropriate trigger by temporarily restricting lobster trap/pot and anchored gillnet fishing in the designated area (gear modifications have since replaced those requirements).

As we have stated, it is critically important to avoid impacts to right whales when possible and to minimize impacts when they do occur. Because DMAs identify aggregations of right whales, it is appropriate to restrict operations in these areas when DMAs are in effect. While we acknowledge that this requirement will impose operational costs, if the establishment of a DMA results in the need for a survey to temporarily move to another location, such concerns are weighted appropriately here in determining that this measure should be included in the suite of mitigation necessary to achieve the least practicable adverse impact.

Comment: ION suggests that NMFS reconsider its position on use of mitigation sources and power-downs, *i.e.,* that NMFS should allow these approaches to reduce operational impacts of required mitigation.

Response: We maintain that use of a ''mitigation source''—commonly understood to involve firing of a single airgun for extended periods of time to avoid the need for pre-clearance and/or ramp-up—is inappropriate here. Our position on this is not based on a lack of evidence that the mitigation source would be effective—indeed, we agree that it is reasonable to assume some degree of efficacy for a mitigation gun in providing a ''warning'' to marine mammals, as we discuss in reference to use of ramp-up. Our determination is instead based on a consideration that unnecessary introduction of sound energy into the water, as occurs during use of a mitigation source, is necessarily a deleterious impact, whereas the alternative—allowance of start-up at times of poor visibility—may result in negative impacts to individual marine mammals in the vicinity, but this is not certain.

Comment: Several commenters criticized our proposal to require shutdowns upon detection of certain species or circumstances (*e.g.,* beaked whales, right whales, whales with calves) at any distance. The Associations suggest that such requirements are ''unreasonable'' because they require shutdowns ''for circumstances in which no Level A or Level B harassment will occur,'' and recommend that such measures be limited to power-down only for detections within 1,000 m. The Associations also contend that these measures will have negative impacts on the effectiveness of visual PSOs, stating that the result would be that ''observers will be constantly monitoring an unlimited zone, which [. . .] may undermine the effectiveness of their monitoring of the 1,000 m zone.'' CGG makes similar claims, adding that these measures would result in a substantial increase in operating costs.

Response: We first note that the minimum Level B harassment zone for any survey, in any location, would be beyond the likely detection distance for visual observers, even under ideal conditions, *e.g.,* the smallest threshold radius out of 21 modeled scenarios from BOEM's PEIS was almost 5 km. Therefore, the Associations' claim that shutdowns at any distance would occur in circumstances where there is no harassment is incorrect. Overall, we disagree with these comments, as well as those specific comments we respond to below, which assert that such measures are not warranted. In these cases, we have identified species or circumstances with particular sensitivities (in conjunction with, in some cases, a high magnitude of authorized take) for which we believe it appropriate to minimize the duration and intensity of the behavioral disruption, as well as to minimize the potential for auditory injury (for low- and high-frequency cetaceans). However, while we also disagree that trained, experienced professional PSOs would somehow misunderstand our intent and spend undue time focusing observational effort at distances beyond approximately 1,000 m from the acoustic source (*i.e.,* the zone within which we assume that monitoring is typically focused, though not necessarily exclusively), in order to ensure that this potential is minimized, and to alleviate to some degree the operational cost associated with shutdowns at any distance, we limit these shutdowns to within 1.5 km (versus at any distance). The rationale for this distance is explained later in this document in ''Mitigation.''

Comment: Several commenters criticized the proposal to require shutdowns based upon aggregations of six or more marine mammals in a state of travel, stating that such a measure is ''vague and unbounded'' and would be impracticable due to the large number of shutdowns that may result.

Response: We acknowledge that this measure, as described in our Notice of Proposed IHAs, does not likely carry benefits commensurate with the likely costs and is therefore impracticable. However, the provided description was in error in that it inadvertently suggested requirements beyond what we intended, *i.e.,* we did not intend that this measure would apply to species that commonly occur in large groups, such as dolphins. We have modified this requirement to clearly state that it applies only to aggregations of large whales (*i.e.,* baleen whales and sperm whales), and to eliminate the behavioral aspect of the requirement, as recommended by commenters. Contrary to claims of commenters, this measure (as clarified/revised) is warranted, in that minimization of disruption for aggregations of resting and/or socializing whales is important and also practicable. As described above, the shutdown requirement is bounded by a maximum distance of 1.5 km.

Comment: Multiple industry commenters criticized the proposed requirement for shutdowns upon observation of a diving sperm whale centered on the forward track of the source vessel, stating that the proposal was unclear and likely unworkable.

Response: We agree with commenters (though we disagree with associated, unsupported statements regarding lack of effects to sperm whales), and have removed this measure.

Comment: TGS stated that we should remove the requirement (specific to TGS) to shut down upon observation of any fin whale.

Response: For reasons described in greater detail in the section entitled ''Mitigation,'' we agree with this comment and have removed the measure.

Comment: The Associations and other industry commenters state that the requirement for shutdowns upon observation of large whales with calf is not warranted and will be ''very impracticable because of the large number of . . . shutdowns it will generate.''

Response: We disagree with these comments and retain this requirement, albeit within the 1.5 km zone versus ''at any distance.'' As we discuss in the ''Mitigation'' section, groups of whales are likely to be more susceptible to disturbance when calves are present (*e.g.,* Bauer *et al.,* 1993), and disturbance of cow-calf pairs could potentially result in separation of vulnerable calves from adults. Separation, if it occurred, could be exacerbated by airgun signals masking communication between adults and the separated calf (Videsen *et al.,* 2017). Absent separation, airgun signals can disrupt or mask vocalizations essential to mother-calf interactions. Given the consequences of potential loss of calves in context of ongoing UMEs for multiple mysticete species, as well as the functional sensitivity of the mysticete whales to frequencies associated with airgun survey activity, we believe this measure is warranted by the MMPA's least practicable adverse impact standard. Commenters provide no justification for the claim that this measure will result in a large number of shutdowns.

Comment: Several industry commenters also suggest that there is not adequate justification for enhanced shutdown requirements for right whales, beaked whales, or *Kogia* spp. These commenters all provide the same points verbatim (paraphrased here): (1) Because the primary threat facing right whales are entanglement with fishing gear and ship strikes, enhanced shutdowns have no impact on the causes of right whale decline; (2) while acknowledging that beaked whales are acoustically sensitive, they claim that evidence does not exist regarding sensitivity to airgun noise; and (3) *Kogia* spp. are grouped with high-frequency cetaceans (and thus are subject to greater propensity for auditory injury) on the basis of studies of harbor porpoise; therefore, this classification is invalid.

Response: These claims lack merit, and we retain these requirements (albeit within the 1.5 km zone versus ''at any distance''). We agree that the primary threats to right whales are entanglement and ship strike, but the deteriorating status of the population (discussed in detail in the section entitled ''Description of Marine Mammals in the Area of the Specified Activities'') indicates that impacts to individual right whales should be avoided where possible and otherwise minimized. The preponderance of evidence clearly demonstrates that beaked whales are acoustically sensitive species. While beaked whale stranding events have been associated with use of tactical sonar, indicating that this specific noise source may be more likely to result in behaviorally-mediated mortality, the lack of such association with airgun surveys does not mean that beaked whales are less acoustically sensitive to the noise source. The same holds for *Kogia* spp., albeit with less evidence for these cryptic species. However, commenters' claim regarding the classification of these species into the high-frequency hearing group holds no merit. The best available scientific information, while limited, indicates that these species are appropriately classed as high-frequency cetaceans; commenters provide no evidence to the contrary. While no data exists regarding *Kogia* spp. hearing, these species were appropriately classified as high-frequency cetaceans by Southall *et al.* (2007) on the basis of high-frequency components of their vocalizations. More recent data confirms that *Kogia* spp. use high-frequency clicks (Merkens *et al.,* 2018) and, by extension, that their classification as high-frequency cetaceans is appropriate.

Comment: The MMC recommends that NMFS require shutdowns upon acoustic detection of sperm whales, as is required for beaked whales and *Kogia* spp.

Response: We agree with the MMC that shutdowns due to the presence of sperm whales should not be limited to visual detection alone. This recommendation appears to reflect some ambiguity in the description of proposed mitigation provided in our Notice of Proposed IHAs, as it was our intent to prescribe mitigation in accordance with this recommendation. In conjunction with modifications to the proposed mitigation (described in full in the section entitled ''Mitigation''), we require that shutdowns be implemented upon confirmed acoustic detection of any species (other than delphinids) within the relevant exclusion zone.

Comment: NRDC and other commenters state that NMFS should prescribe requirements for use of ''noise-quieting'' technology. NRDC elaborates that in addition to requiring noise-quieting technology (or setting a standard for ''noise output''), NMFS should ''prescribe targets to drive research, development, and adoption of alternatives to conventional airguns.''

Response: We agree with commenters that development and use of quieting technologies, or technologies that otherwise reduce the environmental impact of geophysical surveys, is a laudable objective and may be warranted in some cases. However, here the recommended requirements are either not practicable or are not within NMFS's authority to require. To some degree, NRDC misunderstands our discussion of this issue as presented in our Notice of Proposed IHAs. We recognize, for example, that certain technologies, including the Bolt eSource airgun, are commercially available, and that certain techniques such as operation of the array in ''popcorn'' mode may reduce impacts when viable, depending on survey design and objectives. However, a requirement to use different technology from that planned or specified by an applicant—for example, a requirement to use the Bolt eSource airgun—would necessarily require an impracticable expenditure to replace the airguns planned for use. NRDC offers no explanation for why such an incredible cost imposition (in the millions of dollars) should be considered practicable. Separately, NRDC appears to suggest that NMFS must require or otherwise incentivize the development of wholly new or currently experimental technologies. In summary, while we agree that noise quieting technology is beneficial, the suggestions put forward by commenters are either impracticable or outside the authority provided to NMFS by the MMPA. However, NMFS would consider participating in related efforts by NRDC or any other commenter interested in these technologies.

Comment: NRDC claims that NMFS fails to consider mitigation to reduce ship strike in right whale habitat. Separately, NRDC states that NMFS should consider extending ship-speed requirements to all project vessels within ''the North Atlantic right whale BIA.''

Response: We disagree with NRDC's contention. All project vessels are required to adhere to vessel speed requirements. Indeed, the ship speed restrictions in these IHAs are required of all vessels associated with the surveys, regardless of length, whereas NMFS's ship speed regulations apply only to vessels greater than 65 ft in length. We agree with NRDC that ship speed requirements are warranted for all project vessels in designated areas to minimize risk of strike for right whales. However, we are unclear what specific area NRDC may mean in referencing ''the North Atlantic right whale BIA.'' We require that all project vessels adhere to a 10-kn speed restriction when in any seasonal or dynamic management area, or critical habitat.

Comment: Industry commenters were unanimous in expressing concern regarding required vessel strike avoidance mitigation measures, notably regarding safety for operators. In particular, recommendations to reduce speed and shift engines to neutral in certain circumstances were viewed as unsafe for vessels towing gear.

Response: We agree with the concerns expressed by commenters, and clarify that it was not our intent to require such measures for vessels towing gear. Safety of human life is paramount, and where legitimate concerns exist we agree that required mitigation must reflect such concerns. We have revised our discussion of vessel strike avoidance measures (see ''Mitigation'') to clarify that the primary requirements are (1) all vessels must observe a 10-kn speed limit when transiting right whale critical habitat, SMAs, or DMAs, and (2) all vessels must observe separation distances identified in ''Mitigation,'' to the extent practicable as relates to safety. These requirements do not apply to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply or in any case where compliance would create an imminent and serious threat to a person or vessel. Speed alterations (aside from the 10-kn restriction, when applicable), alterations in course, and shifting engines to neutral are recommendations for how separation distances may be achieved but are not requirements, and do not apply to any vessel towing gear.

Comment: ION requests clarification on specific ''precautionary measures'' required in order to minimize potential for vessel strike, citing the following text from our Notice of Proposed IHAs: ''Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should be exercised when an animal is observed.''

Response: We clarify here that the latter statement, *i.e.,* ''precautionary measures should be exercised when an animal is observed,'' carries no specific requirements. We intend only that vessel operators act cautiously in accordance with established practices of seamanship to avoid striking observed animals. The requirements of the former statement, *i.e.,* that vessel speeds must be reduced when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel, applies only to those specific circumstances, *i.e.,* not in speculative fashion if a single animal or small group of animals is observed.

Comment: One individual stated that NMFS should require applicants to monitor propagation conditions, suggesting that this could be accomplished through use of conductivity, temperature, and depth (CTD) measurement devices, and that vessels should not be allowed to operate when propagation is ''exceptionally efficient.''

Response: The commenter does not specify what propagation conditions should be considered ''exceptionally efficient.'' Regardless, we do not agree that such a requirement is warranted. The sound field modeling conducted by BOEM and by the applicants that did not make use of BOEM's modeling is purposely designed to reflect a reasonable range of propagation conditions that are expected to be encountered in the region. This does not mean that there will never be unexpected conditions that may result in propagation beyond the modeled distances. However, this potential does not require that operators cease operating, as such a requirement would be fraught with uncertainty and potentially result in significant additional operating costs.

Comment: NRDC makes several recommendations relating to the use of ramp-up.

Response: First, NRDC states that NMFS should require that ramp-up occur over several stages in order to minimize exposure. We agree with NRDC on this point, but are confused by the recommendation, which appears to restate the ramp-up procedures described by NMFS in our Notice of Proposed IHAs. Second, NRDC states that we ''should give greater consideration to the requirements that apply after shutdown periods.'' Again, we are unclear as to what NRDC's specific recommendation is, but NRDC appears to criticize the allowance of an array restart without ramp-up, assuming that constant observation has been maintained without marine mammal detection. NRDC does not state what they believe to be the problem with this allowance, and we believe that it is consistent with current practice and appropriate in context of the ''least practicable adverse impact.'' Finally, NRDC asserts that the half-hour cutoff ''perversely incentivizes'' continuous firing to avoid the delay of pre-clearance and ramp-up. This is another confusing statement, as we explicitly disallow airgun firing when not necessary for data acquisition, *e.g.,* during line turns.

Comment: NRDC complains that the standard 500-m exclusion zone is ''plainly insufficient to prevent auditory injury,'' and many other commenters echo these comments regarding the sufficiency of the prescribed exclusion and buffer zones.

Response: We have acknowledged that some limited occurrence of auditory injury is likely, for low- and high-frequency cetaceans. However, we disagree that a larger standard exclusion zone is warranted. As we explained in our Notice of Proposed IHAs, our intent in prescribing a standard exclusion zone distance is to (1) encompass zones for most species within which auditory injury could occur on the basis of instantaneous exposure; (2) provide additional protection from the potential for more severe behavioral reactions (*e.g.,* panic, antipredator response) for marine mammals at relatively close range to the acoustic source; (3) provide consistency and ease of implementation for PSOs, who need to monitor and implement the exclusion zone; and (4) to define a distance within which detection probabilities are reasonably high for most species under typical conditions. Our use of 500 m as the zone is not based directly on any quantitative understanding of the range at which auditory injury would be entirely precluded or any range specifically related to disruption of behavioral patterns. Rather, we believe it is a reasonable combination of factors. In summary, a practicable criterion such as this has the advantage of familiarity and simplicity while still providing in most cases a zone larger than relevant auditory injury zones, given realistic movement of source and receiver. Increased shutdowns, without a firm idea of the outcome the measure seeks to avoid, simply displace survey activity in time and increase the total duration of acoustic influence as well as total sound energy in the water (a goal we believe NRDC supports).

We agree that, when practicable, the exclusion zone should encompass distances within which auditory injury is expected to occur on the basis of instantaneous exposure. For high-frequency cetaceans, these distances range from 355–562 m for four of the five applicants (Table 5). For Spectrum, the predicted distance is significantly larger (1,585 m). However, we require an extended exclusion zone of 1.5 km for certain sensitive species, including *Kogia* spp. This means that only one rarely occurring species (harbor porpoise), and for only one applicant, is left unprotected from potential auditory injury in terms of the prescribed distance of the exclusion zone. Moreover, it is unlikely that harbor porpoise would even be detected at distances greater than 500 m. Potential auditory injury for low-frequency cetaceans is based on the accumulation of energy, and is therefore not a straightforward consideration. For example, observation of a whale at the distance calculated as being the ''injury zone'' does not necessarily mean that the animal has in fact incurred auditory injury. Rather, the animal would have to be at the calculated distance (or closer) as the mobile source approaches, passes, and recedes from the exposed animal, being exposed to and accumulating energy from airgun pulses the entire time, as is implied by the name of the ''safe distance'' methodology by which such zone distances are calculated. Therefore, we disagree that it is sensible to create a larger exclusion zone on the basis of the calculated injury zones (although we note that the extended 1.5 km exclusion zone is required for right whales). We also note that the maximum distance cited by NRDC (4,766 m) was an error in our Notice of Proposed IHAs (corrected later in this document; see ''Level A harassment'' in the ''Estimated Take'' section). In fact, the calculated injury distances for two applicants are less than the standard 500-m zone, while those calculated for the remaining three applicants range from 757–951 m. In keeping with the four broad goals outlined above, and in context of the information given here, our standard 500-m exclusion zone is appropriate.

Comment: Several industry commenters criticized the requirement for use of a buffer zone, in addition to the standard 500-m exclusion zone, claiming in part that use of such a buffer is ''counterintuitive.''

Response: Having received multiple comments indicating confusion regarding the proposed measure, we first clarify that the requirement is for a 500-m buffer zone in addition to the 500-m standard exclusion zone, *i.e.,* total typical monitoring zone of 1,000 m, and that the implementation of this requirement relates primarily to the pre-clearance period, when the full 1,000-m zone must be clear of marine mammals prior to beginning ramp-up. During full-power firing, the buffer zone serves only as a sort of ''warning'' area, where the observation of marine mammals should incite readiness to shut down, should those animals enter the 500-m shutdown zone.

We disagree that this measure is counterintuitive, an assertion based on the apparent sense that a larger zone should be in effect when the array is firing and a smaller zone prior to firing. On the contrary, we believe it important to implement a larger zone during pre-clearance, when naïve animals may be present and potentially subject to severe behavioral reactions if airguns begin firing at close range. While the delineation of zones is typically associated with shutdown, the period during which use of the acoustic source is being initiated is critical, and in order to avoid more severe behavioral reactions it is important to be cautionary regarding marine mammal presence in the vicinity when the source is turned on. This requirement has broad acceptance in other required protocols: The Brazilian Institute of the Environment and Natural Resources requires a 1,000-m pre-clearance zone (IBAMA, 2005), the New Zealand Department of Conservation requires that a 1,000-m zone be monitored as both a pre-clearance and a shutdown zone for most species (DOC, 2013), and the Australian Department of the Environment, Water, Heritage and the Arts requires an even more protective scheme, in which a 2,000-m ''power down'' zone is maintained for higher-power surveys (DEWHA, 2008). Broker *et al.* (2015) describe the use of a precautionary 2-km exclusion zone in the absence of sound source verification (SSV), with a minimum zone radius of 1 km (regardless of SSV results). We believe that the simple doubling of the exclusion zone required here is appropriate for use as a pre-clearance zone.

Comment: In writing about the exception made for dolphins from the shutdown requirements, NRDC states that ''more analysis is . . . needed of the potential costs and benefits of excluding bow-riding dolphins from the exclusion zone requirement.''

Response: We recognize the concerns raised by NRDC, and agree that the reasons for bow-riding behavior are unknown and, further, that in context of an active airgun array, the behavior cannot be assumed to be harmless. However, dolphins have a relatively high threshold for the onset of auditory injury and, for small delphinids, more severe adverse behavioral responses are less likely given the evidence of purposeful approach and/or maintenance of proximity to vessels with operating airguns. With regard to the former point, Finneran *et al.* (2015) exposed bottlenose dolphins to repeated pulses from an airgun and measured no TTS. Therefore, the biological benefits of shutting down for small delphinids are expected to be comparatively low, whereas, as indicated through public comment on these proposed actions, the costs of the shutdowns for survey operators is high. Therefore, our consideration of this subject, as addressed in an earlier comment response, indicates that a general (rather than behavior-based) small delphinid exception to the standard shutdown requirement is an appropriate part of the suite of mitigation measures necessary to effect the least practicable adverse impact.

Comment: One individual stated that NMFS should require ''trackline design'' that minimizes the potential for stranding, including by requiring that companies run their nearshore lines at times of reduced propagation efficiency.

Response: The commenter does not specify what is meant by ''nearshore,'' but we prescribe a year-round 30-km standoff from the coast. We assume that 30 km is sufficient to accomplish the commenter's objective in making the recommendation.

Comment: The Associations and other industry commenters raise several concerns regarding the PSO requirements. These are: (1) Concern regarding NMFS's requirement to review PSO qualifications and associated potential for delay, with accompanying recommendation that such reviews be ''bounded by some reasonably short time period, with the default being that the observer is approved if NMFS fails to respond within that time period''; (2) concern whether vessels can ''safely accommodate'' the number of PSOs required by NMFS's staffing requirements; and (3) a claim that NMFS's requirements for PSOs will result in labor shortages, and an accompanying recommendation that these be ''guidelines'' rather than requirements.

Response: We agree with the first concern, and have clarified that NMFS will have one week to review PSO qualifications (from the time that NMFS confirms that adequate information has been submitted) and either approve or reject a PSO. If NMFS does not respond within this time, any PSO meeting the minimum requirements would automatically be approved.

We disagree with the remainder of the statement. NMFS has evaluated the appropriate PSO staffing requirements, as described in ''Mitigation,'' and we have determined that a minimum of two visual PSOs must be on duty at all times during daylight hours in order to adequately ensure visual coverage of the area around the source vessel. Applicants must account for these requirements in selecting vessels that will be suitable for their planned surveys. The Associations' third point contains an apparent misconception, in that not all PSOs must have a minimum of 90 days at-sea experience, with no more than 18 months elapsed since the conclusion of the relevant experience. As described in our Notice of Proposed IHAs and herein, a minimum of one visual PSO and two acoustic PSOs must have such experience (rather than all PSOs). The Associations also apparently believe that a requirement for professional biological observers to be ''trained biologists with experience or training in the field identification of marine mammals, including the identification of behaviors'' is a ''rigid restriction.'' We respectfully disagree with these claims, and note that no labor shortage was experienced in the Gulf of Mexico during 2013–2015 when a significantly greater amount of survey activity (*i.e.,* as many as 30 source vessels) was occurring than is considered here, with requirements similar to those described here. NMFS has discussed the PSO requirements specified herein with the Bureau of Safety and Environmental Enforcement (BSEE) and with third-party observer providers; these parties have indicated that the requirements should not be expected to result in any labor shortage.

Comment: The Associations recommend that passive acoustic monitoring should be optional, citing operational costs. ION also challenges the efficacy of PAM.

Response: We agree with the Associations that PAM complements (rather than replaces) traditional visual monitoring. However, it is now considered to be a critical component of real-time mitigation monitoring in the majority of circumstances for deep penetration airgun surveys. Acoustic monitoring supplants visual monitoring during periods of poor visibility and supplements during periods of good visibility. As such, we strongly disagree with the Associations' outdated recommendation.

There are multiple explanations of how marine mammals could be in a shutdown zone and yet go undetected by observers. Animals are missed because they are underwater (availability bias) or because they are available to be seen, but are missed by observers (perception and detection biases) (*e.g.,* Marsh and Sinclair, 1989). Negative bias on perception or detection of an available animal may result from environmental conditions, limitations inherent to the observation platform, or observer ability. Species vary widely in the inherent characteristics that inform expected bias on their availability for detection or the extent to which availability bias is convolved with detection bias (*e.g.,* Barlow and Forney (2007) estimate probabilities of detecting an animal directly on a transect line (*g*(0)), ranging from 0.23 for small groups of Cuvier's beaked whales to 0.97 for large groups of dolphins). Typical dive times range widely, from just a few minutes to more than 45 minutes for sperm whales (Jochens *et al.,* 2008; Watwood *et al.,* 2006), while *g*(0) for cryptic species such as *Kogia* spp. declines more rapidly with increasing Beaufort sea state than it does for other species (Barlow, 2015). Barlow and Gisiner (2006) estimated that when weather and daylight considerations were taken into account, visual monitoring would detect fewer than two percent of beaked whales that were directly in the path of the ship. PAM can be expected to improve on that performance, and has been used effectively as a mitigation tool by operators in the Gulf of Mexico since at least 2012.

We expect that PAM technology will continue to develop and improve, and look forward in the near-term to the establishment of formal standards regarding specifications for hardware, software, and operator training requirements, under the auspices of the Acoustical Society of America's (ASA) Accredited Standards Committee on Animal Bioacoustics (ANSI S3/SC1/WG3; "Towed Array Passive Acoustic Operations for Bioacoustics Applications"). In short, we expect that PAM will continue to be an integral component of mandatory mitigation monitoring for deep penetration airgun surveys conducted in compliance with the MMPA.

Comment: Several industry commenters expressed concern regarding the potential for a large amount of shutdowns due to acoustic detections of marine mammals in circumstances where the PAM operator is unable to identify the detected species or is unable to determine the location of the detected species in relation to the relevant exclusion zone.

Response: NMFS recognizes these concerns, and appreciates the comments; however, these potential outcomes would be contrary to NMFS's intent in prescribing the use of PAM. Upon review of these comments, we find that our description of PAM use was unclear and offer clarification here. In the event of acoustic detection, shutdown must be implemented only when the PAM operator determined, on the basis of best professional judgment, that shutdown is required for the detected species and that the species is likely within the relevant exclusion zone. For example, although shutdown is required for certain genera of large delphinids, we do not require shutdown upon acoustic detection of any delphinid, as we do not expect that a PAM operator would likely be capable of distinguishing a detected delphinid to species. As in all cases, the detection would be communicated to visual observers (if on duty); if the detected animal(s) are observed visually, shutdown may be required depending on the species. Similarly, we clarify that the shutdowns required upon observation of a large whale with calf or an aggregation of six or more large whales are for visual observation only; a PAM operator cannot be expected to determine on the basis of acoustic detection whether a detected whale is with calf or is part of an aggregation of six or more. Our intent is not to be overly prescriptive, but to empower trained PAM operators to employ professional judgment in determining whether shutdown is required in the event of acoustic detection. That is, we neither require precautionary shutdowns based on acoustic detections when either the species or location cannot be determined, nor do we require absolute certainty that the detected animal is within the relevant exclusion zone if the PAM operator determines that the animal is most likely within the zone on the basis of professional judgment.

Comment: ION recommends that NMFS extend the timeframe for operation of the acoustic source during repair of the PAM system in the event of malfunction.

Response: We believe that the requirements regarding conditions under which a survey is allowed to continue in the event of PAM malfunction are appropriate. These conditions, which are based on established protocols required in New Zealand, have been implemented in other locations with no known reports of undue hardship. We also note that ION does not recommend any alternative. We will be open to considering alternatives in the future, but retain these requirements here.

Comment: ION questions NMFS's intentions regarding pre-clearance requirements at nighttime, requesting that NMFS clarify that observation with PAM satisfies this requirement.

Response: Ramp-up of the acoustic source, when necessary, may occur at times of poor visibility (including nighttime), assuming that a pre-clearance period has been observed. If the pre-clearance period occurs at nighttime, the pre-clearance watch would be conducted only by the acoustic observer. We clarify that, indeed, observation with PAM satisfies the pre-clearance watch requirement at night.

Comment: TGS requests clarification of what they interpret as contradictory instructions with regard to when visual observations must occur.

Response: We clarify here that visual observation, *i.e.,* two visual PSOs on duty, is required during all daylight hours (30 minutes prior to sunrise through 30 minutes following sunset, regardless of visibility) when use of the acoustic source is planned, from 30 minutes prior to ramp-up through one hour after ceasing use of the source (or until 30 minutes after sunset). In addition, visual observation is to occur 30 minutes prior to and during nighttime ramp-up.

Comment: NRDC suggests that NMFS should consider requiring use of thermal detection as a supplement to visual monitoring.

Response: We appreciate the suggestion and agree that relatively new thermal detection platforms have shown promising results. Following review of NRDC's letter, we considered these and other supplemental platforms as suggested. However, to our knowledge, there is no clear guidance available for operators regarding characteristics of effective systems, and the detection systems cited by NRDC are typically extremely expensive, and are therefore considered impracticable for use in most surveys. For example, one system cited by NRDC (Zitterbart *et al.,* 2013)—a spinning infrared camera and an algorithm that detects whale blows on the basis of their thermal signature—was tested through funding provided by the German government and, according to the author at a 2015 workshop concerning mitigation and monitoring for seismic surveys, the system costs hundreds of thousands of dollars. We are not aware of its use in any commercial application. Further, these systems have limitations, as performance may be limited by conditions such as fog, precipitation, sea state, glare, water- and air-temperatures and ambient brightness, and the successful results obtained to date reflect a limited range of environmental conditions and species. NRDC does not provide specific suggestions with regard to recommended systems or characteristics of systems. We do not consider requirements to use systems such as those recommended by NRDC to currently be practicable.

Comment: Mysticetus, LLC (Mysticetus) recommends that all operators be required to use a ''modern PSO software system'' for structured data collection, real-time situational awareness and computerized mitigation decision support. They also list their recommended minimum requirements for a PSO software system. Mysticetus also recommends the creation of a centralized cloud-based database to hold all PSO-gathered data from all survey operations, and states that it should be a requirement of all operators to have their PSO software automatically upload data to this system on a regular schedule. Separately, we received a comment letter from P.N. Halpin of Duke University's Marine Geospatial Ecology Lab; the commenter provides support for the recommendation to create a cloud-based storage system to store and provide public access to PSO data and confirms that the OBIS–SEAMAP team has agreed in principle to host and disseminate such a proposed database. Mysticetus goes on to provide a number of detailed recommendations relating to how our notice might describe the capabilities of a PSO software system, such as is recommended for mandatory use, in relation to our proposed mitigation and monitoring requirements.

Response: We appreciate commenters' careful attention to improvement of required mitigation and monitoring and for their recommendations. We also appreciate the capabilities of ''modern PSO software'' described by Mysticetus, including the Mysticetus System marketed by Mysticetus, LLC. We agree that such systems may be advantageous for the operators, as well as for NMFS and for the public. However, we disagree that NMFS must mandate that one specific software system be used to accomplish the goals of the required mitigation and monitoring, so long as the requirements for mitigation, monitoring, and reporting are met.

Comment: The MMC stated that it supports our proposed requirement relating to corrections of sightings data using detection probabilities, in order to estimate numbers of actual incidents of marine mammal take. However, the MMC also suggests that our proposed use of Carr *et al.* (2011) is not the most appropriate source of such probability values, and suggests that we instead base this approach on Barlow (2015). In addition, the MMC points out that we did not explicitly state that we also intend to account for unobserved areas, and provided a recommended extrapolation method.

Response: We agree with the MMC's statements on this topic and thank them for the helpful suggestions. Although, after review of public comments, we do not require the applicants to conduct these analyses themselves (described in greater detail in the section entitled ''Monitoring and Reporting''), we intend to adopt the MMC's recommended approach in performing this analysis. We will report these corrected results in association with comprehensive reporting from the applicants.

Comment: NRDC asserts that NMFS fails to prescribe requirements sufficient to monitor and report takings of marine mammals, and further draws a comparison to ''related compliance in the Gulf of Mexico'' where they state that ''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' . . . .'' Multiple commenters suggested that monitoring plans should be designed and coordinated across surveys. Commenters also noted that there are many research gaps that need to be filled, and suggested that NMFS should include monitoring requirements that fill those gaps—such as marine mammal habitat use, abundance surveys, masking, mysticete hearing ranges, behavioral response thresholds, ecosystem-wide impacts, and the efficacy of mitigation measures. Specific recommendations included acoustic receivers outside the survey area to allow for recording and assessment before, during, and after surveys, as well as aerial surveys to evaluate platform-based visual monitoring.

Response: Section 101(a)(5)(D) of the MMPA indicates that any authorization NMFS issues shall include ''requirements pertaining to the monitoring and reporting of such taking by harassment.'' This broad requirement allows for a high degree of flexibility in what NMFS may accept or include as a monitoring requirement, but is not specific in identifying a threshold of what should be considered adequate monitoring. Contrary to NRDC's comments, except for IHAs in Arctic waters, NMFS's implementing regulations do not provide a specific standard regarding what required monitoring and reporting measures ''must'' accomplish. However, they do direct that ''requests,'' *i.e.,* the materials submitted by applicants, should include ''the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities, and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity.'' NRDC further extracts pieces of this language to suggest that in the case of these five applicants, they are required to coordinate with each other's monitoring efforts, ignoring the fact that the regulation points to this coordination only in support of minimizing the burden on the applicant and that it refers to coordination with ''schemes already applicable to persons conducting such activity,'' of which there are currently none. NRDC attempts to further this argument that coordination across projects is required by statute by pointing to a compliance scheme that they state is in development for the Gulf of Mexico.

However, as described elsewhere in this document, section 101(a)(5)(D) of the MMPA indicates that the analysis, the findings, and any requirements included in the development of an IHA pertain only to the specified activity—specifically, NMFS is required to include the ''requirements pertaining to the monitoring and reporting of such taking by harassment'' (referring to the taking authorized in the IHA). Notably, section 101(a)(5)(A), which applies in the case of NMFS's incidental take regulations for a specified activity for up to five years, contains similar requirements, but the requirements apply to the entirety of the activities covered under any incidental take rulemaking. Indeed, NMFS's implementing regulations indicate that ''for all petitions for regulations [. . .] applicants must provide the information requested in 216.104 on their activity as a whole.'' Therefore, it is appropriate that a monitoring plan developed in support of BOEM's requested rulemaking to cover incidental take from activities covered by their oil and gas program in the Gulf of Mexico would address, and potentially coordinate across, multiple surveys.

Although the statute provides flexibility in what constitutes acceptable monitoring and reporting measures (increased knowledge of the species and the taking), NMFS's implementing regulations provide additional guidance as to what an applicant should submit in their requests, indicating "Monitoring plans should include a description of the techniques that would be used to determine the movement and activities of marine mammals near the activity site(s) including migration and habitat uses, such as feeding." We appreciate the recommendations provided by the public, and agree that from a content standpoint, many of the recommendations could qualify as appropriate monitoring for any of these surveys. However, we note that many of the monitoring recommendations require a scale of effort that is not commensurate to the scale of either the underlying activities or the anticipated impacts of the activities on marine mammals covered by any single IHA. In other words, many of the recommended measures would necessitate complex and expensive survey designs and methods that would exceed the duration of any one activity (*e.g.,* regular distribution and abundance surveys, moored arrays for before/during/after studies) and/or require levels of collaboration, planning and permitting (behavioral response studies, aerial programs to evaluate mitigation effectiveness) that are not reasonable in the context of an activity that consists of one mobile source moving across a large area and that will last less than a year and, further, is not appropriate in the context of the comparatively smaller scale of total surveys in the Atlantic at the current time.

Most importantly, regardless of whether other monitoring plans would also suffice, we believe that the visual and acoustic monitoring required for each of these surveys meets the MMPA requirement for monitoring and reporting. NRDC implies that monitoring within 1 km of the vessel is not useful or adequate. First, the required monitoring is not limited to within a zone, as PSOs will record the required information at whatever distance they can accurately collect it—and past monitoring reports from similar platforms show useful data collected beyond 1 km. Further, even if the PSOs cannot always see, or acoustically monitor, the entire zone within which take is estimated to occur, the data collected will still be both qualitatively and quantitatively informative, as behaviors will be detectable within these distances and there are accepted methods for extrapolating sightings data to make inferences about larger areas. For these surveys, the PSOs will gather detailed information on the marine mammals both sighted and acoustically detected, their behaviors (different facets detectable visually and acoustically) and locations in relation to the sound source, and the operating status of any sound sources—allowing for a better understanding of both the impacted species as well as the taking itself.

Comment: Multiple commenters provided various comments concerning transparency and data sharing with regard to data reported to NMFS.

Response: We agree with the overall point and will make all data reported to NMFS in accordance with IHA requirements available for public review following review and approval of reports by NMFS. However, several commenters were apparently confused about the nature of data required to be reported to NMFS and/or the mechanism of reporting. For example, Oceana stated that NMFS should "make the seismic survey data available to industry, government, and the public so that all stakeholders can make an informed cost-benefit analysis and decide whether offshore drilling should be allowed. . . ." However, the survey data apparently referenced by Oceana is not required to be provided by the applicants to NMFS, but is provided to BOEM. Oceana also stated that NMFS should "live stream data as often as possible as well as archive the passive acoustic monitoring feed." Respectfully, we are unclear as to what Oceana is referring to.

Comment: Several industry commenters took issue with the 15-km buffers that NMFS understands will be required around National Marine Sanctuaries.

Response: We described these requirements, which are a product of discussions between BOEM and NOAA's Office of National Marine Sanctuaries, in our Notice of Proposed IHAs solely for purposes of thoroughness. Here, we clarify that this standoff distance is not a requirement of NMFS and will not be included in any issued IHAs. As such, criticisms of this requirement (which we expect to be included as conditions in permits issued by BOEM) are not relevant here and we do not respond to them.

Comment: A few commenters suggested that NMFS should fully implement NOAA's Ocean Noise Strategy, which they interpreted as meaning that certain knowledge gaps on marine mammals and noise must be filled before NMFS may issue these IHAs. Another commenter said that to help support implementation of the Ocean Noise Strategy Roadmap (*cetsound.noaa.gov/Assets/cetsound/documents/Roadmap/ONS_Roadmap_Final_Complete.pdf*), the agencies (*i.e.,* NOAA and BOEM) should undertake efforts to evaluate impacts to marine mammal habitat before, during, and after surveys occur.

Response: NMFS appreciates the support for the Ocean Noise Strategy and agrees with the goal of focusing both agency science and agency-required monitoring towards filling known gaps in our understanding of the effects of noise on marine mammals wherever possible and appropriate. The Ocean Noise Strategy does not mandate any specific actions, though; rather, it directs NOAA to use our existing authorities and capacities to focus on the management, science, decision-making tool, and outreach goals outlined in the Roadmap. In the case of MMPA incidental take authorizations, NMFS must abide by statutory directive, and we have described above (both in comment response and elsewhere in the body of this Notice) our rationale for including the monitoring and reporting measures in these IHAs. In the context of MMPA authorizations, it is typically easier to apply some of the monitoring and research goals articulated in the Ocean Noise Strategy through section 101(a)(5)(A) rulemaking, as the expanded scope and longer duration of the coverage period are better suited to more complex, large-scale, or expensive approaches (*e.g.,* such as those utilized for U.S. Navy training and testing incidental take regulations).

National Environmental Policy Act

Comment: NRDC and Oceana provide a litany of complaints regarding the sufficiency of BOEM's EIS and its suitability for supporting NMFS's decision analysis, and state that NMFS must prepare a separate analysis before taking action.

Response: Following independent evaluation of BOEM's EIS, and review of public comments, NMFS determined BOEM's 2014 Final PEIS to be comprehensive in analyzing the broad scope of potential survey activities, and that the evaluation of the direct, indirect, and cumulative impacts on the human environment, including the marine environment, is adequate to support NMFS's consideration for future issuance of ITAs to geophysical companies and other potential applicants through tiering and incorporation by reference. NMFS further determined that subsequent issuance of ITAs for survey activities is likely to fall within the scope of the analysis in the 2014 Final PEIS, particularly since the impacts of the alternatives evaluated by BOEM (1) assess impact over a much longer period of time (*i.e.,* nine years) than is analyzed by NMFS for any given ITA, (2) encompass many of the same factors NMFS historically considered when reviewing ITAs for geophysical surveys or related activity (*i.e.,* marine mammal exposures, intensity of acoustic exposure, monitoring and mitigation factors, and more), and (3) are substantially the same as the impacts of NMFS's issuance of any given ITA for take of marine mammals incidental to future applicants' survey activities. The 2014 Final PEIS also addresses NOAA's required components for adoption as it meets the requirements for an adequate EIS under the CEQ regulations (40 CFR part 1500–1508) and NOAA Administrative Order 216–6A and reflects comments and expert input provided by NOAA as a cooperating agency. Therefore, NMFS subsequently signed a Record of Decision that: (1) Adopted the Final PEIS to support NMFS's analysis associated with issuance of ITAs pursuant to sections 101(a)(5)(A) or (D) of the MMPA and the regulations governing the taking and importing of marine mammals (50 CFR part 216), and (2) in accordance with 40 CFR 1505.2, announced and explained the basis for NMFS's decision to review and potentially issue ITAs under the MMPA on a case-by-case basis, if appropriate, guided by the analyses in the Final PEIS and mitigation measures specified in BOEM's 2014 ROD.

However, following review of public comments, NMFS agrees with NRDC and other commenters who suggested that it would not be appropriate for NMFS to simply adopt BOEM's EIS (our stated approach in the Notice of Proposed IHAs). Although we disagree with claims that the EIS is deficient, it is appropriate to evaluate whether supplementation is necessary. In so doing, we consider (1) whether new information not previously considered in the EIS is now available; (2) whether that new information may change the impact analysis contained in the EIS; and (3) whether our impact conclusions may change as a result of the new information and new impact analyses. However, we further consider that the EIS was purposely developed so that additional information could be included in subsequent NEPA evaluations. Because we determined that relevant new information was in fact available, in addition to applicant-specific details, we determined it appropriate to conduct a supplemental Environmental Assessment.

NMFS determined that conducting NEPA review and preparing a tiered EA is appropriate to analyze environmental impacts associated with NMFS's issuance of separate IHAs to five different companies. NMFS further determined that the issuance of these five IHAs are ''similar'' but not ''connected actions'' per 40 CFR 1508.25(a)(3) due to general commonalities in geography, timing, and type of activity, which provides a reasonable basis for evaluating them together in a single environmental analysis. The EA also incorporates relevant portions of BOEM's Final PEIS while focusing analysis on environmental issues specific to the five IHAs. NMFS has completed the necessary environmental analysis under NEPA.

Miscellaneous

Comment: Several commenters suggest that NMFS should require the applicants to consolidate their surveys.

Response: Requiring individual applicants to alter their survey objectives and/or design does not fall within NMFS's authority. Moreover, though these multiple concurrent surveys are perceived as ''duplicative,'' they are in fact designed specifically to produce proprietary data that satisfies the needs of survey funders. As is the current practice in the Gulf of Mexico, it is within BOEM's jurisdiction as the permitting agency to require permit applicants to submit statements indicating that existing data are not available to meet the data needs identified for the applicant's survey (*i.e.,* non-duplicative survey statement), but such requirements are not within NMFS's purview. For example, NRDC claims erroneously that NMFS ''has authority under the mitigation provision of the MMPA to consider directing the companies to consolidate their surveys,'' placing such a requirement under the auspices of practicability. Leaving aside that directing any given applicant to abandon their survey plans would not in fact be practicable, it is inappropriate to consider this suggested requirement through that lens. Similarly, the MMC vaguely references section 101(a)(5)(A)(i)(II)(aa) in stating that NMFS is provided authority to require such consolidation—we assume that MMC intended to reference the parallel language at section 101(a)(5)(D)(ii)(I), which states only that NMFS shall prescribe the ''means of effecting the least practicable impact on such species or stock and its habitat.'' NMFS considers the specified activity described by an applicant in reviewing a request for an incidental take authorization; nothing in the statute provides authority to direct consolidation of independent specified activities (regardless of any presumption of duplication, about which NMFS is not qualified to judge).

The MMC specifically cites a number of collaborative surveys conducted in foreign waters, and recommends that NMFS ''work with BOEM'' to require such collaboration. However, MMC provides no useful recommendations as to how such collaboration might be achieved. Given the absence of appropriate statutory authority, we recommend that the MMC itself undertake to foster such collaboration between geophysical data acquisition companies and relevant Federal agencies as it deems necessary to protect and conserve marine mammals. NMFS looks forward to joining in such an MMC-led collaboration, as appropriate.

We also note that industry commenters stated, anticipating suggestions of this sort, that such recommendations ''are based upon a substantial misunderstanding of important technical, operational, and economic aspects of seismic surveying.'' These commenters also noted that, based on the findings of an expert panel recently convened by BOEM to study the issue of duplicative surveys (see Appendix L in BOEM, 2017), none of the surveys considered here would meet the definition established for a ''duplicate'' survey.

Comment: NRDC contends that NMFS must consider a standard requiring analysis and selection of minimum source levels. In furtherance of this overall quieting goal, NRDC also states that NMFS should consider requiring that all vessels employed in the survey activities undergo regular maintenance to minimize propeller cavitation and be required to employ the best ship-quieting designs and technologies available for their class of ship, and that we should require these vessels to undergo measurement for their underwater noise output.

Response: An expert panel convened by BOEM to determine whether it would be feasible to develop standards to determine a lowest practicable source level has determined that it would not be reasonable or practicable to develop such metrics (see Appendix L in BOEM, 2017). We appreciate that NRDC disagrees with the panel's findings, but we do not believe it appropriate to address these grievances to NMFS. NRDC further claims that NMFS's deference to the findings of an expert panel convened specifically to consider this issue is ''arbitrary under the MMPA.'' The bulk of NRDC's comment appears to be addressed to BOEM, and we encourage NRDC to engage with BOEM regarding these supposed shortcomings of the panel's findings. The subject matter is outside NMFS's expertise, and we have no basis upon which to doubt the panel's published findings. We decline to address here the ways in which NRDC claims that BOEM misunderstood the issue.

With regard to the recommended requirements to measure or control vessel noise, or to make some minimum requirements regarding the design of vessels used in the surveys, we disagree that these requirements would be practicable. While we agree that vessel noise is of concern in a cumulative and chronic sense, it is not of substantial concern in relation to the MMPA's least practicable adverse impact standard, given the few vessels used in any given specified activity. NMFS looks forward to continued collaboration with NRDC and others towards ship quieting.

Description of Marine Mammals in the Area of the Specified Activities

We refer readers to NMFS's Stock Assessment Reports (SAR; *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*), species descriptions provided on NMFS's website (*www.fisheries.noaa.gov/find-species*), and to the applicants' species descriptions (Sections 3 and 4 of the applications). These sources summarize available information regarding physical descriptions, status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of the potentially affected species, and are not reprinted here.

Table 2 lists all species with expected potential for occurrence in the mid- and south Atlantic and summarizes information related to the population or stock, including potential biological removal (PBR). For taxonomy, we follow Committee on Taxonomy (2017). PBR, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population, is considered in concert with known sources of ongoing anthropogenic mortality (as described in NMFS's SARs). For status of species, we provide information regarding U.S. regulatory status under the MMPA and ESA.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study area. NMFS's stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. Survey abundance (as compared to stock or species abundance) is the total number of individuals estimated within the survey area, which may or may not align completely with a stock's geographic range as defined in the SARs. These surveys may also extend beyond U.S. waters.

In some cases, species are treated as guilds. In general ecological terms, a guild is a group of species that have similar requirements and play a similar role within a community. However, for purposes of stock assessment or abundance prediction, certain species may be treated together as a guild because they are difficult to distinguish visually and many observations are ambiguous. For example, NMFS's Atlantic SARs assess *Mesoplodon* spp. and *Kogia* spp. as guilds. Here, we consider pilot whales, beaked whales (excluding the northern bottlenose whale), and *Kogia* spp. as guilds. In the following discussion, reference to ''pilot whales'' includes both the long-finned and short-finned pilot whale, reference to ''beaked whales'' includes the Cuvier's, Blainville's, Gervais, Sowerby's, and True's beaked whales, and reference to ''*Kogia* spp.'' includes both the dwarf and pygmy sperm whale.

Thirty-four species (with 39 managed stocks) are considered to have the potential to co-occur with the planned survey activities. Species that could potentially occur in the survey areas but are not expected to have reasonable potential to be harassed by any survey are omitted from further analysis. These include extralimital species, which are species that do not normally occur in a given area but for which there are one or more occurrence records that are considered beyond the normal range of the species. Extralimital species or stocks unlikely to co-occur with survey activity include nine estuarine bottlenose dolphin stocks, four pinniped species, the white-beaked dolphin (*Lagenorhynchus albirostris*), and the beluga whale (*Delphinapterus leucas*). For detailed discussion of these species, please see our **Federal Register** Notice of Proposed IHAs (82 FR 26244; June 6, 2017). In addition, the West Indian manatee (*Trichechus manatus latirostris*) may be found in coastal waters of the Atlantic. However, manatees are managed by the U.S. Fish and Wildlife Service and are not considered further in this document. All managed stocks in this region are assessed in NMFS's U.S. Atlantic SARs. All values presented in Table 2 are the most recent available at the time of publication and are available in the 2017 SARs (Hayes *et al.,* 2018a) and draft 2018 SARs (available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports*).

TABLE 2—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF SURVEY ACTIVITIES

Common name	Scientific name	Stock	ESA/ MMPA status; strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2]	Predicted mean (CV)/ maximum abundance [3]	Predicted abundance outside EEZ [4]	PBR	Annual M/SI (CV) [5]
Order Cetartiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)								
Family Balaenidae:								
North Atlantic right whale.	*Eubalaena glacialis*	Western North Atlantic (WNA).	E/D; Y	451 (n/a; 445; n/a)	394 (0.07) *	1	0.9	5.56
Family Balaenopteridae (rorquals):								
Humpback whale	*Megaptera novaeangliae novaeangliae*.	Gulf of Maine	-; N	896 (n/a; 896; 2015)	1,637 (0.07) */ 1,994.	8	14.6	9.8

TABLE 2—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF SURVEY ACTIVITIES—Continued

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N)[1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey)[2]	Predicted mean (CV)/maximum abundance[3]	Predicted abundance outside EEZ[4]	PBR	Annual M/SI (CV)[5]
Minke whale	*Balaenoptera acutorostrata acutorostrata.*	Canadian East Coast	-; N	2,591 (0.81; 1,425; 2011).	2,112 (0.05) */2,431.	929	14	7.5
Bryde's whale	*B. edeni brydei*	None defined[6]	-; n/a	n/a	7 (0.58)/n/a	7	n/a	n/a
Sei whale	*B. borealis borealis*	Nova Scotia	E/D; Y	357 (0.52; 236; 2011)	717 (0.30) */1,519.	46	0.5	0.6
Fin whale	*B. physalus physalus*	WNA	E/D; Y	1,618 (0.33; 1,234; 2011).	4,633 (0.08)/6,538.	44	2.5	2.5
Blue whale	*B. musculus musculus*	WNA	E/D; Y	Unknown (n/a; 440; n/a).	11 (0.41)/n/a	4	0.9	Unk.
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)								
Family Physeteridae:								
Sperm whale	*Physeter macrocephalus.*	North Atlantic	E/D; Y	2,288 (0.28; 1,815; 2011).	5,353 (0.12)/7,193.	2,456	3.6	0.8
Family Kogiidae:								
Pygmy sperm whale.	*Kogia breviceps*	WNA	-; N	3,785 (0.47; 2,598; 2011)[7].	678 (0.23)/n/a[7].	428	21	3.5 (1.0)
Dwarf sperm whale	*K. sima*	WNA	-; N					
Family Ziphiidae (beaked whales):								
Cuvier's beaked whale.	*Ziphius cavirostris*	WNA	-; N	6,532 (0.32; 5,021; 2011).	14,491 (0.17)/16,635[7].	9,426	50	0.4
Gervais beaked whale.	*Mesoplodon europaeus*	WNA	-; N	7,092 (0.54; 4,632; 2011)[7].			46	0.2
Blainville's beaked whale.	*M. densirostris*	WNA	-; N					
Sowerby's beaked whale.	*M. bidens*	WNA	-; N					
True's beaked whale.	*M. mirus*	WNA	-; N					
Northern bottlenose whale.	*Hyperoodon ampullatus*	WNA	-; N	Unknown	90 (0.63)/n/a	11	Undet.	0
Family Delphinidae:								
Rough-toothed dolphin.	*Steno bredanensis*	WNA	-; N	136 (1.0; 67; 2016)	532 (0.36)/n/a	313	0.7	0
Common bottlenose dolphin.	*Tursiops truncatus truncatus.*	WNA Offshore	-; N	77,532 (0.40; 56,053; 2011).	97,476 (0.06)/144,505[7].	5,280	561	39.4 (0.29)
		WNA Coastal, Northern Migratory.	D; Y	6,639 (0.41; 4,759; 2016)			48	6.1 (0.32)–13.2 (0.22)
		WNA Coastal, Southern Migratory.	D; Y	3,751 (0.60; 2,353; 2016).			23	0–14.3 (0.31)
		WNA Coastal, South Carolina/Georgia.	D; Y	6,027 (0.34; 4,569; 2016).			46	1.4–1.6
		WNA Coastal, Northern Florida.	D; Y	877 (0.49; 595; 2016)			6	0.6
		WNA Coastal, Central Florida.	D; Y	1,218 (0.35; 913; 2016)			9.1	0.4
Clymene dolphin	*Stenella clymene*	WNA	-; N	6,086 (0.93; 3,132; 1998)[8].	12,515 (0.56)/n/a.	11,503	Undet.	0
Atlantic spotted dolphin.	*S. frontalis*	WNA	-; N	44,715 (0.43; 31,610; 2011).	55,436 (0.32)/137,795.	7,339	316	0
Pantropical spotted dolphin.	*S. attenuata attenuata*	WNA	-; N	3,333 (0.91; 1,733; 2011).	4,436 (0.33)/n/a.	2,781	17	0
Spinner dolphin	*S. longirostris longirostris.*	WNA	-; N	Unknown	262 (0.93)/n/a	184	Undet.	0
Striped dolphin	*S. coeruleoalba*	WNA	-; N	54,807 (0.3; 42,804; 2011).	75,657 (0.21)/172,158.	15,166	428	0
Common dolphin	*Delphinus delphis delphis.*	WNA	-; N	70,184 (0.28; 55,690; 2011).	86,098 (0.12)/129,977.	3,154	557	406 (0.10)
Fraser's dolphin	*Lagenodelphis hosei*	WNA	-; N	Unknown	492 (0.76)/n/a	474	Undet.	0
Atlantic white-sided dolphin.	*Lagenorhynchus acutus*	WNA	-; N	48,819 (0.61; 30,403; 2011).	37,180 (0.07)/59,008.	368	304	57 (0.15)
Risso's dolphin	*Grampus griseus*	WNA	-; N	18,250 (0.46; 12,619; 2011).	7,732 (0.09)/18,377.	1,060	126	49.9 (0.24)
Melon-headed whale.	*Peponocephala electra*	WNA	-; N	Unknown	1,175 (0.50)/n/a.	1,095	Undet.	0
Pygmy killer whale	*Feresa attenuata*	WNA	-; N	Unknown	n/a	n/a	Undet.	0
False killer whale	*Pseudorca crassidens*	WNA	-; Y	442 (1.06; 212; 2011)	95 (0.84)/n/a	35	2.1	Unk.
Killer whale	*Orcinus orca*	WNA	-; N	Unknown	11 (0.82)/n/a	4	Undet.	0
Short-finned pilot whale.	*Globicephala macrorhynchus.*	WNA	-; N	28,924 (0.24; 23,637; 2016).	18,977 (0.11)/35,715[6].	2,258	236	168 (0.13)
Long-finned pilot whale	*G. melas melas*	WNA	-; N	5,636 (0.63; 3,464; 2011).			35	27 (0.18)

TABLE 2—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF SURVEY ACTIVITIES—Continued

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2]	Predicted mean (CV)/maximum abundance [3]	Predicted abundance outside EEZ [4]	PBR	Annual M/SI (CV) [5]
Family Phocoenidae (porpoises):								
Harbor porpoise	*Phocoena phocoena phocoena.*	Gulf of Maine/Bay of Fundy.	-; N	79,833 (0.32; 61,415; 2011).	45,089 (0.12)*/ 50,315.	91	706	255 (0.18)

[1] Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] NMFS marine mammal stock assessment reports online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments.* CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For the right whale, the best abundance value is based on a model of the sighting histories of individually identifiable animals (as of October 2017). The model of these histories produced a median abundance value of 451 whales (95 percent credible intervals 434–464). The minimum estimate of 440 blue whales represents recognizable photo-identified individuals.

[3] This information represents species- or guild-specific abundance predicted by habitat-based cetacean density models (Roberts *et al.,* 2016). For the North Atlantic right whale, we report the outputs of a more recently updated model (Roberts *et al.,* 2017). These models provide the best available scientific information regarding predicted density patterns of cetaceans in the U.S. Atlantic Ocean, and we provide the corresponding mean annual and maximum monthly abundance predictions. Total abundance estimates were produced by computing the mean density of all pixels in the modeled area and multiplying by its area. Roberts *et al.* (2016) did not produce a density model for pygmy killer whales off the east coast. For those species marked with an asterisk, the available information supported development of either two or four seasonal models; each model has an associated abundance prediction. Here, we report the maximum predicted seasonal abundance.

[4] The density models used to predict acoustic exposures (*e.g.,* Roberts *et al.,* 2016) provide abundance predictions for the area within the U.S. EEZ. However, the model outputs were also extrapolated to the portion of the specific geographic region outside the EEZ in order to predict acoustic exposures in that area (*i.e.,* from 200 nmi to 350 nmi offshore). Therefore, we calculated corresponding seasonal abundance estimates for this region. The maximum seasonal abundance estimate is reported.

[5] These values, found in NMFS's SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.,* commercial fisheries, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.

[6] Bryde's whales are occasionally reported off the southeastern U.S. and southern West Indies. NMFS defines and manages a stock of Bryde's whales that is resident in the northern Gulf of Mexico, but does not define a separate stock in the Atlantic Ocean.

[7] Abundance estimates are in some cases reported for a guild or group of species when those species are difficult to differentiate at sea. Similarly, the habitat-based cetacean density models produced by Roberts *et al.* (2016) are based in part on available observational data which, in some cases, is limited to genus or guild in terms of taxonomic definition. NMFS's SARs present pooled abundance estimates for *Kogia* spp. and *Mesoplodon* spp., while Roberts *et al.* (2016) produced density models to genus level for *Kogia* spp. and *Globicephala* spp. and as a guild for most beaked whales (*Ziphius cavirostris* and *Mesoplodon* spp.). Finally, Roberts *et al.* (2016) produced a density model for bottlenose dolphins that does not differentiate between offshore and coastal stocks.

[8] NMFS's abundance estimates for the Clymene dolphin is greater than eight years old and not considered current. PBR is therefore considered undetermined for this stock, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimate.

For the majority of species potentially present in the specific geographic region, NMFS has designated only a single generic stock (*e.g.,* ''western North Atlantic'') for management purposes. This includes the ''Canadian east coast'' stock of minke whales, which includes all minke whales found in U.S. waters. For the humpback and sei whales, NMFS defines stocks on the basis of feeding locations, *i.e.,* Gulf of Maine and Nova Scotia, respectively. However, our reference to humpback whales and sei whales in this document refers to any individuals of the species that are found in the specific geographic region. These individuals may be from the same breeding population (*e.g.,* West Indies breeding population of humpback whales) but visit different feeding areas. For the bottlenose dolphin, NMFS defines an oceanic stock and multiple coastal stocks.

North Atlantic Right Whale—We provide additional discussion of the North Atlantic right whale in order to address the current status of the species, which has deteriorated since publication of our Notice of Proposed IHAs. The North Atlantic right whale was severely depleted by historical whaling, and was originally listed as endangered under the ESA in 1970. The right whale's range historically extended to the eastern North Atlantic, as well as the Denmark Strait and waters south of Greenland. However, sightings of right whales beyond their current western North Atlantic distribution are rare and the eastern North Atlantic population may be functionally extinct (Kraus and Rolland, 2007; Best *et al.,* 2001). In the western North Atlantic, a median abundance value of 451 whales in October 2017 (as reported in NMFS's draft 2018 SARs and Table 2) based on a Bayesian mark-recapture open population model, which accounts for individual differences in the probability of being photographed (95 percent credible intervals 434–464, Pace *et al.,* 2017). Accurate pre-exploitation abundance estimates are not available for either population of the species. The western population may have numbered fewer than 100 individuals by 1935, when international protection for right whales came into effect (Kenney *et al.,* 1995).

Modeling suggests that in 1980, females had a life expectancy of approximately 52 years of age (twice that of males at the time) (Fujiwara and Caswell, 2001). However, due to reduced survival probability, in 1995 female life expectancy was estimated to have declined to approximately 15 years, with males having a slightly higher life expectancy into the 20s (Fujiwara and Caswell, 2001). A recent study demonstrated that females have substantially higher mortality than males (Pace *et al.,* 2017), and as a result, also have substantially shorter life expectancies.

Gestation is approximately one year, after which calves typically nurse for around a year (Kenney, 2009; Kraus *et al.,* 2007; Lockyer, 1984). After weaning calves, females typically undergo a 'resting' year before becoming pregnant again, presumably because they need time to recover from the energy deficit experienced during lactation (Fortune *et al.,* 2012, 2013; Pettis *et al.,* 2017b). From 1983 to 2005, annual average calving intervals ranged from 3 to 5.8 years (Knowlton *et al.,* 1994; Kraus *et al.,* 2007). Between 2006 and 2015, annual average calving intervals continued to vary within this range, but in 2016 and 2017 longer calving intervals were reported (6.3 to 6.6 years in 2016 and 10.2 years in 2017; Pettis and Hamilton, 2015, 2016; Pettis *et al.,* 2017a; Surrey-Marsden *et al.,* 2017; Hayes *et al.,* 2018b). Females have been known to give birth as young as five years old, but the mean age of first parturition is about 10 years old (Kraus *et al.,* 2007).

Pregnant North Atlantic right whales migrate south, through the mid-Atlantic region of the United States, to low latitudes during late fall where they overwinter and give birth in shallow, coastal waters (Kenney, 2009; Krzystan *et al.,* 2018). During spring, these females migrate back north with their new calves to high latitude foraging grounds where they feed on large concentrations of copepods, primarily *Calanus finmarchicus* (NMFS, 2017). Some non-reproductive North Atlantic right whales (males, juveniles, non-reproducing females) also migrate south through the mid-Atlantic region, although at more variable times throughout the winter, while others appear to not migrate south, and instead remain in the northern feeding grounds year round or go elsewhere (Bort *et al.,* 2015; Morano *et al.,* 2012; NMFS, 2017). Nonetheless, calving females arrive to the southern calving grounds earlier and stay in the area more than twice as long as other demographics (Krzystan *et al.,* 2018). Little is known about North Atlantic right whale habitat use in the mid-Atlantic, but recent acoustic data indicate near year-round presence of at least some whales off the coasts of New Jersey, Virginia, and North Carolina (Davis *et al.,* 2017; Hodge *et al.,* 2015a; Salisbury *et al.,* 2016; Whitt *et al.,* 2013). Oedekoven *et al.* (2015) conducted an expert elicitation exercise to assess potential seasonal abundance of right whales in the mid-Atlantic, confirming that very low numbers of whales should be expected to be present in the region outside of the November to April timeframe. While it is generally not known where North Atlantic right whales mate, some evidence suggests that mating may occur in the northern feeding grounds (Cole *et al.,* 2013; Matthews *et al.,* 2014).

The western North Atlantic right whale population demonstrated overall growth of 2.8 percent per year between 1990 to 2010, despite a decline in 1993 and no growth between 1997 and 2000 (Pace *et al.,* 2017). However, since 2010 the population has been in decline, with a 99.99 percent probability of a decline of just under one percent per year (Pace *et al.,* 2017). Between 1990 and 2015, survival rates appeared to be relatively stable, but differed between the sexes, with males having higher survivorship than females (males: 0.985 ± 0.0038; females: 0.968 ± 0.0073) leading to a male-biased sex ratio (approximately 1.46 males per female; Pace *et al.,* 2017). During this same period, calving rates varied substantially, with low calving rates coinciding with all three periods of decline or no growth (Pace *et al.,* 2017). On average, North Atlantic right whale calving rates are estimated to be roughly half that of southern right whales (*E. australis*) (Pace *et al.,* 2017), which are increasing in abundance (NMFS, 2015c).

While data are not yet available to statistically estimate the population's trend beyond 2015, three lines of evidence indicate the population is still in decline. First, calving rates in recent years were low, with only five new calves being documented in 2017 (Pettis *et al.,* 2017a), well below the number needed to compensate for expected mortalities (Pace *et al.,* 2017). In 2018, no new North Atlantic right whale calves were documented in their calving grounds; this represented the first time since annual NOAA aerial surveys began in 1989 that no new right whale calves were observed. Long-term photographic identification data indicate new calves rarely go undetected, so these years likely represent a continuation of the low calving rates that began in 2012 (Kraus *et al.,* 2007; Pace *et al.,* 2017). Second, as noted above, the abundance estimate for 2016 is 451 individuals, down approximately 1.5 percent from 458 in 2015. Third, since June 2017, at least 20 North Atlantic right whales have died in what has been declared an Unusual Mortality Event (UME; see additional discussion of the UME below).

Analysis of mtDNA from North Atlantic right whales has identified seven mtDNA haplotypes in the western North Atlantic (Malik *et al.,* 1999; McLeod and White, 2010). This is significantly less diverse than southern right whales and may indicate inbreeding (Hayes *et al.,* 2018a; Malik *et al.,* 2000; Schaeff *et al.,* 1997). While analysis of historic DNA taken from museum specimens indicates that the eastern and western populations were likely not genetically distinct, the lack of recovery of the eastern North Atlantic population indicates at least some level of population segregation (Rosenbaum *et al.,* 1997, 2000). Overall, the species has low genetic diversity as would be expected based on its low abundance. However, analysis of 16th and 17th century whaling bones indicate this low genetic diversity may pre-date whaling activities (McLeod *et al.,* 2010). Despite this, Frasier *et al.* (2013) recently identified a post-copulatory mechanism that appears to be slowly increasing genetic diversity among right whale calves.

In recent years, there has been a shift in distribution in right whale feeding grounds, with fewer animals being seen in the Great South Channel and the Bay of Fundy and perhaps more animals being observed in the Gulf of Saint Lawrence and mid-Atlantic region (Daoust *et al.,* 2017; Davis *et al.,* 2017; Hayes *et al.,* 2018a; Pace *et al.,* 2017; Meyer-Gutbrod *et al.,* 2018). However, in recent years, a few known individuals from the western population have been seen in the eastern Atlantic, suggesting some individuals may have wider ranges than previously thought (Kenney, 2009).

Currently, no identified right whale recovery goals have been met (for more information on these goals, see the 2005 recovery plan; NMFS, 2005, 2017). With whaling now prohibited, the two major known human causes of mortality are vessel strikes and entanglement in fishing gear (Hayes *et al.,* 2018b). Some progress has been made in mitigating vessel strikes by regulating vessel speeds in certain areas (78 FR 73726; December 9, 2013) (Conn and Silber, 2013), but entanglement in fishing gear remains a major threat (Kraus *et al.,* 2016), which appears to be worsening (Hayes *et al.,* 2018b). From 1990 to 2010, the population experienced overall growth consistent with one of its recovery goals. However, the population is currently experiencing a UME that appears to be related to both vessel strikes and entanglement in fishing gear (Daoust *et al.,* 2017; see below for further discussion). In addition, the low female survival, male biased sex ratio, and low calving success indicated by recent modeling are contributing to the population's current decline (Pace *et al.,* 2017). While there are likely a multitude of factors involved, low calving has been linked to poor female health (Rolland *et al.,* 2016) and reduced prey availability (Meyer-Gutbrod and Greene, 2014, 2017; Meyer-Gutbrod *et al.,* 2018). Furthermore, entanglement in fishing gear appears to have substantial health and energetic costs that affect both survival and reproduction (Pettis *et al.,* 2017b; Robbins *et al.,* 2015; Rolland *et al.,* 2017; van der Hoop *et al.,* 2017; Hayes *et al.,* 2018b; Hunt *et al.,* 2018; Lysiak *et al.,* 2018). In fact, there is evidence of a population-wide decline in health since the early 1990s, the last time the population experienced a population decline (Rolland *et al.,* 2016). Given this status, the species resilience to future perturbations is considered very low (Hayes *et al.,* 2018b). Using a matrix population projection model, Hayes *et al.* (2018b) estimate that by 2029 the population will to decline to the 1990 estimate of 123 females if the current rate of decline is not altered. Consistent with this, recent modelling efforts by Meyer-Gutbrod and Greene (2017) indicate that that the species may decline towards extinction if prey conditions worsen, as predicted under future climate scenarios, and anthropogenic mortalities are not reduced (Grieve *et al.,* 2017; Meyer-Gutbrod *et al.,* 2018). In fact, recent data from the Gulf of Maine and Gulf of St. Lawrence indicate prey densities may already be in decline (Devine *et al.,* 2017; Johnson *et al.,* 2013; Meyer-Gutbrod *et al.,* 2018).

Discussion of Abundance Estimates—In Table 2 above, we report two sets of abundance estimates: Those from NMFS's SARs and those predicted by Roberts *et al.* (2016)—for the latter we provide both the annual mean and maximum, for those taxa for which monthly predictions are available (*i.e.,* all taxa for which density surface models, versus stratified models, were produced). Please see Table 2, footnotes 2–3 for more detail. We provided a relatively brief discussion of available abundance estimates in the Notice of Proposed IHAs, stating that the Roberts *et al.* (2016) abundance predictions are generally the most appropriate in this case for purposes of comparison with estimated exposures (see ''Estimated Take''). This is because the outputs of these models were used in most cases to generate the exposure estimates, *i.e.,* we appropriately make relative comparisons between the exposures predicted by the outputs of the model and the abundance predicted by the model. Following review of public comments received and additional review of available information regarding abundance estimates, we provide revised and additional discussion of available abundance estimates and our use of these herein.

Because both the SAR (in most cases) and Roberts *et al.* (2016) values provide estimates of abundance only within the U.S. EEZ, whereas the specified activities (and associated exposure estimates) extend beyond this region out to 350 nmi, we calculated the expected abundance of each species in the region offshore of the EEZ out to 350 nmi. These values, reported in Table 2, are appropriately added to the Roberts *et al.* (2016) EEZ estimates to provide the total model-predicted abundance. Please see footnote 4 for more detail. Our prior use of abundance estimates that ignore the assumed abundance of animals outside the EEZ (explicit in the exposure estimation process) was an error that is rectified here.

As was described in our Notice of Proposed IHAs, NMFS's SAR abundance estimates are typically generated from the most recent shipboard and/or aerial surveys conducted, and often incorporate correction for detection bias. While these snapshot estimates provide valuable information about a stock, they are not generally relevant here for use in comparison to the take estimates, as stated above. The Roberts *et al.* (2016) abundance estimates represent the output of predictive models derived from observations and associated environmental parameters and are in fact based on substantially more data than are NMFS's SAR abundance estimates—thus minimizing the influence of interannual variability on abundance estimates. For example, NMFS's pilot whale abundance estimates from surveys conducted in 2004 and 2011 differed by 21 percent—a change not expected to represent the actual change in abundance—indicating that it may be more appropriate to use a model prediction that incorporates all available data.

The abundance values reported by Roberts *et al.* (2016), and which we largely used in our analyses in the Notice of Proposed IHAs, are mean annual abundance estimates (for species for which data are sufficient to model seasonality; for other species only a stratified model with static abundance could be produced). However, for those species for which seasonal variability could be modeled (via density surface models), abundance estimates are produced for each month (monthly maps of species distribution and associated abundance values are provided in supplementary reports for each taxon; these are available online at: *seamap.env.duke.edu/models/Duke-EC-GOM-2015/*). Following review of public comments received, we determined it appropriate to use the most appropriate maximum abundance estimate for purposes of comparison with the exposure estimate, rather than the mean. While it is appropriate to use a mean density value in estimating potential exposures over a year in order to avoid over- or under-estimation, the best actual population estimate for comparison would be the maximum theoretical population. That is, exposure estimates are most appropriately generated through use of means precisely because densities are expected to fluctuate within a study area throughout the year; however, because these fluctuations do not represent actual changes in population size, the maximum predicted abundance should be used in comparison with a given exposure estimate.

The appropriate maximum estimate for each taxon more closely represents actual total theoretical abundance of the stock as a whole, as those animals may exit the study area during other months but still exist conceptually as members of the population. The mean does not represent the actual population abundance, because although there are seasonal shifts in distribution, the actual population abundance should be as estimated for the period when the largest portion of the population is present in the area. While species may migrate or shift distribution out of the study area, total abundance of a stock changes only via births and deaths, *i.e.,* there is only one true abundance of the species. We note that for some taxa, Roberts *et al.* express confidence in the monthly model outputs, *e.g.,* where the predicted seasonal variations in abundance match those reported in the literature. However, for others they do not, *e.g.,* where there is little information available in the literature to corroborate the predicted seasonal variation. Lack of corroboration in the latter example would be a valid reason for not relying on monthly model outputs when determining the timing or location of a specific project. However, this does not impact our determination that the maximum theoretical population abundance is appropriate to use for purposes of comparison. For those taxa for which the monthly predictions are recommended for use, we use the maximum monthly prediction. For the remaining taxa for which a density surface model could be produced, we believe that use of the maximum monthly prediction may also be warranted. However, because for some of these species there are substantial month-to-month fluctuations and a corresponding lack of data in the literature regarding seasonal distribution, we use the maximum mean seasonal (*i.e.,* three-month) abundance prediction for purposes of comparison as a precaution.

For most species, we use the Roberts *et al.* (2016) abundance estimate, but substitute the appropriate maximum estimate for the mean annual estimate. Where we deviate from this practice, *e.g.,* because another available abundance estimate provides more complete coverage of the stock's range, we provide additional discussion below. We also note that, regarding SAR abundance estimates, Waring *et al.* (2015) state that the population of sperm whales found within the eastern U.S. Atlantic EEZ likely represent only a fraction of the total stock, indicating that the abundance associated with animals found in the EEZ—whether the SAR abundance or the model-predicted abundance—likely underestimate the true abundance of the relevant population. Additionally, the majority of current NMFS SAR estimates—those based on 2011 NOAA survey effort—do not account for availability bias due to submerged animals, so these abundance estimates are likely biased low.

NMFS's abundance estimate for the North Atlantic right whale is based on models of the sighting histories of individual whales identified using photo-identification techniques. North Atlantic right whales represent one of the most intensely studied populations of cetaceans in the world with effort supported by a rigorously maintained individual sightings database and considerable survey effort throughout their range; therefore, the most appropriate abundance estimate is based on this photo-identification database. The current estimate of 451 individuals (95% credible intervals 434–464) reflects the database as of November 2017 (*www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports*).

The 2007 Canadian Trans-North Atlantic Sighting Survey (TNASS), which provided full coverage of the Atlantic Canadian coast (Lawson and Gosselin, 2009), provided abundance estimates for multiple stocks. The abundance estimates from this survey were corrected for perception and availability bias, when possible. In general, where the TNASS survey effort provided superior coverage of a stock's range (as compared with NOAA survey effort), we elect to use the resulting abundance estimate over either the current NMFS abundance estimate (derived from survey effort with inferior coverage of the stock range) or the Roberts *et al.* (2016) predictions (which are based on survey data from within U.S. waters). The TNASS data were not made available to the model authors (Roberts *et al.,* 2015a).

We use the TNASS abundance estimate for the minke whale and for the short-beaked common dolphin. While the TNASS survey also produced an abundance estimate of 3,522 (CV=0.27) fin whales, and similarly better represents the stock range than does NMFS's SAR estimate, this value underrepresents the maximum population predicted by Roberts *et al.* (2016). We also note that, while there appears to be some slight overlap in their coverage of stock ranges, the abundance estimates provided by the TNASS surveys and by NMFS's SAR estimates largely cover separate portions of the ranges. The TNASS effort involved aerial surveys covering the Labrador Shelf and Grand Banks, the Gulf of St. Lawrence, and the Scotian Shelf, and the abundance estimates also included the results of aerial surveys conducted by NOAA in the Bay of Fundy. NMFS's current SAR estimates reflect NOAA shipboard and aerial survey effort conducted from Florida to the lower Bay of Fundy. Therefore, the most appropriate abundance estimate for these stocks may be a combination of the abundance estimates (for common dolphin: 70,184 (SAR) + 173,486 (TNASS) = 243,670; for minke whale: 2,591 (SAR) + 20,741 (TNASS) = 23,332). Other abundance estimates that may cover additional portions of these stocks' ranges are described in Waring *et al.* (2013). However, we use only the TNASS estimates, which better cover the stock ranges, because we are uncertain about the degree of potential coverage overlap in Canadian waters.

Note that, while the same TNASS survey produced an abundance estimate of 2,612 (CV=0.26) humpback whales, the survey did not provide superior coverage of the stock's range in the same way that it did for minke whales (Waring *et al.,* 2016; Lawson and Gosselin, 2011). In addition, based on photo-identification only 39 percent of individual humpback whales observed along the mid- and south Atlantic U.S. coast are from the Gulf of Maine stock (Barco *et al.,* 2002). Therefore, we use the Roberts *et al.* (2016) prediction for humpback whales. We note that the Roberts *et al.* (2016) maximum estimate of 1,994 humpback whales likely underrepresents the relevant population, *i.e.,* the West Indies breeding population. Bettridge *et al.* (2003) estimated the size of this population at 12,312 (95% CI 8,688–15,954) whales in 2004–05, which is consistent with previous population estimates of approximately 10,000–11,000 whales (Stevick *et al.,* 2003; Smith *et al.,* 1999) and the increasing trend for the West Indies DPS (Bettridge *et al.,* 2015). However, we retain the value predicted by Roberts *et al.* (2016) for appropriate comparison with the number of exposures predicted in the U.S. EEZ.

The current SARs abundance estimate for *Kogia* spp. is substantially higher than that provided by Roberts *et al.* (2016). However, the data from which the SARs estimate is derived was not made available to Roberts *et al.* (Roberts *et al.,* 2015h), and those more recent surveys reported observing substantially greater numbers of *Kogia* spp. than did earlier surveys (43 sightings, more than the combined total of 31 reported from all surveys from 1992–2014 considered by Roberts *et al.* (2016)) (NMFS, 2011). A 2013 NOAA survey, also not available to the model authors, reported 68 sightings of *Kogia* spp. (NMFS, 2013a). In addition, the SARs report an increase in *Kogia* spp. strandings (92 from 2001–05; 187 from 2007–11) (Waring *et al.,* 2007; 2013). A simultaneous increase in at-sea observations and strandings suggests increased abundance of *Kogia* spp., though NMFS has not conducted any trend analysis (Waring *et al.,* 2013). Therefore, we believe the most appropriate abundance estimate for use here is that currently reported by NMFS in the SARs. In fact, Waring *et al.* (2013) suggest that because this estimate was corrected for perception bias but not availability bias, the true estimate could be two to four times larger.

Biologically Important Areas—Several biologically important areas for some marine mammal species are recognized in the survey areas in the mid- and south Atlantic. Critical habitat is designated for the North Atlantic right whale within the southeast United States (81 FR 4838; January 27, 2016). Critical habitat is defined by section 3 of the ESA as (1) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such areas are essential for the conservation of the species. Critical habitat for the right whale in the southeast United States (*i.e.,* Unit 2) encompasses calving habitat and is designated on the basis of the following essential features: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7° C, and never more than 17° C; and (3) water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 nmi^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

The area associated with such features includes nearshore and offshore waters of the southeastern United States, extending from Cape Fear, North Carolina south to 28° N. The specific area designated as Unit 2 of critical habitat, as defined by regulation (81 FR 4838; January 27, 2016), is demarcated by rhumb lines connecting the specific points identified in 50 CFR 226.203(b)(2), as shown in Figure 2.

There is no critical habitat designated for any other species within the survey area.

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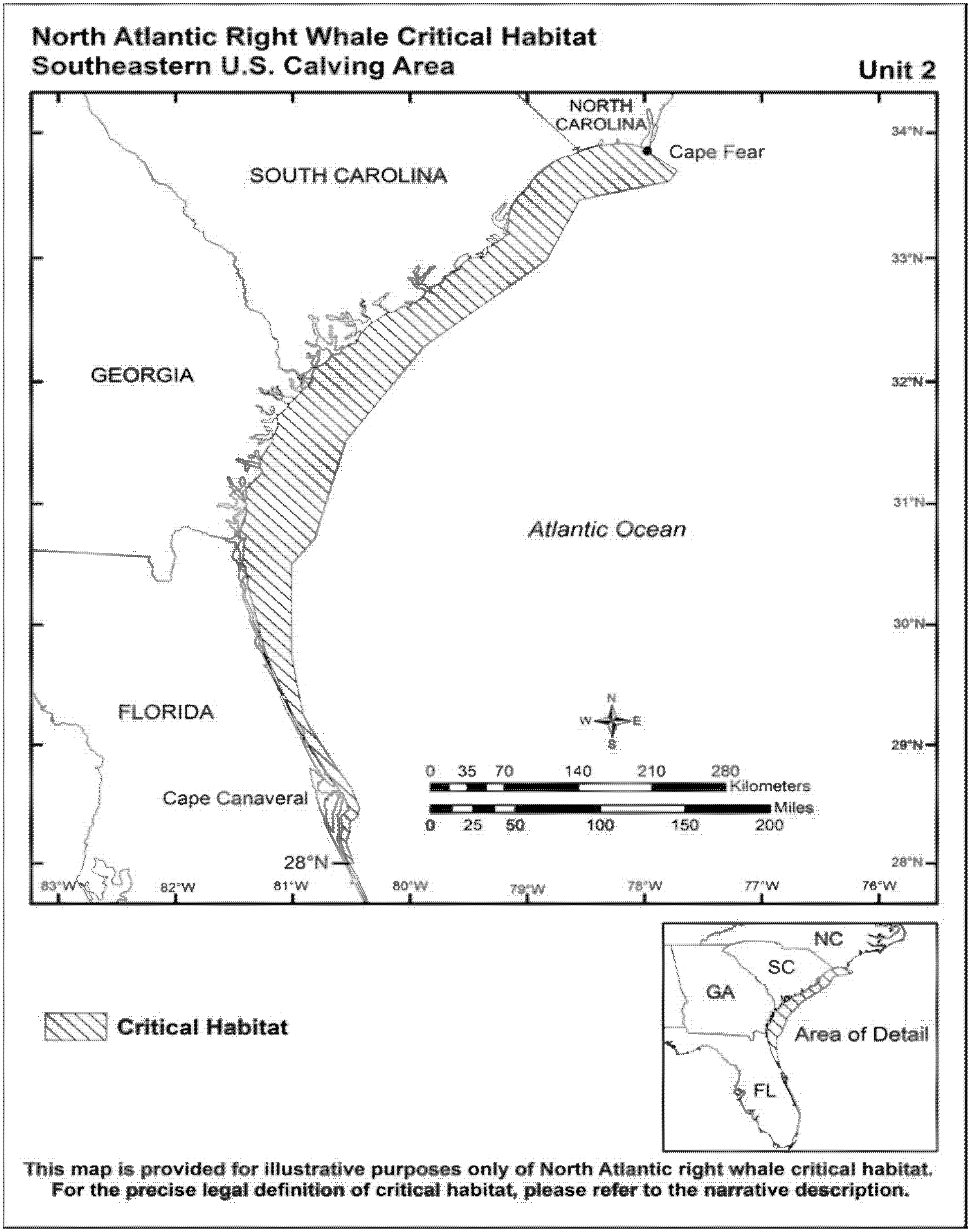

Figure 2. North Atlantic Right Whale Critical Habitat, Southeast United States.

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Biologically important areas for North Atlantic right whales in the mid- and south Atlantic were further described by LaBrecque *et al.* (2015). The authors describe an area of importance for reproduction that somewhat expands the boundaries of the critical habitat designation, including waters out to the 25-m isobath from Cape Canaveral to Cape Lookout from mid-November to mid-April, on the basis of habitat analyses (Good, 2008; Keller *et al.,* 2012) and sightings data (*e.g.,* Keller *et al.,* 2006; Schulte and Taylor, 2012) indicating that sea surface temperatures between 13° to 15° C and water depths between 10–20 m are critical parameters for calving. Right whales leave northern feeding grounds in November and December to migrate along the continental shelf to the calving grounds or to unknown winter areas before returning to northern areas by late spring. Right whales are known to travel along the continental shelf, but it is unknown whether they use the entire shelf area or are restricted to nearshore waters (Schick *et al.,* 2009; Whitt *et al.,* 2013). LaBrecque *et al.* (2015) define an important area for migratory behavior on the basis of aerial and vessel-based survey data, photo-identification data, radio-tracking data, and expert judgment.

As noted by LaBrecque *et al.* (2015), additional cetacean species are known to have strong links to bathymetric features, although there is currently insufficient information to specifically identify these areas. For example, pilot whales and Risso's dolphins aggregate at the shelf break in the survey area. These and other locations predicted as areas of high abundance (Roberts *et al.,* 2016) form the basis of spatiotemporal restrictions on survey effort as described under ''Mitigation.'' In addition, other data indicate potential areas of importance that are not yet fully described. Risch *et al.* (2014) describe minke whale presence offshore of the shelf break (evidenced by passive acoustic recorders), which may be indicative of a migratory area, while other data provides evidence that sei whales aggregate near meandering frontal eddies over the continental shelf in the Mid-Atlantic Bight (Newhall *et al.,* 2012).

Unusual Mortality Events (UME)—A UME is defined under the MMPA as ''a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response.'' From 1991 to the present, there have been approximately twelve formally recognized UMEs affecting marine mammals in the survey area and involving species under NMFS's jurisdiction. A recently ended UME involved bottlenose dolphins. Three UMEs are ongoing and under investigation. These involve humpback whales, North Atlantic right whales, and minke whales. Specific information for each ongoing UME is provided below. There is currently no direct connection between the three UMEs, as there is no evident cause of stranding or death that is common across the three species involved in the different UMEs. Additionally, strandings across the three species are not clustering in space or time.

Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through Florida (though there are only two records to date south of North Carolina). As of October 2018, partial or full necropsy examinations have been conducted on approximately half of the 84 known cases. Of the cases examined, approximately half had evidence of human interaction (ship strike or entanglement). Some of these investigated mortalities showed blunt force trauma or pre-mortem propeller wounds indicative of vessel strike, indicating a strike rate above the annual long-term average; however, these findings of pre-mortem vessel strike are not consistent across all of the whales examined and more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. Three previous UMEs involving humpback whales have occurred since 2000, in 2003, 2005, and 2006. More information is available at *www.fisheries.noaa.gov/national/marine-life-distress/2016-2018-humpback-whale-unusual-mortality-event-along-atlantic-coast* (accessed October 17, 2018).

Since January 2017, elevated minke whale strandings have occurred along the Atlantic coast from Maine through South Carolina, with highest numbers in Massachusetts, Maine, and New York. As of October 2018, partial or full necropsy examinations have been conducted on more than 60 percent of the 54 known cases. Preliminary findings in several of the whales have shown evidence of human interactions or infectious disease. These findings are not consistent across all of the whales examined, so more research is needed. As part of the UME investigation process, NOAA is assembling an independent team of scientists to coordinate with the Working Group on Marine Mammal Unusual Mortality Events to review the data collected, sample stranded whales, and determine the next steps for the investigation. More information is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-minke-whale-unusual-mortality-event-along-atlantic-coast* (accessed October 17, 2018).

Elevated North Atlantic right whale mortalities began in June 2017, primarily in Canada. To date, there are a total of 20 confirmed dead stranded whales (12 in Canada; 8 in the United States), and 5 live whale entanglements in Canada have been documented. Full necropsy examinations have been conducted on 13 of the cases, with results currently available for seven of these that occurred in Canada (Daoust *et al.,* 2017). Results indicate that two whales died from entanglement in fishing gear and, for four whales, necropsy findings were compatible with acute death due to trauma (although it is uncertain whether they were struck pre- or post-mortem) (Daoust *et al.,* 2017). Several investigated cases are undetermined due to advanced decomposition. Overall, findings to date confirm that vessel strikes and fishing gear entanglement continue to be the key threats to recovery of North Atlantic right whales. In response, the Canadian government has enacted fishery closures to help reduce future entanglements and has modified fixed gear fisheries, as well as implementing temporary mandatory vessel speed restrictions in a portion of the Gulf of St. Lawrence. NOAA is cooperating with Canadian government officials as they investigate the incidents in Canadian waters. A previous UME involving right whales occurred in 1996. More information is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-north-atlantic-right-whale-unusual-mortality-event* (accessed October 17, 2018).

Beginning in July 2013, elevated strandings of bottlenose dolphins were observed along the Atlantic coast from New York to Florida. The investigation was closed in 2015, with the UME ultimately being attributed to cetacean morbillivirus (though additional contributory factors are under investigation; *www.fisheries.noaa.gov/national/marine-life-distress/2013-2015-bottlenose-dolphin-unusual-mortality-event-mid-atlantic*; accessed July 2, 2018). Dolphin strandings during 2013–15 were greater than six times higher than the annual average from 2007–12, with the most strandings reported from Virginia, North Carolina, and Florida. A total of approximately 1,650 bottlenose dolphins stranded from June 2013 to March 2015 and, additionally, a small number of individuals of several other cetacean species stranded during the UME and tested positive for morbillivirus (humpback whale, fin whale, minke whale, pygmy sperm whale, and striped dolphin). Only one offshore ecotype dolphin has been identified, meaning that over 99 percent of affected dolphins were of the coastal ecotype (D. Fauquier; pers. comm.). Research, to include analyses of stranding samples and post-UME monitoring and modeling of surviving populations, will continue in order to better understand the impacts of the UME on the affected stocks. Notably, an earlier major UME in 1987–88 was also caused by morbillivirus. Over 740 stranded dolphins were recovered during that event.

Additional recent UMEs include various localized events with undetermined cause involving bottlenose dolphins (*e.g.,* South Carolina in 2011; Virginia in 2009) and an event affecting common dolphins and Atlantic white-sided dolphins from North Carolina to New Jersey (2008; undetermined). For more information on UMEs, please visit: *www.fisheries.noaa.gov/national/marine-life-distress/marine-mammal-unusual-mortality-events.*

Take Reduction Planning—Take reduction plans are designed to help recover and prevent the depletion of strategic marine mammal stocks that interact with certain U.S. commercial fisheries, as required by Section 118 of the MMPA. The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the mortality and serious injury of marine mammals incidental to commercial fishing to less than the potential biological removal level. The long-term goal is to reduce, within five years of its implementation, the mortality and serious injury of marine mammals incidental to commercial fishing to insignificant levels, approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans. Take reduction teams are convened to develop these plans.

There are several take reduction plans in place for marine mammals in the survey areas of the mid- and south Atlantic. We described these here briefly in order to fully describe, in conjunction with referenced material, the baseline conditions for the affected marine mammal stocks. The Atlantic Large Whale Take Reduction Plan (ALWTRP) was implemented in 1997 to reduce injuries and deaths of large whales due to incidental entanglement in fishing gear. The ALWTRP is an evolving plan that changes as NMFS learns more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. It has several components, including restrictions on where and how gear can be set and requirements for entangling gears (*i.e.,* trap/pot and gillnet gears). The ALWTRP addresses those species most affected by fishing gear entanglements, *i.e.,* North Atlantic right whale, humpback whale, fin whale, and minke whale. Annual human-caused mortality exceeds PBR for the North Atlantic right whale and certain other ESA-listed whale species. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/protected/whaletrp/.*

NMFS implemented a Harbor Porpoise Take Reduction Plan (HPTRP) to reduce interactions between harbor porpoise and commercial gillnet gear in both New England and the mid-Atlantic. The HPTRP has several components including restrictions on where, when, and how gear can be set, and in some areas requires the use of acoustic deterrent devices. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/protected/porptrp/.*

The Atlantic Trawl Gear Take Reduction Team was developed to address the incidental mortality and serious injury of pilot whales, common dolphins, and white-sided dolphins incidental to Atlantic trawl fisheries. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/Protected/mmp/atgtrp/.* Separately, NMFS established a Pelagic Longline Take Reduction Plan (PLTRP) to address the incidental mortality and serious injury of pilot whales in the mid-Atlantic region of the Atlantic pelagic longline fishery. The PLTRP includes a special research area, gear modifications, outreach material, observer coverage, and captains' communications. Pilot whales incur substantial incidental mortality and serious injury due to commercial fishing, and therefore are of particular concern. More information is available online at: *www.nmfs.noaa.gov/pr/interactions/trt/pl-trt.html.*

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). NMFS (2018) describes generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Pinniped functional hearing is not discussed here, as no pinnipeds are expected to be affected by the specified activity. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): Generalized hearing is estimated to occur between approximately 7 Hz and 35 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus;* including two members of the genus *Lagenorhynchus,* on the basis of recent echolocation data and genetic data): Generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Thirty-four marine mammal species, all cetaceans, have the reasonable potential to co-occur with the survey activities. Please refer to Table 2. Of the species that may be present, seven are classified as low-frequency cetaceans (*i.e.,* all mysticete species), 24 are classified as mid-frequency cetaceans (*i.e.,* all delphinid and ziphiid species and the sperm whale), and three are classified as high-frequency cetaceans (*i.e.,* harbor porpoise and *Kogia* spp.).

Potential Effects of the Specified Activities on Marine Mammals and Their Habitat

In our Notice of Proposed IHAs, this section included a comprehensive summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat, including general background information on sound and specific discussion of potential effects to marine mammals from noise produced through use of airgun arrays. We do not repeat that discussion here, instead referring the reader to the Notice of Proposed IHAs. However, we do provide a more thorough discussion regarding potential impacts to marine mammal habitat via effects to prey species, as well as discussion of important new information regarding potential impacts to prey species produced since publication of our notice. The ''Estimated Take'' section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analyses and Determinations'' section will include an analysis of how these specific activities will impact marine mammals and will consider the content of this section, the ''Estimated Take'' section, and the ''Mitigation'' section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations.

Description of Active Acoustic Sound Sources

In our Notice of Proposed IHAs, this section contained a brief technical background on sound, the characteristics of certain sound types, and on metrics used in the proposal inasmuch as the information is relevant to the specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document. Here, we summarize key information relating to terminology used in this notice.

Amplitude (or ''loudness'') of sound is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)). The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to 1 μPa), while the received level is the SPL at the listener's position (referenced to 1 μPa).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures. Sound exposure level (SEL; represented as dB re 1 μPa^2–s) represents the total energy contained within a pulse, and considers both intensity and duration of exposure. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0–p) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure. Another common metric is peak-to-peak sound pressure (pk–pk), which is the algebraic difference between the peak positive and peak negative sound pressures. Peak-to-peak pressure is typically approximately 6 dB higher than peak pressure (Southall *et al.,* 2007).

As described in more detail in our Notice of Proposed IHAs, airgun arrays are in a general sense considered to be omnidirectional sources of pulsed noise. Pulsed sound sources (as compared with non-pulsed sources) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features. Airguns produce sound with energy in a frequency range from about 10–2,000 Hz, with most energy radiated at frequencies below 200 Hz. Although the amplitude of the acoustic wave emitted from the source is equal in all directions (*i.e.,* omnidirectional), airgun arrays do possess some directionality due to different phase delays between guns in different directions. Airgun arrays are typically tuned to maximize functionality for data acquisition purposes, meaning that sound transmitted in horizontal directions and at higher frequencies is minimized to the extent possible.

Anticipated Effects on Marine Mammal Habitat

We received numerous public comments regarding potential effects to marine mammal habitat, including to prey species, including some comments pointing out additional relevant literature and/or claiming that we had not adequately considered potential impacts to prey species. While we disagree that we had not adequately considered potential impacts to marine mammal habitat, particularly with regard to marine mammal prey, in response to public comment we did consider additional literature regarding potential impacts to prey species, as well as some new literature made available since publication of our Notice of Proposed IHAs (*e.g.,* McCauley *et al.,* 2017). Portions of this information were described in responses to comments above. We provide a revised summary of our review of available literature regarding impacts to prey species here (please see our Notice of Proposed IHAs for our discussions of potential effects to other aspects of marine mammal habitat, including acoustic habitat). Our overall conclusions regarding potential impacts of the specified activities on marine mammal habitat are unchanged. As stated in our Notice of Proposed IHAs, our review of the available information and the specific nature of the activities considered herein suggest that the activities associated with the planned actions are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species or on the quality of acoustic habitat. Further, any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations. Information supporting this conclusion is summarized below.

Effects to Prey—As stated above, here we provide an updated and more detailed discussion of the available information regarding potential effects to prey, as well as additional support for our conclusion.

Sound may affect marine mammals through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, zooplankton). Marine mammal prey varies by species, season, and location and, for some, is not well documented. Here, we describe studies regarding the effects of noise on known marine mammal prey.

Fish utilize the soundscape (see our Notice of Proposed IHAs for discussion of this concept) and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al.,* 1999; Fay, 2009). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008). The potential effects of airgun noise on fishes depends on the overlapping frequency range, distance from the sound source, water depth of exposure, and species-specific hearing sensitivity, anatomy, and physiology. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality.

Fish react to sounds which are especially strong and/or intermittent low-frequency sounds, and behavioral responses such as flight or avoidance are the most likely effects. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to airguns depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Several studies have demonstrated that airgun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999). One recent study found a 78 percent decline in snapper-grouper complex species abundance during evening hours at a reef habitat site off central North Carolina following an airgun survey (Paxton *et al.,* 2017). During the days prior to the survey passing, fish use of this habitat was highest during the same hours.

However, our review shows that the bulk of studies indicate no or slight reaction to noise (*e.g.,* Miller and Cripps, 2013; Dalen and Knutsen, 1987; Pena *et al.,* 2013; Chapman and Hawkins, 1969; Wardle *et al.,* 2001; Sara *et al.,* 2007; Jorgenson and Gyselman, 2009; Blaxter *et al.,* 1981; Cott *et al.,* 2012; Boeger *et al.,* 2006), and that, most commonly, while there are likely to be impacts to fish as a result of noise from nearby airguns, such effects will be temporary. For example, investigators reported significant, short-term declines in commercial fishing catch rate of gadid fishes during and for up to five days after seismic survey operations, but the catch rate subsequently returned to normal (Engas *et al.,* 1996; Engas and Lokkeborg, 2002); other studies have reported similar findings (Hassel *et al.,* 2004). Skalski *et al.* (1992) also found a reduction in catch rates—for rockfish (*Sebastes* spp.) in response to controlled airgun exposure—but suggested that the mechanism underlying the decline was not dispersal but rather decreased responsiveness to baited hooks associated with an alarm behavioral response. A companion study showed that alarm and startle responses were not sustained following the removal of the sound source (Pearson *et al.,* 1992); therefore, Skalski *et al.* (1992) suggested that the effects on fish abundance may be transitory, primarily occurring during the sound exposure itself. In some cases, effects on catch rates are variable within a study, which may be more broadly representative of temporary displacement of fish in response to airgun noise (*i.e.,* catch rates may increase in some locations and decrease in others) than any long-term damage to the fish themselves (Streever *et al.,* 2016).

While the findings of Paxton *et al.* (2017) may be interpreted as a significant shift in distribution that could compromise life history behaviors—as some commenters have done—we interpret these findings as corroborating prior studies indicating that typically a startle response or short-term displacement should be expected. In fact, the evening hours during which the decline in fish habitat use were recorded (via video recording) occurred on the same day that the airgun survey passed, and no subsequent data is presented to support an inference that the response was long-lasting. Additionally, given that the finding is based on video images, the lack of recorded fish presence does not support a conclusion that the fish actually moved away from the site or suffered any serious impairment. Other studies have been inconclusive regarding the abundance effects of airgun noise (Thomson *et al.,* 2014).

SPLs of sufficient strength have been known to cause injury to fish and fish mortality and, in some studies, fish auditory systems have been damaged by airgun noise (McCauley *et al.,* 2003; Popper *et al.,* 2005; Song *et al.,* 2008). (No mortality occurred to fish in any of these studies.) While experiencing a TTS, fish may be more susceptible to fitness impacts resulting from effects to communication, predator/prey detection, etc. (Popper *et al.,* 2014). However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells (Smith, 2016). Halvorsen *et al.* (2012a) showed that a TTS of 4–6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long—neither condition should be expected in relation to the specified activities.

Injury caused by barotrauma can range from slight to severe and can cause death, and is most likely for fish with swim bladders. Barotrauma injuries have been documented during controlled exposure to impact pile driving (an impulsive noise source, as are airguns) (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013). For geophysical surveys, the sound source is constantly moving, and most fish would likely avoid the sound source prior to receiving sound of sufficient intensity to cause physiological or anatomical damage.

Invertebrates appear to be able to detect sounds (Pumphrey, 1950; Frings and Frings, 1967) and are most sensitive to low-frequency sounds (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Available data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect airgun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Cephalopods have a specialized sensory organ inside the head called a statocyst that may help an animal determine its position in space (orientation) and maintain balance (Budelmann, 1992). Packard *et al.* (1990) showed that cephalopods were sensitive to particle motion, not sound pressure, and Mooney *et al.* (2010) demonstrated that squid statocysts act as an accelerometer through which particle motion of the sound field can be detected. Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013); however, these controlled exposures involved long exposure to sounds dissimilar to airgun pulses (*i.e.,* 2 hours of continuous exposure to 1-second sweeps, 50–400 Hz). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014).

Impacts to benthic communities from impulsive sound generated by active acoustic sound sources are not well documented. There are no published data that indicate whether threshold shift injuries or effects of auditory masking occur in benthic invertebrates, and there are little data to suggest whether sounds from seismic surveys would have any substantial impact on invertebrate behavior (Hawkins *et al.,* 2014), though some studies have indicated no short-term or long-term effects of airgun exposure (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). Exposure to airgun signals was found to significantly increase mortality in scallops, in addition to causing significant changes in behavioral patterns and disruption of hemolymph chemistry during exposure (Day *et al.,* 2017). However, the implications of this finding are not straightforward, as the authors state that the observed levels of mortality were not beyond naturally occurring rates. Fitzgibbon *et al.* (2017) found significant changes to hemolymph cell counts in spiny lobsters subjected to repeated airgun signals, with the effects lasting up to a year post-exposure. However, despite the high levels of exposure, direct mortality was not observed. Further, in reference to the study, Day *et al.* (2016) stated that ''[s]eismic surveys appear to be unlikely to result in immediate large scale mortality [. . .] and, on their own, do not appear to result in any degree of mortality'' and that ''[e]arly stage lobster embryos showed no effect from air gun exposure, indicating that at this point in life history, they are resilient to exposure and subsequent recruitment should be unaffected.''

There is little information concerning potential impacts of noise on zooplankton populations. However, one recent study (McCauley *et al.,* 2017) investigated zooplankton abundance, diversity, and mortality before and after exposure to airgun noise, finding that the exposure resulted in significant depletion for more than half the taxa present and that there were two to three times more dead zooplankton after airgun exposure compared with controls for all taxa. The majority of taxa present were copepods and cladocerans; for these taxa, the range within which effects on abundance were detected was up to approximately 1.2 km. In order to have significant impacts on *r*-selected species such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned (McCauley *et al.,* 2017). It is also possible that the findings reflect avoidance by zooplankton rather than mortality (McCauley *et al.,* 2017). Therefore, the large scale of effect observed here is of concern—particularly where repeated noise exposure is expected—and further study is warranted.

A modeling exercise was conducted as a follow-up to the McCauley *et al.* (2017) study, in order to assess the potential for impacts on ocean ecosystem dynamics and zooplankton population dynamics (Richardson *et al.,* 2017). Richardson *et al.* (2017) found that for copepods with a short life cycle in a high-energy environment, a full-scale airgun survey would impact copepod abundance up to three days following the end of the survey, suggesting that effects such as those found by McCauley *et al.* (2017) would not be expected to be detectable downstream of the survey areas, either spatially or temporally. However, these findings are relevant for zooplankton with rapid reproductive cycles in areas where there is a high natural replenishment rate resulting from new water masses moving in, and the findings may not apply in lower-energy environments or for zooplankton with longer life-cycles. In fact, the study found that by turning off the current, as may reflect lower-energy environments, the time to recovery for the modelled population extended from several days to several weeks.

In the absence of further validation of the McCauley *et al.* (2017) findings, if we assume a worst-case likelihood of severe impacts to zooplankton within approximately 1 km of the acoustic source, the large spatial scale and expected wide dispersal of survey vessels does not lead us to expect any meaningful follow-on effects to the prey base for odontocete predators (the region is not an important feeding area for taxa that feed directly on zooplankton, *i.e.,* mysticetes). While the large scale of effect observed by McCauley *et al.* (2017) may be of concern, NMFS concludes that these findings indicate a need for more study, particularly where repeated noise exposure is expected—a condition unlikely to occur in relation to the time period in which the surveys considered for the five IHAs will take place.

A recent review article concluded that, while laboratory results provide scientific evidence for high-intensity and low-frequency sound-induced physical trauma and other negative effects on some fish and invertebrates, the sound exposure scenarios in some cases are not realistic to those encountered by marine organisms during routine seismic operations (Carroll *et al.,* 2017). The review finds that there has been no evidence of reduced catch or abundance following seismic activities for invertebrates, and that there is conflicting evidence for fish with catch observed to increase, decrease, or remain the same. Further, where there is evidence for decreased catch rates in response to airgun noise, these findings provide no information about the underlying biological cause of catch rate reduction (Carroll *et al.,* 2017).

As addressed earlier in ''Comments and Responses,'' some members of the public made strong assertions regarding the likely effects of airgun survey noise on marine mammal prey. These assertions included, for example, that the specified activities would harm fish and invertebrate species over the long-term, cause reductions in recruitment and effects to behavior that may reduce reproductive potential and foraging success and increase the risk of predation, and induce changes in community composition via such population-level impacts. We have addressed these claims both in our comment responses and in our review of the available literature, above. We also reviewed available information regarding populations of representative prey stocks in the northern Gulf of Mexico (GOM), which is the only U.S. location where marine seismic surveys are a routinely occurring activity. While we recognize the need for caution in assuming correlation between the ongoing survey activity in the GOM and the health of assessed stocks there, we believe this information has some value in informing the likelihood of population-level effects to prey species and, therefore, the likelihood that the specified activities would negatively impact marine mammal populations via effects to prey. We note that the information reported below is in context of managed commercial and recreational fishery exploitation, in addition to any other impacts (*e.g.,* noise) on the stocks. The species listed below are known prey species for marine mammals and represent groups with different life histories and patterns of habitat use.

• Red snapper (*Lutjanus campechanus*): Red snapper are bottom-dwelling fish generally found at approximately 10–190 m deep that typically live near hard structures on the continental shelf that have moderate to high relief (for example, coral reefs, artificial reefs, rocks, ledges, and caves), sloping soft-bottom areas, and limestone deposits. Larval snapper swim freely within the water column. Increases in total and spawning stock biomass are predicted beginning in about 1990 (Cass-Calay *et al.,* 2015). Regional estimates suggest that recruitment in the west has generally increased since the 1980s, and has recently been above average, while recruitment in the east peaked in the mid-2000s, and has since declined. However, the most recent assessment suggests a less significant decline (to moderate levels) (Cass-Calay *et al.,* 2015).

- Yellowfin tuna (*Thunnus albacares*): Yellowfin tuna are highly migratory, living in deep pelagic waters, and spawn in the GOM from May to August. However, we note that a single stock is currently assumed for the entire Atlantic, with additional spawning grounds in the Gulf of Guinea, Caribbean Sea, and off Cabo Verde. The most recent assessment indicates that spawning stock biomass for yellowfin tuna is stable or increasing somewhat and that, overall, the stock is near levels that produce the maximum sustainable yield (ICCAT, 2016).
- King mackerel (*Scomberomorus cavalla*): King mackerel are a coastal pelagic species, found in open waters near the coast in waters from approximately 35–180 m deep. King mackerel migrate in response to changes in water temperature, and spawn in shelf waters from May through October. Estimates of recruitment demonstrate normal cyclical patterns over the past 50 years, with a period of higher recruitment most recently (1990–2007) (SEDAR, 2014). Long-term spawning stock biomass patterns indicate that the spawning stock has been either rebuilding or remained relatively consistent over the last 20 years, with nothing indicating that the stock has declined in these recent decades (SEDAR, 2014).

In summary, impacts of the specified activities will likely be limited to behavioral responses, the majority of prey species will be capable of moving out of the project area during surveys, a rapid return to normal recruitment, distribution, and behavior for prey species is anticipated, and, overall, impacts to prey species will be minor and temporary. Prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects. Mortality from decompression injuries is possible in close proximity to a sound, but only limited data on mortality in response to airgun noise exposure are available (Hawkins *et al.,* 2014). The most likely impacts for most prey species in a given survey area would be temporary avoidance of the area. Surveys using towed airgun arrays move through an area relatively quickly, limiting exposure to multiple impulsive sounds. In all cases, sound levels would return to ambient once a survey moves out of the area or ends and the noise source is shut down and, when exposure to sound ends, behavioral and/or physiological responses are expected to end relatively quickly (McCauley *et al.,* 2000b). The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. While the potential for disruption of spawning aggregations or schools of important prey species can be meaningful on a local scale, the mobile and temporary nature of most surveys and the likelihood of temporary avoidance behavior suggest that impacts would be minor.

Based on the information discussed herein, we reaffirm our conclusion that impacts of the specified activities are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species. Further, any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Estimated Take

This section provides information regarding the number of incidental takes authorized, which informs both NMFS's consideration of ''small numbers'' and the negligible impact determinations.

Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Anticipated takes would primarily be by Level B harassment, as use of the acoustic sources (*i.e.,* airgun arrays) can result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result for low- and high-frequency species due to the size of the predicted auditory injury zones for those species. We do not expect auditory injury to occur for mid-frequency species, as discussed in greater detail below. The required mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. It is unlikely that lethal takes would occur even in the absence of the mitigation and monitoring measures, and no such takes are anticipated or authorized. Below we describe how the authorized take was estimated using acoustic thresholds, sound field modeling, and marine mammal density data.

Acoustic Thresholds

NMFS uses acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals generally would be reasonably expected to exhibit disruption of behavioral patterns (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment—Although available data are consistent with the basic concept that louder sounds evoke more significant behavioral responses than softer sounds, defining precise sound levels that will potentially disrupt behavioral patterns is difficult because responses depend on the context in which the animal receives the sound, including an animal's behavioral mode when it hears sounds (*e.g.,* feeding, resting, or migrating), prior experience, and biological factors (*e.g.,* age and sex). Some species, such as beaked whales, are known to be more highly sensitive to certain anthropogenic sounds than other species. Other contextual factors, such as signal characteristics, distance from the source, duration of exposure, and signal to noise ratio, may also help determine response to a given received level of sound. Therefore, levels at which responses occur are not necessarily consistent and can be difficult to predict (Southall *et al.,* 2007; Ellison *et al.,* 2012; Bain and Williams, 2006).

However, based on the practical need to use a relatively simple threshold based on available information that is both predictable and measurable for most activities, NMFS has historically used a generalized acoustic threshold based on received level to estimate the onset of Level B harassment. These thresholds are 160 dB rms (intermittent sources, which include impulsive sources) and 120 dB rms (continuous sources). Airguns are impulsive sound sources; therefore, the 160 dB rms threshold is appropriate for use in evaluating effects from the specified activities.

Level A Harassment—NMFS's *Technical Guidance for Assessing the Effects of Anthropogenic Sound on*

Marine Mammal Hearing (NMFS, 2018) identifies dual criteria to assess the potential for auditory injury (Level A harassment) to occur for different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise. The technical guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, and reflects the best available science on the potential for noise to affect auditory sensitivity by:

- Dividing sound sources into two groups (*i.e.,* impulsive and non-impulsive) based on their potential to affect hearing sensitivity;
- Choosing metrics that best address the impacts of noise on hearing sensitivity, *i.e.,* peak sound pressure level (peak SPL) (reflects the physical properties of impulsive sound sources to affect hearing sensitivity) and cumulative sound exposure level (cSEL) (accounts for not only level of exposure but also duration of exposure); and
- Dividing marine mammals into hearing groups and developing auditory weighting functions based on the science supporting that not all marine mammals hear and use sound in the same manner.

The premise of the dual criteria approach is that, while there is no definitive answer to the question of which acoustic metric is most appropriate for assessing the potential for injury, both the received level and duration of received signals are important to an understanding of the potential for auditory injury. Therefore, peak SPL is used to define a pressure criterion above which auditory injury is predicted to occur, regardless of exposure duration (*i.e.,* any single exposure at or above this level is considered to cause auditory injury), and cSEL is used to account for the total energy received over the duration of sound exposure (*i.e.,* both received level and duration of exposure) (Southall *et al.,* 2007; NMFS, 2018). As a general principle, whichever criterion is exceeded first (*i.e.,* results in the largest isopleth) would be used as the effective injury criterion (*i.e.,* the more precautionary of the criteria). Note that cSEL acoustic threshold levels incorporate marine mammal auditory weighting functions, while peak pressure thresholds do not (*i.e.,* flat or unweighted). Weighting functions for each hearing group (*e.g.,* low-, mid-, and high-frequency cetaceans) are described in NMFS (2018).

NMFS (2018) recommends 24 hours as a maximum accumulation period relative to cSEL thresholds. These thresholds were developed by compiling and synthesizing the best available science, and are provided in Table 3 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS (2018), and more information is available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

TABLE 3—EXPOSURE CRITERIA FOR AUDITORY INJURY FOR IMPULSIVE SOURCES

Hearing group	Peak pressure [1] (dB)	Cumulative sound exposure level [2] (dB)
Low-frequency cetaceans	219	183
Mid-frequency cetaceans	230	185
High-frequency cetaceans	202	155

[1] Referenced to 1 μPa; unweighted within generalized hearing range.
[2] Referenced to 1 μPa^2s; weighted according to appropriate auditory weighting function.

NMFS considers these updated thresholds and associated weighting functions to be the best available information for assessing whether exposure to specific activities is likely to result in changes in marine mammal hearing sensitivity.

Sound Field Modeling

BOEM's PEIS (BOEM, 2014a) provides information related to estimation of the sound fields that would be generated by potential geophysical survey activity on the mid- and south Atlantic OCS. We provide a brief summary of that modeling effort here; for more information, please see our Notice of Proposed IHAs. For full detail, please see Appendix D of BOEM's PEIS (Zykov and Carr, 2014 in BOEM, 2014a). The acoustic modeling generated a three-dimensional acoustic propagation field as a function of source characteristics and physical properties of the ocean for later integration with marine mammal density information in an animal movement model to estimate potential acoustic exposures.

The authors selected 15 modeling sites throughout BOEM's mid-Atlantic and south Atlantic OCS planning areas for use in modeling predicted sound fields resulting from use of the airgun array. The water depth at the sites varied from 30–5,400 m. Two types of bottom composition were considered: Sand and clay, their selection depending on the water depth at the source. Twelve possible sound speed profiles for the water column were used to cover the variation of the sound velocity distribution in the water with location and season. Twenty-one distinct propagation scenarios resulted from considering different sound speed profiles at some of the modeling sites. Two acoustic propagation models were employed to estimate the acoustic field radiated by the sound sources. A version of JASCO Applied Science's Marine Operations Noise Model (MONM), based on the Range-dependent Acoustic Model (RAM) parabolic-equations model, MONM–RAM, was used to estimate the SELs for low-frequency sources (below 2 kHz) such as an airgun array. For more information on sound propagation model types, please see, *e.g.,* Etter (2013). The model takes into account the geoacoustic properties of the sea bottom, vertical sound speed profile in the water column, range-dependent bathymetry, and the directivity of the source. The directional source levels for the airgun array were modeled using the Airgun Array Source Model (AASM) based on the specifications of the source such as the arrangement and volume of the guns, firing pressure, and depth below the sea surface. The modeled directional source levels were used as the input for the acoustic propagation model. For background information on major factors affecting underwater sound propagation, please see Zykov and Carr (2014).

The modeling used a 5,400 in^3 airgun array as a representative example. The array has dimensions of 16 x 15 m and consists of 18 air guns placed in three identical strings of six air guns each (please see Figure D–6 of Zykov and

Carr (2014)). The volume of individual air guns ranges from 105–660 in^3. Firing pressure for all elements is 2,000 psi. The depth below the sea surface for the array was set at 6.5 m. Please see Table 1 for a comparison to the airgun arrays planned for use by the applicant companies. Horizontal third-octave band directionality plots resulting from source modeling are shown in Figure D–8 of Zykov and Carr (2014). The estimated received levels are expressed in terms of the SEL metric over the duration of a single source pulse. For the purposes of this study, the SEL results were converted to the rms SPL metric using a range dependent conversion coefficient.

Four depth regions were classified based on bathymetry: Shallow continental shelf (<60 m); continental shelf (60–150 m); continental slope (150–1,000 m); and deep ocean (>1,000 m). The modeling results show that the largest threshold radii are typically associated with sites in intermediate water depths (250 and 900 m). Low frequencies propagate relatively poorly in shallow water (*i.e.,* water depths on the same order as or less than the wavelength). At intermediate water depths, this stripping of low-frequency sound no longer occurs, and longer-range propagation can be enhanced by the channeling of sound caused by reflection from the surface and seafloor (depending on the nature of the sound speed profile and sediment type). Table 4 shows scenario-specific modeling results for distances to the 160 dB level; results presented are for the 95 percent range to threshold.

TABLE 4—MODELING SCENARIOS AND SITE-SPECIFIC MODELED THRESHOLD RADII FROM BOEM'S PEIS

Scenario No.	Site No.[1]	Water depth (m)	Season	Bottom type	Threshold radii (m)[2]
1	1	5,390	Winter	Clay	4,969
2	2	2,560	Winter	Clay	5,184
3	3	880	Winter	Sand	8,104
4	4	249	Winter	Sand	8,725
5	5	288	Winter	Sand	8,896
6	1	5,390	Spring	Clay	4,989
7	6	3,200	Spring	Clay	5,026
8	3	880	Spring	Sand	8,056
9	7	251	Spring	Sand	8,593
10	8	249	Spring	Sand	8,615
11	1	5,390	Summer	Clay	4,973
12	6	3,200	Summer	Clay	5,013
13	3	880	Summer	Sand	8,095
14	9	275	Summer	Sand	9,122
15	10	4,300	Fall	Clay	5,121
16	11	3,010	Fall	Clay	5,098
17	12	4,890	Fall	Clay	4,959
18	13	3,580	Fall	Clay	5,069
19	3	880	Fall	Sand	8,083
20	14	100	Fall	Sand	8,531
21	15	51	Fall	Sand	8,384
Mean					6,838

Adapted from Tables D–21 and D–22 of Zykov and Carr (2014).
[1] Please see Figure D–35 of Zykov and Carr (2014) for site locations.
[2] Threshold radii to 160 dB (rms) SPL, 95 percent range.

We provide this description of the modeling performed for BOEM's PEIS as a general point of reference for the surveys, and also because three of the applicant companies—TGS, CGG, and Western—directly used these results to inform their exposure modeling, rather than performing separate sound field modeling. As described by BOEM (2014a), the modeled array was selected to be representative of the large airgun arrays likely to be used by geophysical exploration companies in the mid- and south Atlantic OCS. Therefore, we use the BOEM (2014a) results as a reasonable proxy for those three companies (please see ''Detailed Description of Activities'' for further description of the acoustic sources planned for use by these three companies). ION and Spectrum elected to perform separate sound field modeling efforts, and these are described below.

ION—ION provided information related to estimation of the sound fields that would be generated by their geophysical survey activity on the mid- and south Atlantic OCS. We provide a brief summary of that modeling effort here; for more information, please see our Notice of Proposed IHAs. For full detail, please see Appendix A of ION's application (Li, 2014; referred to hereafter as Appendix A of ION's application). ION plans to use a 36-element airgun array with a 6,420 in^3 total firing volume (please see ''Detailed Description of Activities'' for further description of ION's acoustic source). The modeling assumed that ION would operate from July to December. Sixteen representative sites were selected along survey track lines planned by ION for use in modeling predicted sound fields resulting from use of the airgun array (see Figure 2 in Appendix A of ION's application for site locations). Two acoustic propagation models were employed to estimate the acoustic field radiated by the sound sources. As was described above for BOEM's PEIS, the acoustic signature of the airgun array was predicted using AASM and MONM was used to calculate the sound propagation and acoustic field near each defined site. The modeling process follows generally that described previously for BOEM's PEIS. Key differences are the characteristics of the acoustic source (see Table 1), locations of the modeled sites, and the use of a restricted set of sound velocity profiles (*e.g.,* fall and winter). Site-specific modeling results for distances to the 160 dB rms level were presented in Table 8 of our Notice of Proposed IHAs and are not reprinted here; mean result for the

95 percent range to threshold was 5,836 m.

Spectrum—Spectrum provided information related to estimation of the sound fields that would be generated by their geophysical survey activity on the mid- and south Atlantic OCS. We provide a brief summary of that modeling effort here; for more information, please see our Notice of Proposed IHAs. For full detail, please see Appendix A of Spectrum's application (Frankel *et al.,* 2015; referred to hereafter as Appendix A of Spectrum's application). Spectrum plans to use a 32-element airgun array with a 4,920 in^3 total firing volume (please see ''Detailed Description of Activities'' for further description of Spectrum's acoustic source). Array characteristics were input into the GUNDALF model to calculate the source level and predict the array signature. The directivity pattern of the airgun array was calculated using the beamforming module in the CASS-GRAB acoustic propagation model. These models provided source input information for the range-dependent acoustic model (RAM), which was then used to predict acoustic propagation and estimate the resulting sound field. The RAM model creates frequency-specific, three-dimensional directivity patterns (sound field) based upon the size and location of each airgun in the array. As described previously, physical characteristics of the underwater environment (*e.g.,* sound velocity profile, bathymetry, substrate composition) are critical to understanding acoustic propagation; 16 modeling locations were selected that span the acoustic conditions of the survey area. Spectrum elected to use sound velocity profiles for winter and spring and assumed that half of the survey would occur in winter and half in spring. Site-specific modeling results for distances to the 160 dB rms level were presented in Table 9 of our Notice of Proposed IHAs and are not reprinted here; mean result for the 95 percent range to threshold was 9,775 m.

Marine Mammal Density Information

The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). Historically, distance sampling methodology (Buckland *et al.,* 2001) has been applied to visual line-transect survey data to estimate abundance within large geographic strata (*e.g.,* Fulling *et al.,* 2003; Mullin and Fulling, 2004; Palka, 2006). Design-based surveys that apply such sampling techniques produce stratified abundance estimates and do not provide information at appropriate spatiotemporal scales for assessing environmental risk of a planned survey. To address this issue of scale, efforts were developed to relate animal observations and environmental correlates such as sea surface temperature in order to develop predictive models used to produce fine-scale maps of habitat suitability (*e.g.,* Waring *et al.,* 2001; Hamazaki, 2002; Best *et al.,* 2012). However, these studies generally produce relative estimates that cannot be directly used to quantify potential exposures of marine mammals to sound, for example. A more recent approach known as density surface modeling couples traditional distance sampling with multivariate regression modeling to produce density maps predicted from fine-scale environmental covariates (*e.g.,* DoN, 2007; Becker *et al.,* 2014; Roberts *et al.,* 2016).

At the time the applications were initially developed, the best available information concerning marine mammal densities in the survey area was the U.S. Navy's Navy Operating Area (OPAREA) Density Estimates (NODEs) (DoN, 2007). These habitat-based cetacean density models utilized vessel-based and aerial survey data collected by NMFS from 1998–2005 during broad-scale abundance studies. Modeling methodology is detailed in DoN (2007). A more advanced cetacean density modeling effort, described in Roberts *et al.* (2016), was ongoing during initial development of the applications, and the model outputs were made available to the applicant companies. All information relating to this effort was made publicly available in March 2016.

Roberts *et al.* (2016) provided several key improvements with respect to the NODEs effort, by incorporating additional aerial and shipboard survey data from NMFS and from other organizations collected over the period 1992–2014, incorporating 60 percent more shipboard and 500 percent more aerial survey hours than did NODEs; controlling for the influence of sea state, group size, availability bias, and perception bias on the probability of making a sighting; and modeling density from an expanded set of eight physiographic and 16 dynamic oceanographic and biological covariates. There are multiple reasons why marine mammals may be undetected by observers. Animals are missed because they are underwater (availability bias) or because they are available to be seen, but are missed by observers (perception and detection biases) (*e.g.,* Marsh and Sinclair, 1989). Negative bias on perception or detection of an available animal may result from environmental conditions, limitations inherent to the observation platform, or observer ability. Therefore, failure to correct for these biases may lead to underestimates of cetacean abundance (*e.g.,* NMFS's SAR estimates fail to correct for availability bias). Use of additional data was used to improve detection functions for taxa that were rarely sighted in specific survey platform configurations. The degree of underestimation would likely be particularly high for species that exhibit long dive times or are cryptic, such as sperm whales or beaked whales. In summary, consideration of additional survey data and an improved modeling strategy allowed for an increased number of taxa modeled and better spatiotemporal resolutions of the resulting predictions. In general, we consider the models produced by Roberts *et al.* (2016) to be the best available source of data regarding cetacean density in the Atlantic. More information, including the model results and supplementary information for each model, is available at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/.*

Aerial and shipboard survey data produced by the Atlantic Marine Assessment Program for Protected Species (AMAPPS) program provides an additional source of information regarding marine mammal presence in the survey areas. These surveys represent a collaborative effort between NMFS, BOEM, and the Navy. Although the cetacean density models described above do include survey data from 2010–14, the AMAPPS data for those years was not made available to the model authors. Future model updates will incorporate these data, but currently the AMAPPS data comprise a separate source of information (*e.g.,* NMFS, 2010a, 2011, 2012, 2013a, 2014, 2015a).

Cetacean density predictions provided by the Roberts *et al.* (2016) models are in most cases limited to the U.S. EEZ. However, the planned survey areas extend beyond the EEZ out to 350 nmi. Because specific modeling results were not available for this region at the time the exposure estimates were developed, the Roberts *et al.* (2016) model predictions were extrapolated out to the additional area (described in further detail below). Newer modeling products regarding cetacean densities in areas of the western North Atlantic beyond the EEZ became available (Mannocci *et al.,* 2017) following development of the exposure estimates; however, this information was not reasonably available to the applicants in developing their applications or to NMFS in preparing the Notice of Proposed IHAs. Therefore, we retain use of the extrapolated density values from Roberts *et al.* (2016) in estimating potential exposures in the region beyond the EEZ; this approach remains reasonably representative of cetacean densities in the portion of the specific geographic region outside the EEZ.

North Atlantic Right Whale—Following publication of our Notice of Proposed IHAs, we became aware of an effort by Roberts *et al.* to update certain density models, including for the North Atlantic right whale. In contrast to other new information that was not reasonably available to us in developing the exposure estimates discussed herein (*e.g.,* Mannocci *et al.,* 2017 and additional Roberts *et al.* model revisions (discussed below)), we determined that the revised North Atlantic right whale models represent a significant improvement to the available information. These updates greatly expanded the dataset used to derive density outputs, especially within the action area, as they incorporated both AMAPPs data as well as data from aerial surveys conducted by several organizations in the southeast United States. By including these additional data sources, the number of right whale sightings used to inform the models within the action area increased by over 2,500 sightings (approximately 40 sightings in the 2015 model versus approximately 2,560 sightings in the 2017 model) (Roberts *et al.,* 2017). In addition, the updated models incorporated several improvements to minimize known biases and used an improved seasonal definition that more closely aligns with right whale biology. Importantly, the updated model outputs showed a strong relationship between right whale abundance in the action area and distance to shore out to approximately 80 km (Roberts *et al.,* 2017)—the same relationship was indicated as being out to approximately 50 km by the previous model version (Roberts *et al.,* 2016). As a result of these significant model improvements and in context of the significant concern regarding North Atlantic right whale status, we determined it necessary to produce revised exposure estimates for the North Atlantic right whale (described in further detail below). As stated by the authors, their goal in updating the right whale model was to re-examine all aspects of the model and make as many improvements as possible. This updated model represents the best available scientific information regarding North Atlantic right whale density and distribution.

We note that, in addition to the models for North Atlantic right whales, Roberts *et al.* (2017) presented updated models for 10 additional taxa (fin, humpback, minke, sei, and sperm whales; separate models for Cuvier's, Mesoplodont, and unidentified beaked whales; pilot whales; and harbor porpoise). While these models incorporate several improvements (additional data (although mostly outside of the action area), new seasonal definitions, updates to better correct for known biases), we evaluated the model outputs as being generally similar to those produced by Roberts *et al.* (2016). Thus, while the Roberts *et al.* (2017) models for these additional species likely represent minor improvements over the Roberts *et al.* (2016) models for these species, they are unlikely to result in meaningful differences if used in an exposure analysis. That is, we consider both the Roberts *et al.* (2016) and Roberts *et al.* (2017) model outputs the best available density estimates for these additional species, and estimates of exposure based on the outputs of one model are unlikely to be meaningfully different than estimates based on outputs from the other. Therefore, because these revised models were not available to us at the time of initial development of the exposure estimates and do not represent a significant improvement in the state of available scientific information, as do the updated right whale models, we did not request these updated models from the authors and retain use of the 2015 model version for these taxa.

Description of Exposure Estimates

Here, we provide applicant-specific descriptions of the processes employed to estimate potential exposures of marine mammals to given levels of received sound. The discussions provided here are specific to estimated exposures at or above the criterion for Level B harassment (*i.e.,* 160 dB rms); we provide a separate discussion below regarding our consideration of potential Level A harassment. We provide a brief summary of the exposure modeling process performed for BOEM's PEIS as a point of reference; for more information, please see our Notice of Proposed IHAs. For full detail, see Appendix E of the PEIS (BOEM, 2014a).

This description builds on the description of sound field modeling provided earlier in this section and in Appendix D of BOEM's PEIS. As described previously, 21 distinct acoustic propagation regions were defined. Reflecting seasonal differences in sound velocity profiles, these regions were specific to each season. Using the NODEs data, the average density of each species was then numerically determined for each region. However, the NODEs models do not provide outputs for the extended continental shelf areas seaward of the EEZ; therefore, known density information at the edge of the area modeled by NODEs was extrapolated to the remainder of the study area.

The results of the acoustic modeling exercise (*i.e.,* estimated 3D sound field) and the region-specific density estimates were then input into MAI's Acoustic Integration Model (AIM). AIM is a software package developed to predict the exposure of receivers (*e.g.,* an animal) to any stimulus propagating through space and time through use of a four-dimensional, individual-based, Monte Carlo-based statistical model. Within the model, simulated marine animals (*i.e.,* animats) may be programmed to behave in specific ways on the basis of measured field data. An animat movement engine controls the geographic and vertical movements (*e.g.,* speed and direction) of sound sources and animats through four dimensions (time and space) according to user inputs.

Species-specific animats were created with programmed behavioral parameters describing dive depth, surfacing and dive durations, swimming speed, course change, and behavioral aversions (*e.g.,* water too shallow). The programmed animats were then randomly distributed over a given bounded simulation area. Because the exact positions of sound sources and animals are not known in advance for proposed activities, multiple runs of realistic predictions are used to provide statistical validity to the simulated scenarios. Each species-specific simulation is seeded with a given density of animats. A separate simulation was created and run for each combination of location, movement pattern, and marine mammal species.

A model run consists of a user-specified number of steps forward in time, in which each animat is moved according to the rules describing its behavior. For each time step of the model run, the received sound levels at each animat (*i.e.,* each marine mammal) are calculated. AIM returns the movement patterns of the animats, and the received sound levels are calculated separately using the given acoustic propagation predictions at different locations. At the end of each time step, an animat ''evaluates'' its environment, including its 3D location, the time, and any received sound level.

Animat positions relative to the acoustic source (*i.e.,* range, bearing, and depth) were used to extract received level estimates from the acoustic propagation modeling results. The source levels, and therefore subsequently the received levels, include the embedded corrections for signal pulse length and M-weighting. M-weighting is a type of frequency weighting curve intended to reflect the differential potential for sound to affect marine mammals based on their sensitivity to the particular frequencies produced (Southall *et al.,* 2007). Please see Appendix D of BOEM's PEIS for further description of the application of M-weighting filters. For each bearing, distance, and depth from the source, the received level values were expressed as SPLs (rms) with units of dB re 1μ Pa. These are then converted back to intensity and summed over the duration of the exercise to generate an integrated energy level, expressed in terms of dB re 1 μPa^2-sec or dB SEL. The number of animats per species that exceeded a given criterion (*e.g.,* 160 dB rms) may then be determined, and these results scaled according to the relationship of model-to-real world densities per species. That is, the exposure results are corrected using the actual species- and region-specific density derived from the density model outputs (as described above) to give real-world estimates of exposure to sound exceeding a given received level.

As noted previously, the NODEs models (DoN, 2007) provided the best available information at the time of initial development for these applications. Outputs of the cetacean density models described by Roberts *et al.* (2016) were subsequently made available to the applicant companies, which, with the exception of CGG, had previously submitted applications. Two applicants (TGS and Western) elected to consider the new information and produced revised applications accordingly. CGG used the Roberts *et al.* (2016) models in developing their application. Two applicants (Spectrum and ION) declined to use the Roberts *et al.* (2016) density models. However, we worked with MAI—which performed the initial exposure modeling provided in the Spectrum and ION applications—to produce revised exposure estimates utilizing the outputs of the Roberts *et al.* (2016) density models.

In order to revise the exposure estimates for Spectrum and ION, we first extracted appropriate density estimates from the Roberts *et al.* (2016) model outputs. Because both Spectrum and ION used modeling processes conceptually similar to that described above for BOEM's PEIS, these density estimates would replace those previously derived from the NODEs models in rescaling the exposure estimation results from those derived from animal movement modeling using a user-specified density. The steps involved in calculating mean marine mammal densities over the 21 modeling areas used in both BOEM's PEIS and the applications were described in our Notice of Proposed IHAs, and are not repeated here. As was the case for the NODEs model outputs, the Roberts *et al.* (2016) model outputs are restricted to the U.S. EEZ. Therefore, we similarly extended the edge densities to cover the area outside of the data extent. This process was also described in our Notice of Proposed IHAs, and is not repeated here.

Spectrum—Spectrum's sound field estimation process was previously described, and their exposure modeling process is substantially similar to that described above for BOEM's PEIS. Spectrum's exposure modeling process was described in full in our Notice of Proposed IHAs; please see that document for more detail. As described previously, Spectrum limited their analysis to winter and spring seasons and therefore used only ten of the 21 seasonal propagation acoustic regions. Half of the survey activity was assumed to occur in winter and half in spring.

In summary, the original exposure results were obtained using AIM to model source and animat movements, with received SEL for each animat predicted at a 30-second time step. This predicted SEL history was used to determine the maximum SPL (rms or peak) and cSEL for each animat, and the number of exposures exceeding relevant criteria recorded. The number of exposures are summed for all animats to get the number of exposures for each species, with that summed value then scaled by the ratio of real-world density to the model density value. The final scaling value was the ratio of the length of the modeled survey line to the length of survey line in each modeling region. The exposure estimates provided in Spectrum's application were based on the NODEs model outputs. In order to make use of the best available information (*i.e.,* Roberts *et al.* (2016)), we extracted species- and region-specific density values as described above. These were provided to MAI in order to rescale the original exposure results produced using the seeded animat density; revised exposure estimates are shown in Table 6.

As stated above, Spectrum notified NMFS on June 26, 2018, of a modification to their survey plan. Note that analysis corresponding with Spectrum's original survey plan is retained here, in "Estimated Take." Please see "Spectrum Survey Plan Modification" for further information and for revised (and authorized) take numbers (Table 17) relating to Spectrum's modified survey plan.

ION—ION's sound field estimation process was previously described, and their exposure modeling process is substantially similar to that described above for BOEM's PEIS (and for Spectrum). ION's exposure modeling process was described in full in our Notice of Proposed IHAs; please see that document for more detail. The same acoustic propagation regions described for BOEM's PEIS were used by ION for exposure modeling; however, ION limited their analysis to summer and fall seasons and therefore used only 11 of the 21 regions. Whichever season returned the higher number of estimated exposures for a given species was assumed to be the season in which the survey occurred, *i.e.,* ION's requested take authorization corresponds to the higher of the two seasonal species-specific exposure estimates.

In summary, the original exposure results were obtained using AIM to model source and animat movements, with received SEL for each animat predicted at a 30-second time step. This predicted SEL history was used to determine the maximum SPL (rms or peak) and cSEL for each animat, and the number of exposures exceeding relevant criteria recorded. The number of exposures are summed for all animats to get the number of exposures for each species, with that summed value then scaled by the ratio of real-world density to the model density value. The final scaling value was the ratio of the length of the modeled survey line to the length of survey line in each modeling region. As described above, the exposure estimates provided in ION's application were based on the NODEs model outputs. In order to make use of the best available information (*i.e.,* Roberts *et al.* (2016)), we extracted species- and region-specific density values as described above. These were provided to MAI in order to rescale the original exposure results produced using the seeded animat density; revised exposure estimates are shown in Table 6.

TGS—TGS did not conduct their own sound field modeling, instead relying on the sound field estimates provided by BOEM (2014a). For purposes of exposure modeling, TGS considered threshold radii for three depth bins: <880 m, 880–2,560 m, >2,560 m (note that there are no sound field modeling sites at depths between 880–2,560 m).

When considering the 21 modeling scenarios across the 15 sites, threshold radii shown in Table 4 break down evenly with 11 at depths ≤880 m (mean threshold radius of 8,473 m) and ten at depths ≥2,560 m (mean threshold radius of 5,040 m). Therefore, the overall mean for all scenarios of 6,838 m was used for estimating potential exposures for track lines occurring in water depths of 880–2,560 m.

Regarding marine mammal occurrence, TGS considered both the Roberts *et al.* (2016) density models as well as the AMAPPS data. TGS stated that there are aspects of the Roberts *et al.* (2016) methodology that limit the model outputs' applicability to estimating marine mammal exposures to underwater sound and determined it appropriate to develop their own density estimates for certain species using AMAPPS data.

As stated above, we believe the density models described by Roberts *et al.* (2016) provide the best available information at the time of our evaluation and recommend their use for species other than those expected to be extremely rare in a given area. However, TGS used the most recent observational data available in their alternative take estimation process conducted for seven of the affected species or groups. We acknowledge their concerns regarding use of predictive density models for species with relatively few observations in the survey area, *e.g.,* that model-derived density estimates must be applied cautiously on a species-by-species basis with the recognition that in some cases the out-of-bound predictions could produce unrealistic results (Becker *et al.,* 2014). Further, use of uniform (*i.e.,* stratified) density models assumes a given density over a large geographic range which may include areas where the species has rarely or never been observed. For the seven species or species groups that TGS applied their alternative approach to (described below), five are modeled in whole or part through use of stratified models. We also acknowledge (as do Roberts *et al.* (2016)) that predicted habitat may not be occupied at expected densities or that models may not agree in all cases with known occurrence patterns, and that there is uncertainty associated with predictive habitat modeling (*e.g.,* Becker *et al.,* 2010; Forney *et al.,* 2012). We determined that TGS' alternative approach (for seven species or species groups) is acceptable and, importantly, we recognize that there is no model or approach that is always the most appropriate and that there may be multiple approaches that may be considered acceptable (*e.g.,* Box, 1979). Further detailed discussion on these topics was provided in our Notice of Proposed IHAs, and is not repeated here.

In summary, TGS described the following issues in support of their development of an alternative approach for certain species:

- There are very few sightings of some species despite substantial survey effort;
- The modeling approach extrapolates based on habitat associations and assumes some species' occurrence in areas where they have never been or were rarely documented (despite substantial effort);
- In some cases, uniform density models spread densities of species with small sample sizes across large areas of the EEZ without regard to habitat, and;
- The most recent NOAA shipboard and aerial survey data (*i.e.,* AMAPPS) were not included in model development.

As a result of their general concerns regarding suitability of model outputs for exposure estimation, TGS developed a scheme related to the number of observations in the dataset available to Roberts *et al.* (2016) for use in developing the density models. Extremely rare species (*i.e.,* less than four sightings in the survey area) were considered to have a very low probability of encounter, and it was assumed that the species might be encountered once. Therefore, a single group of the species was considered as expected to be exposed to sound exceeding the 160 dB rms harassment criterion. We agree with this approach for rarely occurring species and adopted it for all applicants, as described below.

As described previously, marine mammal abundance has traditionally been estimated by applying distance sampling methodology (Buckland *et al.,* 2001) to visual line-transect survey data. Buckland *et al.* (2001) recommend a minimum sample size of 60–80 sightings to provide reasonably robust estimates of density and abundance to fit the mathematical detection function required for this estimation; smaller sample sizes result in higher variance and thus less confidence and less accurate estimates. While we agree that TGS' approach is a reasonable one, we also note that the Buckland *et al.* (2001) recommendation that sample size should generally be at least 60–80 should be considered as general guidance but not an absolute rule. Buckland *et al.* (2001) provide no theoretical proof for it and, in fact, it has not been followed as a rule in practice. Miller and Thomas (2015) provide an example where a detection function fitted to 30 sightings resulted in a detection function with low bias. NMFS's line-transect abundance estimates are in some cases based on many fewer sightings, *e.g.,* stock assessments based on Palka (2012). For species meeting the Buckland *et al.* guideline within the survey area, TGS used Roberts *et al.* (2016)'s model. For species with fewer sightings (but with greater than four sightings in the survey area), TGS used what they refer to as ''Line Transect Theory'' in conjunction with AMAPPS data to estimate species density within the assumed 160 dB rms zone of ensonification.

Nine species or species groups met TGS' requirement of having at least 60 sightings within the survey area in the dataset available to Roberts *et al.* (2016): Atlantic spotted dolphin, pilot whales, striped dolphin, beaked whales, bottlenose dolphin, Risso's dolphin, common dolphin, sperm whale, and humpback whale. The steps involved in the exposure estimation process for these species was described in full in our Notice of Proposed IHAs and is not repeated here.

Seven species or species groups met TGS' criterion for conducting exposure modeling, but did not have the recommended 60 sightings in the survey area: Minke whale, fin whale, *Kogia* spp., harbor porpoise, pantropical spotted dolphin, clymene dolphin, and rough-toothed dolphin. For these species, TGS did not feel use of the density models was appropriate and developed a method using the available data instead (*i.e.,* AMAPPS data as well as data considered by Roberts *et al.* (2016), excluding results of surveys conducted entirely outside of an area roughly coincident with the planned survey area); species-specific rationale is provided in section 6.3 of TGS' application. Please see section 6.3 of TGS' application for further details regarding the AMAPPS survey effort considered by TGS. Table 6–1 in TGS' application summarizes the AMAPPS data available for consideration by the authors. The steps involved in the exposure estimation process for these species was described in full in our Notice of Proposed IHAs and is not repeated here (see Table 6–4 in TGS' application for numerical process details).

TGS initially proposed use of a mitigation source (*i.e.,* 90-in^3 airgun) for line turns and transits not exceeding three hours and produced exposure estimates specific to use of the mitigation source. As described in ''Mitigation,'' we do not allow use of the mitigation source; therefore, exposure estimates specific to use of a mitigation gun would not actually occur. In their application, TGS provided exposure estimates specific to use of the full-power array and to use of the mitigation gun for the seven species for which the alternative approach was followed, but not for the nine species whose exposure estimates are based on the Roberts *et al.* (2016) density models (for the latter group, only a combined total was provided). Therefore, in our Notice of Proposed IHAs, we did not include mitigation gun exposure estimates for the former group but did for the latter group, noting exposure estimates for those nine species were slightly overestimated. However, following publication of our Notice of Proposed IHAs, TGS provided a breakdown for these species according to full-power array versus mitigation source; therefore, we have removed the estimates associated with use of the mitigation source for all species. Take authorization numbers provided for TGS (Table 6) reflect this appropriate adjustment.

Western—Western's approach to estimating potential marine mammal exposures to underwater sound was identical to that described above for TGS; therefore, we do not provide a separate description for Western.

Western also initially proposed use of a mitigation source for line turns and transits not exceeding three hours and produced exposure estimates specific to use of the mitigation source. Like TGS, Western's application provided information specific to use of the full-power array versus the mitigation source for the seven species for which the alternative approach was followed, but not for the nine species whose exposure estimates are based on the Roberts *et al.* (2016) density models (for the latter group, only a combined total was provided). However, unlike TGS, Western did not provide additional information following publication of our Notice of Proposed IHAs. Therefore, mitigation gun exposure estimates are included in the total for the latter group, and exposure estimates for those nine species are slightly overestimated.

CGG—CGG used applicable results from BOEM's sound field modeling exercise in conjunction with the outputs of models described by Roberts *et al.* (2016) to inform their estimates of likely acoustic exposures. CGG's exposure modeling process was described in full in our Notice of Proposed IHAs; please see that document for more detail. Considering only the BOEM modeling sites that are in or near CGG's survey area provided a mean radial distance to the 160 dB rms criterion of 6,751 m (range 5,013–8,593 m). Taxon-specific model outputs, averaged over the six-month period planned for the survey (*i.e.,* July-December) where relevant, were used with the assumed ensonification zone to provide estimates of marine mammal exposures to noise above the 160 dB rms threshold. Similar to other applicants, CGG performed an interpolation analysis to estimate density values for the portion of planned survey area outside the EEZ.

North Atlantic Right Whale—As described above, given the current status of North Atlantic right whales, we re-evaluated available information subsequent to public review of our proposed IHAs. Finding that significant improvements were available to us, we determined it appropriate to re-estimate acoustic exposures specifically for right whales using the updated models. To do so, we relied on the sound field modeling results provided in BOEM's 2014 PEIS (see description above and Appendix D in BOEM (2014a)), as was previously done by TGS, CGG, and Western in their IHA applications. Using site- and season-specific radii to the 160 dB rms threshold (95 percent range, see Table 4 above or Table D–22 in BOEM (2014a)) and the total amount of trackline planned by each company within the acoustic modeling regions specified in BOEM's 2014 PEIS (see Appendix E, Table E–5 and Figures E–11 to E14 in BOEM (2014a)), we calculated monthly, region-specific ensonified areas for each company as if their entire survey tracklines were completed in each month. Then, using the updated 2017 density model outputs (Roberts *et al.,* 2017), we calculated average monthly regional right whale densities, which were then multiplied by the monthly ensonified areas. Finally, these data were averaged (annually or according to the planned operating window where appropriate) to estimate the average total exposure of North Atlantic right whales. In this way, we incorporated the seasonal variation in density of right whales since we do not know the exact distribution of survey effort within each company's operating window.

Importantly, in these calculations we took into account the time-area restrictions specified in ''Mitigation.'' For the year-round closure areas, data (*i.e.,* ensonified areas and North Atlantic right whale densities) were not used to formulate exposure estimates since surveys would be completely prohibited within these areas. In the seasonal restriction areas, only data from months when the areas are open were used in calculating the exposure estimates. The final resulting exposure estimates then are based on the best available information on North Atlantic right whale densities within the action area (Roberts *et al.,* 2017), fully take into account all time-area restrictions, and are specific to each company's tracklines and planned operating window (if specified). Take estimates shown in Table 6 for North Atlantic right whales reflect this analysis, and replace those previously estimated using different information and specified in our Notice of Proposed IHAs.

Time-Area Restrictions—Following review of public comments, we conducted an analysis of expected take avoided due to implementation of the time-area restrictions described in ''Mitigation.'' To do this, we took an approach related to that previously described for right whales. In brief, we started with the existing take estimates as described in our Notice of Proposed IHAs and then calculated the take that would be avoided due to the planned restrictions. We then subtracted this from the originally proposed take to get our final take estimates. As described below, we took a slightly different approach for the sperm whale as compared with other species in that we accounted for the seasonal restriction of Area #4 (the ''Hatteras and North'' restriction; see ''Mitigation''). We did this because the area was designed in part specifically to benefit sperm whales, and because density model outputs are provided at monthly resolution for sperm whales, whereas density model outputs are provided at only annual resolution for beaked whales and pilot whales (Area #4 was also designed specifically to benefit these species). Take avoided due to seasonal restrictions, versus year-round closures, cannot be calculated for species for which only annual density outputs are available. For those species with monthly data availability but for which the seasonal restriction was not designed, we determined that the analysis was unlikely to result in meaningful changes to the take estimates.

For sperm whales, we calculated the monthly density within each year-round closure area using the Roberts *et al.* (2016) model outputs and calculated the monthly ensonified area within each year-round closure for each company based on their planned tracklines and the radii to the 160 dB rms threshold. We then multiplied these monthly numbers by each other to estimate the monthly take avoided and, finally, computed the annual average of these avoided takes to estimate the overall take that would be avoided due to the year-round closures. For the seasonal restrictions, only Area #4 (the ''Hatteras and North'' restriction; see ''Mitigation'') was accounted for since it is the only seasonal restriction designed specifically to protect sperm whales. While we considered accounting for the North Atlantic right whale seasonal restriction, we opted not to since it primarily protects shallower waters where sperm whales are less likely to be found, and the added complication of incorporating the restriction was unlikely to result in meaningful changes to the overall take estimates for sperm whales. To account for Area #4, we calculated the change in take due to the restriction in a similar fashion to the year-round closures above, except that instead of calculating the change in take based on an annual average, we calculated the difference between the average take for when the area is open and when the area is closed in order to calculate the overall change in take due to restricting surveys within this area. As before, for these calculations we took into account specific survey timing where relevant but otherwise assumed the surveys could happen at any time of the year. The combined year-round and seasonal avoided takes were then subtracted from the originally proposed take authorizations described in our Notice of Proposed IHAs to calculate the final take estimates for sperm whales.

For other species, a simpler approach was taken. First, we did not account for any seasonal restrictions, either because sufficient data is not available or because the seasonal restrictions' benefit in protecting species for which they were not specifically designed is unclear. Second, we did not recalculate density estimates specifically within the year-round closures, but instead relied on density estimates derived from the Roberts *et al.* (2016) model outputs for each acoustic modeling region used in BOEM's 2014 PEIS. Using these density estimates, we then followed the same procedure detailed above for sperm whales (multiplied monthly or seasonal densities by monthly or seasonal ensonified area, and compute annual or operating window average) to estimate the take that would be avoided due to the year-round closures. These avoided takes were then subtracted from the originally proposed take authorizations described in our Notice of Proposed IHAs to calculate the final take estimates.

Level A Harassment

All requests for IHAs described herein were received prior to NMFS's original 2016 technical guidance and, therefore, did not reflect consideration of the currently best available information regarding the potential for auditory injury. In our Notice of Proposed IHAs, we described a process by which we estimated expected takes by Level A harassment in reflection of both NMFS's technical guidance and the specific survey characteristics (*i.e.,* actual line-kms and specific airgun arrays planned for use) using modeled auditory injury exposure results found in BOEM's 2014 PEIS. The PEIS results were based on both the Southall *et al.* (2007) guidance (a precursor to NMFS's technical guidance) and the historical 180-dB rms criterion (which provides information relevant to a comparison to the likelihood of injurious exposure resulting from peak pressure). That process was described in our Notice of Proposed IHAs and is not repeated here. However, following review of public comments, we determined it appropriate to re-evaluate the analysis, as described below.

In our Notice of Proposed IHAs, we acknowledged that the Level A exposure estimates provided therein—based on adjustments made to the results provided in BOEM's PEIS—were a rough approximation of potential exposures, with multiple limitations in reflection of the available information or lack thereof. For example, specific trackline locations planned by the applicant companies may differ somewhat from those considered in BOEM's PEIS, although it is likely that all portions of the survey area are considered in the PEIS analysis. More importantly, the PEIS exposure estimates were based on outputs of the NODEs models (DoN, 2007) available for BOEM's analysis versus the density models subsequently provided by Roberts *et al.* (2016), which we believe represent the best available information for purposes of exposure estimation. In addition, we noted that we did not attempt to approximate the probability of marine mammal aversion or to incorporate the effects of mitigation on the likelihood of Level A harassment. Following review of public comments, we reconsidered the likelihood of potential auditory injury, specific to each hearing group (*i.e.,* low-frequency, mid-frequency, and high-frequency), and re-evaluated the specific Level A harassment estimates presented in our Notice of Proposed IHAs. Here, we provide a revised analysis of likely takes by Level A harassment.

Specifically, we determined that there is a low likelihood of take by Level A harassment for any species, and that this likelihood is primarily influenced by the specific hearing group. For mid- and high-frequency cetaceans, potential auditory injury would be expected to occur on the basis of instantaneous exposure to peak pressure output from an airgun array, leading to a relatively straightforward consideration of the Level A harassment zone as an areal subset of the Level B harassment zone and, therefore, takes by Level A harassment as a subset of the previously enumerated takes by Level B harassment. However, for mid-frequency cetaceans, additional considerations of the small calculated Level A harassment zone size in conjunction with the properties of sound fields produced by arrays in the near field versus far field lead to a logical conclusion that Level A harassment is so unlikely for species in this hearing group as to be discountable. For low-frequency cetaceans, consideration of the likely potential for auditory injury is not straightforward, as such exposure would occur on the basis of the accumulation of energy output over time by an airgun array. Additional factors, such as the relative motion of source and receiver and the implementation of mitigation lead us to conclude that a quantitative evaluation of such potential, in light of the available information, does not make sense. Our evaluations for all three hearing groups are detailed below.

As part of the exposure estimation process described in our Notice of Proposed IHAs, we calculated expected injury zones specific to each applicant's array for each hearing group relative to injury criteria for both the cSEL and peak pressure metrics. The results of this process, shown in Table 5, remain valid and were used to inform the revised estimates of take by Level A harassment described herein. For the cSEL metric, in order to incorporate the technical guidance's weighting functions over an array's full acoustic band, we obtained unweighted spectrum data (modeled in 1 Hz bands) for a reasonably equivalent acoustic source (*i.e.,* a 36-airgun array with total volume of 6,600 in^3). Using these data, we made adjustments (dB) to the unweighted spectrum levels, by frequency, according to the weighting functions for each relevant marine mammal hearing group. We then converted these adjusted/weighted spectrum levels to pressures (micropascals) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within NMFS's User Spreadsheet (*i.e.,* override the Spreadsheet's more simple weighting factor adjustment).

When NMFS (2016) was published, in recognition of the fact that appropriate isopleth distances could be more technically challenging to predict because of the duration component in the new thresholds, NMFS developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density to help predict exposures. For mobile sources, such as the surveys considered here, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed (the ''safe distance'' methodology discussed below). For more information about the User Spreadsheet, please see *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*.

Using the User Spreadsheet's ''safe distance'' methodology for mobile sources (described by Sivle *et al.,* 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 4.5 kn, shot intervals specified by the applicants, and pulse duration of 100 ms, we then calculated potential radial distances to auditory injury zones relative to the cSEL metric. We also calculated potential radial distances to auditory injury zones on the basis of maximum peak pressure using values provided by the applicants (Table 1) and assuming a simple model of spherical spreading propagation. We note that our Notice of Proposed IHAs contained an error. On page 26254 of that notice, we stated that the range of distances for injury zones relative to the cSEL metric was 80–4,766 m. The correct range is 80–951 m; results are shown in Table 5.

TABLE 5—ESTIMATED AUDITORY INJURY ZONES [1]

Hearing group	Metric	Spectrum	ION	TGS	Western	CGG
Low-frequency	cSEL	757	951	380	80	757
	peak	224	79	63	71	50
Mid-frequency	cSEL	0	0	0	0	0
	peak	63	22	18	20	14
High-frequency	cSEL	1	8	1	0	1
	peak	1,585	562	447	501	355
Estimated near-field [2]		417	233	142	80	141

[1] Radial isopleth distances presented in meters.
[2] See discussion of ''near-field'' below.

Based on our analysis of expected injury zones (Table 5), accumulation of energy is considered to be the predominant source of potential auditory injury for low-frequency cetaceans in all cases, while instantaneous exposure to peak pressure received levels is considered to be the predominant source of potential injury for both mid- and high-frequency cetaceans in all cases. Please note that discussion in this section and estimates of take by Level A harassment provided in Table 6 for Spectrum relate to Spectrum's original survey plan. Please see ''Spectrum Survey Plan Modification'' for additional discussion of Level A harassment reflecting Spectrum's modified survey plan.

Mid-Frequency Cetaceans—For all mid-frequency cetaceans, following re-evaluation of the available scientific literature regarding the auditory sensitivity of mid-frequency cetaceans and the properties of airgun array sound fields, we do not expect any reasonable potential for Level A harassment to occur. For these species, the only potential injury zones (for all applicants) would be based on the peak pressure metric (Table 5). However, the estimated zone sizes for the 230 dB peak threshold for mid-frequency cetaceans range from only 14 m to 63 m. While in a theoretical modeling scenario it is possible for animats to engage with such small assumed zones around a notional point source and, subsequently, for these interactions to scale to predictions of real-world exposures given a sufficient number of predicted 24-hr survey days in confluence with sufficiently high predicted real-world animal densities—*i.e.,* the modeling process that resulted in the predicted exposure estimates for mid-frequency cetaceans in BOEM's PEIS—this is not a realistic outcome. The source level of the array is a theoretical definition assuming a point source and measurement in the far-field of the source (MacGillivray, 2006). As described by Caldwell and Dragoset (2000), an array is not a point source, but one that spans a small area. In the far-field, individual elements in arrays will effectively work as one source because individual pressure peaks will have coalesced into one relatively broad pulse. The array can then be considered a ''point source.'' For distances within the near-field, *i.e.,* approximately 2–3 times the array dimensions, pressure peaks from individual elements do not arrive simultaneously because the observation point is not equidistant from each element. The effect is destructive interference of the outputs of each element, so that peak pressures in the near-field will be significantly lower than the output of the largest individual element. Here, the 230 dB peak isopleth distances would in all cases be expected to be within the near-field of the arrays where the definition of source level breaks down. Therefore, actual locations within these distances (*i.e.,* 14–63 m) of the array center where the sound level exceeds 230 dB peak SPL would not necessarily exist. In general, Caldwell and Dragoset (2000) suggest that the near-field for airgun arrays is considered to extend out to approximately 250 m.

In order to provide quantitative support for this theoretical argument, we calculated expected maximum distances at which the near-field would transition to the far-field (Table 5). For a specific array one can estimate the distance at which the near-field transitions to the far-field by:

$$D = \frac{L^2}{4\lambda}$$

with the condition that $D \gg \lambda$, and where D is the distance, L is the longest dimension of the array, and λ is the wavelength of the signal (Lurton, 2002). Given that λ can be defined by:

$$\lambda = \frac{v}{f}$$

where f is the frequency of the sound signal and v is the speed of the sound in the medium of interest, one can rewrite the equation for D as:

$$D = \frac{fL^2}{4v}$$

and calculate D directly given a particular frequency and known speed of sound (here assumed to be 1,500 meters per second in water, although this varies with environmental conditions).

To determine the closest distance to the arrays at which the source level predictions in Table 1 are valid (*i.e.,* maximum extent of the near-field), we calculated *D* based on an assumed frequency of 1 kHz. A frequency of 1 kHz is commonly used in near-field/far-field calculations for airgun arrays (Zykov and Carr, 2014; MacGillivray, 2006; NSF and USGS, 2011), and based on representative airgun spectrum data and field measurements of an airgun array used on the R/V *Marcus G. Langseth,* nearly all (greater than 95 percent) of the energy from airgun arrays is below 1 kHz (Tolstoy *et al.,* 2009). Thus, using 1 kHz as the upper cut-off for calculating the maximum extent of the near-field should reasonably represent the near-field extent in field conditions.

If the largest distance to the peak sound pressure level threshold was equal to or less than the longest dimension of the array (*i.e.,* under the array), or within the near-field, then received levels that meet or exceed the threshold in most cases are not expected to occur. This is because within the near-field and within the dimensions of the array, the source levels specified in Table 1 are overestimated and not applicable. In fact, until one reaches a distance of approximately three or four times the near-field distance the average intensity of sound at any given distance from the array is still less than that based on calculations that assume a directional point source (Lurton, 2002). For example, an airgun array used on the R/V *Marcus G. Langseth* has an approximate diagonal of 29 m, resulting in a near-field distance of 140 m at 1 kHz (NSF and USGS, 2011). Field measurements of this array indicate that the source behaves like multiple discrete sources, rather than a directional point source, beginning at approximately 400 m (deep site) to 1 km (shallow site) from the center of the array (Tolstoy *et al.,* 2009), distances that are actually greater than four times the calculated 140-m near-field distance. Within these distances, the recorded received levels were always lower than would be predicted based on calculations that assume a directional point source, and increasingly so as one moves closer towards the array (Tolstoy *et al.,* 2009). Given this, relying on the calculated distances (Table 5) as the distances at which we expect to be in the near-field is a conservative approach since even beyond this distance the acoustic modeling still overestimates the actual received level.

Within the near-field, in order to explicitly evaluate the likelihood of exceeding any particular acoustic threshold, one would need to consider the exact position of the animal, its relationship to individual array elements, and how the individual acoustic sources propagate and their acoustic fields interact. Given that within the near-field and dimensions of the array source levels would be below those in Table 1, we believe exceedance of the peak pressure threshold would only be possible under highly unlikely circumstances.

Therefore, we expect the potential for Level A harassment of mid-frequency cetaceans to be de minimis, even before the likely moderating effects of aversion and/or other compensatory behaviors (*e.g.,* Nachtigall *et al.,* 2018) are considered. We do not believe that Level A harassment is a likely outcome for any mid-frequency cetacean and do not authorize any Level A harassment for these species.

Low-Frequency Cetaceans—For low-frequency cetaceans, we previously adjusted the BOEM PEIS estimates of potential Level A harassment to account for NMFS's technical acoustic guidance, as described in our Notice of Proposed IHAs. This process resulted in few estimated Level A harassment exposures for low-frequency cetaceans, *i.e.,* 2–22 such exposures for humpback whales and 0–1 such exposures for minke whales, depending on array specifics, and zero exposures for right whales and fin whales (see Table 11 in our Notice of Proposed IHAs). The potential injury zones are relatively large for low-frequency cetaceans (up to 951 m; Table 5); therefore, we expect that some Level A harassment may occur for the most commonly occurring low-frequency cetacean species (*i.e.,* humpback, fin, and minke whales). However, we also note that injury on the basis of accumulation of energy is not a straightforward consideration of calculated zone size, as is consideration of injury on the basis of instantaneous peak pressure exposure. For example, observation of a whale at the distance calculated as being the ''injury zone'' using the cSEL criterion does not necessarily mean that the animal has in fact incurred auditory injury. Rather, the animal would have to be at the calculated distance (or closer) as the mobile source approaches, passes, and recedes from the exposed animal, being exposed to and accumulating energy from airgun pulses the entire time, as is implied by the name of the ''safe distance'' methodology by which such zone distances are calculated.

Therefore, while we do believe that some limited Level A harassment of low-frequency cetaceans is likely unavoidable, despite the required mitigation measures (including ramp-up, shutdown upon detection within a 500-m exclusion zone for most mysticetes and shutdown upon detection of North Atlantic right whales within an expanded 1.5-km exclusion zone; see ''Mitigation''), we do not believe that the process followed in estimating potential Level A harassment in our Notice of Proposed IHAs is the most appropriate method. Further, upon re-evaluation of the results of that process, we do not have confidence in those results, which suggest that Level A harassment is likely for humpback whales but not for fin whales. Upon reconsideration of the available information, we note that the original information from BOEM's PEIS includes prediction of zero incidents of Level A harassment for fin whales while predicting non-zero results for all other mysticete species (see Table E–4 in BOEM (2014a))—a puzzling result that underlies the lack of predicted Level A harassment for fin whales in our Notice of Proposed IHAs. Therefore, we apply a simplified approach intended to acknowledge that there would likely be some minimal, yet difficult to accurately quantify, Level A harassment of certain mysticete species. As a result of the planned mitigation, including a seasonal restriction (or alternate methods of equivalent impact avoidance) and an expanded right whale exclusion zone of 1.5 km (intended to practicably avoid or minimize interaction with North Atlantic right whales; see ''Mitigation''), we do not expect any reasonable potential for Level A harassment of North Atlantic right whales (consistent with the predictions of our original analysis). Any likely potential for the occurrence of Level A harassment is further minimized by likely aversion. For example, Ellison *et al.* (2016) demonstrated that animal movement models where no aversion probability was used overestimated the potential for high levels of exposure required for PTS by about five times.

In order to account for the minimal likelihood of Level A harassment occurring for low-frequency cetaceans, we assume that in most cases during the course of conducting the survey at least one group of each species could incur auditory injury for all applicants other than Western. (As shown in Table 5, the calculated injury zone for Western is only 80 m. It is extremely unlikely that injury could occur given such a small calculated zone, especially in context of a required 500-m exclusion zone.) We acknowledge that application of group size to estimation of take is more appropriate for take resulting from instantaneous exposure than it is for take resulting from the accumulation of energy, as any given group may disperse to some degree in a way that could lead to differing accumulation among individuals of the group. However, given the low likelihood of take by Level A harassment, small group sizes typical of mysticetes, and the likelihood that these individuals will remain within close distance of one another during the exposure, we believe that use of group size is appropriate in this context.

For applicants other than Western, we consider both the size of the calculated potential injury zone and the total amount of planned survey effort. Spectrum, CGG, and ION have larger calculated potential injury zones, *i.e.,* larger than the required 500-m exclusion zone (Table 5). However, ION has significantly less total survey effort (approximately half of what is planned by Spectrum and CGG; Table 1). TGS has a significantly smaller calculated injury zone, *i.e.,* smaller than the required 500-m exclusion zone. However, at 380 m, the zone is sufficiently large that a whale could potentially occur within the zone without being observed in time to implement shutdown, and TGS's planned survey effort is substantially larger (approximately twice as large as that planned by Spectrum and CGG). Therefore, TGS' lower likelihood of causing injury is offset to some degree by their substantially greater survey effort. Finally, on the basis of expected taking by Level B harassment (Table 6), we see that the location and timing of CGG's planned survey effort results in significantly less potential interaction with humpback whales than for Spectrum and TGS.

In summary, we conclude there is sufficiently reasonable potential for Level A harassment (even considering the likely effects of aversion) that it is appropriate to authorize take by Level A harassment for a minimum of one average size group of each relevant species (*i.e.,* humpback, minke, and fin whales) for Spectrum, TGS, ION, and CGG. For Spectrum, in consideration of the calculated injury zone and level of planned effort, we increase this to two groups of each relevant species. For TGS, in consideration of the level of planned survey effort and despite the smaller calculated injury zone, we also increase this to two groups of each relevant species. For CGG, in consideration of the calculated injury zone and level of planned effort, we increase this to two groups for minke whales and fin whales only, given the lower potential for interaction with humpback whales. For ION, given the lower level of planned survey effort, we maintain the take authorization at one group of each relevant species. As a point of reference, we note that BOEM's PEIS analysis of potential takes by Level A harassment estimated that no more than 5.9 humpback whales could experience auditory injury in any given year for all surveys combined, despite a greater amount of assumed activity. Estimates were much less for all other species (see Table E–4 of BOEM (2014a)). As noted above, please see ''Spectrum Survey Plan Modification'' for additional discussion of Level A harassment reflecting Spectrum's modified survey plan, including Table 17, providing revised (and authorized) levels of take by Level A harassment for Spectrum.

Average group size was determined by considering observational data from AMAPPS survey effort (*e.g.,* NMFS, 2010a, 2011, 2012, 2013a, 2014, 2015a). Average group sizes were as follows: Fin whale, 1.3 whales; humpback whale, 1.4 whales; minke whale, 1.2 whales. Therefore, we assume an average group size of two whales for each species. These take authorizations, which are subtracted from the estimates for take by Level B harassment to avoid double-counting, are shown in Table 6.

High-Frequency Cetaceans—For high-frequency cetaceans (*i.e., Kogia* spp. and harbor porpoise), injury zones are based on instantaneous exposure to peak pressure and are larger than the expected near-field in all cases (*i.e.,* 355–1,585 m). Therefore, we assume that Level A harassment is likely for some individuals of these species. In order to avoid consistency issues that may result when estimates of Level A harassment are based off of the results of a separate analysis that was founded in part on use of different density inputs, as was the case for the estimates of Level A harassment described in our Notice of Proposed IHAs, we simplified the analysis through use of the existing estimates of Level B harassment for each applicant. Under the assumption that some of these estimated exposures would in fact result in Level A harassment versus Level B harassment, we used applicant-specific calculated Level A and Level B harassment zones to generate estimates of the portion of estimated Level B harassment incidents that would be expected to be Level A harassment instead. For example, radial isopleth distances for Spectrum's calculated harassment zones are 1,585 m for Level A harassment and a mean of 9,775 m for Level B harassment, which we use to calculate relative area. On this basis, we assume that approximately 2.6 percent of estimated Level B harassment incidents would potentially be Level A harassment instead (for Spectrum). These final estimates, shown in Table 6, were then subtracted from the total take by Level B harassment. As noted for low-frequency cetaceans, we recognize that the effects of aversion would likely reduce these already low levels of Level A harassment.

We recognize that the Level A exposure estimates provided here are a rough approximation of actual exposures; however, our intention is to use the information available to us, in reflection of available science regarding the potential for auditory injury, to acknowledge the potential for such outcomes in a way that is a reasonable approximation. Our revised analysis of potential Level A harassment, as reflected in Table 6, accomplishes this goal. As described in our Notice of Proposed IHAs, we note here that four of the five applicant companies (excepting Spectrum) declined to request authorization of take by Level A harassment. These four applicants claim, in summary, that injurious exposures will not occur largely due to the effectiveness of planned mitigation. While we agree that Level A harassment is unlikely for mid-frequency cetaceans, and that only limited injurious exposure is likely for low-frequency cetaceans, we do not find this assertion persuasive in all cases. Therefore, we are authorizing limited take by Level A harassment, as displayed in Table 6.

Rare Species

Certain species potentially present in the survey areas are expected to be encountered only extremely rarely, if at all. Although Roberts *et al.* (2016) provide density models for these species (with the exception of the pygmy killer whale), due to the small numbers of sightings that underlie these models' predictions we believe it appropriate to account for the small likelihood that these species would be encountered by assuming that these species might be encountered once by a given survey, and that Level A harassment would not occur for these species. With the exception of the northern bottlenose whale, none of these species should be considered cryptic (*i.e.,* difficult to observe when present) versus rare (*i.e.,* not likely to be present). Average group size was determined by considering known sightings in the western North

Atlantic (CETAP, 1982; Hansen *et al,* 1994; NMFS, 2010a, 2011, 2012, 2013a, 2014, 2015a; Waring *et al.,* 2007, 2015). We provided discussion for each of these species in our Notice of Proposed IHAs, and do not repeat the discussion here. For each of these species—sei, Bryde's, and blue whales; the northern bottlenose whale; killer whale, false killer whale, pygmy killer whale, and melon-headed whale; and spinner, Fraser's, and Atlantic white-sided dolphins—we authorize take equivalent to one group of each species per applicant (Table 6).

Table 6 provides the authorized numbers of take by Level A and Level B harassment for each applicant. The numbers of authorized take reflect the expected exposure numbers provided in Table 10 of our Notice of Proposed IHAs, as derived by various methods described above, and additionally include take numbers for rare species that reflect the approach described above for average group size. In summary, the exposure estimates provided in Table 10 of our Notice of Proposed IHAs have been changed in reflection of the following: (1) Revised exposure estimates for North Atlantic right whales using Roberts *et al.* (2017); (2) removed exposure estimates specific to use of the disallowed mitigation source as necessary for certain species (TGS only); (3) removed estimated take avoided as a result of implementation of planned time-area restrictions; and (4) revised analysis of potential Level A harassment.

As described previously, for most species these estimated exposure levels apply to a generic western North Atlantic stock defined by NMFS for management purposes. For the humpback and sei whale, any takes are assumed to occur to individuals of the species occurring in the specific geographic region (which may or may not be individuals from the Gulf of Maine and Nova Scotia stocks, respectively). For bottlenose dolphins, NMFS defines an offshore stock and multiple coastal stocks of dolphins, and we are not able to quantitatively determine the extent to which the estimated exposures may accrue to the oceanic versus various coastal stocks. However, because of the spatial distribution of planned survey effort and our prescribed mitigation, we assume that almost all incidents of take for bottlenose dolphins would accrue to the offshore stock.

TABLE 6—NUMBERS OF POTENTIAL INSTANCES OF INCIDENTAL TAKE AUTHORIZED

Common name	Spectrum [1]		TGS		ION		Western		CGG	
	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
North Atlantic right whale	0	6	0	9	0	2	0	4	0	2
Humpback whale	4	41	4	56	2	5	0	49	2	5
Minke whale	4	419	4	208	2	10	0	100	4	124
Bryde's whale	0	2	0	2	0	2	0	2	0	2
Sei whale	0	2	0	2	0	2	0	2	0	2
Fin whale	4	333	4	1,140	2	3	0	537	4	45
Blue whale	0	1	0	1	0	1	0	1	0	1
Sperm whale	0	1,077	0	3,579	0	16	0	1,941	0	1,304
Kogia spp.	5	200	5	1,216	[2] 2	28	3	569	[2] 2	238
Beaked whales	0	3,357	0	12,072	0	490	0	4,960	0	3,511
Northern bottlenose whale	0	4	0	4	0	4	0	4	0	4
Rough-toothed dolphin	0	201	0	261	0	[1] 14	0	123	0	177
Common bottlenose dolphin	0	37,562	0	40,595	0	2,599	0	23,600	0	9,063
Clymene dolphin	0	6,459	0	821	0	252	0	391	0	6,382
Atlantic spotted dolphin	0	16,926	0	41,222	0	568	0	18,724	0	6,596
Pantropical spotted dolphin	0	1,632	0	1,470	0	78	0	690	0	1,566
Spinner dolphin	0	91	0	91	0	91	0	91	0	91
Striped dolphin	0	8,022	0	23,418	0	162	0	8,845	0	6,328
Common dolphin	0	11,087	0	52,728	0	372	0	20,683	0	6,026
Fraser's dolphin	0	204	0	204	0	204	0	204	0	204
Atlantic white-sided dolphin	0	48	0	48	0	48	0	48	0	48
Risso's dolphin	0	755	0	3,241	0	90	0	1,608	0	809
Melon-headed whale	0	50	0	50	0	50	0	50	0	50
Pygmy killer whale	0	6	0	6	0	6	0	6	0	6
False killer whale	0	28	0	28	0	28	0	28	0	28
Killer whale	0	7	0	7	0	7	0	7	0	7
Pilot whales	0	2,765	0	8,902	0	199	0	4,682	0	1,964
Harbor porpoise	16	611	[2] 3	322	[2] 3	18	[2] 3	152	[2] 3	27

[1] Take numbers provided for Spectrum reflect Spectrum's original survey plan and are retained here in reference to the negligible impact and small numbers analyses provided later in this document for Spectrum. For revised (and authorized) take numbers for Spectrum reflecting their modified survey plan, please see "Spectrum Survey Plan Modification."

[2] Exposure estimate increased to account for average group size observed during AMAPPS survey effort. For ION, estimated Level A harassment of *Kogia* spp. and harbor porpoise was zero and, for CGG, estimated Level A harassment of harbor porpoise was zero. We assume as a precaution that one group (as estimated from AMAPPS data) may incur Level A harassment.

Mitigation

Under section 101(a)(5)(D) of the MMPA, NMFS must set forth the ''permissible methods of taking pursuant to such activity, and other 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, and on the availability of such species or stock for taking for certain subsistence uses.'' (While section 101(a)(5)(D) refers to ''least practicable impact,'' we hereafter use the term ''least practicable adverse impact,'' the term as it appears in section 101(a)(5)(A). Given the provision in which the language appears, and its similarity to the parallel provision in section 101(a)(5)(A), we believe that ''least practicable impact'' in section 101(a)(5)(D) similarly is referring to the requirement to prescribe the means of effecting the least practicable *adverse* impact, and we interpret the term in that manner.) Consideration of the availability of marine mammal species or stocks for taking for subsistence uses pertains only to Alaska, and is therefore not relevant here. NMFS does not have a regulatory definition for ''least practicable adverse impact.''

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp.3d 1210, 1229 (D. Haw. 2015), the Court stated that NMFS ''appear[s] to think [it] satisf[ies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' More recently, expressing similar concerns in a challenge to an incidental take rule for U.S. Navy Operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar (SURTASS LFA) (77 FR 50290), the Ninth Circuit Court of Appeals in *Natural Resources Defense Council (NRDC)* v. *Pritzker,* 828 F.3d 1125, 1134 (9th Cir. 2016), stated, ''[c]ompliance with the 'negligible impact' requirement does not mean there [is] compliance with the 'least practicable adverse impact' standard.'' As the Ninth Circuit noted in its opinion, however, the Court was interpreting the statute without the benefit of NMFS's formal interpretation. We state here explicitly that NMFS is in full agreement that the ''negligible impact'' and ''least practicable adverse impact'' requirements are distinct, even though both statutory standards refer to species and stocks. With that in mind, we provide further explanation of our interpretation of least practicable adverse impact, and explain what distinguishes it from the negligible impact standard. This discussion is consistent with, and expands upon, previous rules we have issued (such as the Navy Gulf of Alaska rule (82 FR 19530; April 27, 2017)).

Before NMFS can issue an incidental take authorization under sections 101(a)(5)(A) or (D) of the MMPA, it must make a finding that the taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS's and U.S. Fish and Wildlife Service's implementing regulations for section 101(a)(5) both define ''negligible impact'' as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103 and 50 CFR 18.27(c)). Recruitment (*i.e.,* reproduction) and survival rates are used to determine population growth rates [1] and, therefore are considered in evaluating population level impacts.

Not every population-level impact violates the negligible impact requirement. The negligible impact standard does not require a finding that the anticipated take will have ''no effect'' on population numbers or growth rates. The statutory standard does not require that the same recovery rate be maintained, rather that no significant effect on annual rates of recruitment or survival occurs. The key factor is the significance of the level of impact on rates of recruitment or survival. See 54 FR 40338, 40341–42 (September 29, 1989).

While some level of impact on population numbers or growth rates of a species or stock may occur and still satisfy the negligible impact requirement—even without consideration of mitigation—the least practicable adverse impact provision separately requires NMFS to prescribe means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. 50 CFR 216.102(b). These are typically identified as mitigation measures.[2]

The negligible impact and least practicable adverse impact standards in the MMPA both call for evaluation at the level of the ''species or stock.'' The MMPA does not define the term ''species.'' However, Merriam-Webster Dictionary defines ''species'' to include ''related organisms or *populations* potentially capable of interbreeding.'' See *www.merriam-webster.com/dictionary/species* (emphasis added). The MMPA defines ''stock'' as a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature. 16 U.S.C. 1362(11). The definition of ''population'' is ''a group of interbreeding organisms that represents the level of organization at which speciation begins.'' *www.merriam-webster.com/dictionary/population.* The definition of ''population'' is strikingly similar to the MMPA's definition of ''stock,'' with both involving groups of individuals that belong to the same species and located in a manner that allows for interbreeding. In fact, the term ''stock'' in the MMPA is interchangeable with the statutory term ''population stock.'' 16 U.S.C. 1362(11). Thus, the MMPA terms ''species'' and ''stock'' both relate to populations, and it is therefore appropriate to view both the negligible impact standard and the least practicable adverse impact standard, both of which call for evaluation at the level of the species or stock, as having a population-level focus.

This interpretation is consistent with Congress's statutory findings for enacting the MMPA, nearly all of which are most applicable at the species or stock (*i.e.,* population) level. See 16 U.S.C. 1361 (finding that it is species and population stocks that are or may be in danger of extinction or depletion; that it is species and population stocks that should not diminish beyond being significant functioning elements of their ecosystems; and that it is species and population stocks that should not be permitted to diminish below their optimum sustainable population level). Annual rates of recruitment (*i.e.,* reproduction) and survival are the key biological metrics used in the evaluation of population-level impacts, and accordingly these same metrics are also used in the evaluation of population level impacts for the least practicable adverse impact standard.

Recognizing this common focus of the least practicable adverse impact and negligible impact provisions on the ''species or stock'' does not mean we conflate the two standards; despite some common statutory language, we recognize the two provisions are different and have different functions. First, a negligible impact finding is required before NMFS can issue an incidental take authorization. Although it is acceptable to use the mitigation measures to reach a negligible impact finding (see 50 CFR 216.104(c)), no amount of mitigation can enable NMFS

[1] A growth rate can be positive, negative, or flat.

[2] For purposes of this discussion we omit reference to the language in the standard for least practicable adverse impact that says we also must mitigate for subsistence impacts because they are not at issue in these actions.

to issue an incidental take authorization for an activity that still would not meet the negligible impact standard. Moreover, even where NMFS can reach a negligible impact finding—which we emphasize does allow for the possibility of some ''negligible'' population-level impact—the agency must still prescribe measures that will effect the least practicable amount of adverse impact upon the affected species or stock.

Section 101(a)(5)(D)(ii)(I) (like section 101(a)(5)(A)(i)(II)) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(D)(ii)(I) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, we reiterate that the least practicable adverse impact standard also requires consideration of measures for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for subsistence impacts; whereas the negligible impact standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[3]

In *NRDC* v. *Pritzker,* the Court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of military readiness needs.'' *Id.* at 1134 (emphases added). This statement is consistent with our understanding stated above that even when the effects of an action satisfy the negligible impact standard (*i.e.,* in the Court's words, ''population levels are not threatened significantly''), still the agency must prescribe mitigation under the least practicable adverse impact standard. However, as the statute indicates, the focus of both standards is ultimately the impact on the affected ''species or stock,'' and not solely focused on or directed at the impact on individual marine mammals.

We have carefully reviewed and considered the Ninth Circuit's opinion in *NRDC* v. *Pritzker* in its entirety. While the Court's reference to ''marine mammals'' rather than ''marine mammal species or stocks'' in the italicized language above might be construed as a holding that the least practicable adverse impact standard applies at the individual ''marine mammal'' level, *i.e.,* that NMFS must require mitigation to minimize impacts to each individual marine mammal unless impracticable, we believe such an interpretation reflects an incomplete appreciation of the Court's holding. In our view, the opinion as a whole turned on the Court's determination that NMFS had not given separate and independent meaning to the least practicable adverse impact standard apart from the negligible impact standard, and further, that the Court's use of the term ''marine mammals'' was not addressing the question of whether the standard applies to individual animals as opposed to the species or stock as a whole. We recognize that while consideration of mitigation can play a role in a negligible impact determination, consideration of mitigation measures extends beyond that analysis. In evaluating what mitigation measures are appropriate, NMFS considers the potential impacts of the specified activity, the availability of measures to minimize those potential impacts, and the practicability of implementing those measures, as we describe below.

Given the *NRDC* v. *Pritzker* decision, we discuss here how we determine whether a measure or set of measures meets the ''least practicable adverse impact'' standard. Our separate analysis of whether the take anticipated to result from applicants' activities satisfies the ''negligible impact'' standard appears in the section ''Negligible Impact Analyses and Determinations'' below.

Our evaluation of potential mitigation measures includes consideration of two primary factors:

(1) The manner in which, and the degree to which, implementation of the potential measure(s) is expected to reduce adverse impacts to marine mammal species or stocks, their habitat, and their availability for subsistence uses (when relevant). This analysis considers such things as the nature of the potential adverse impact (such as likelihood, scope, and range), the likelihood that the measure will be effective if implemented, and the likelihood of successful implementation.

(2) The practicability of the measure for applicant implementation. Practicability of implementation may consider such things as cost, impact on operations, personnel safety, and practicality of implementation.

While the language of the least practicable adverse impact standard calls for minimizing impacts to affected species or stocks, we recognize that the reduction of impacts to those species or stocks accrues through the application of mitigation measures that limit impacts to individual animals. Accordingly, NMFS's analysis focuses on measures designed to avoid or minimize impacts on marine mammals from activities that are likely to increase the probability or severity of population-level effects.

While complete information on impacts to species or stocks from a specified activity is not available for every activity type, and additional information would help NMFS better understand how specific disturbance events affect the fitness of individuals of certain species, there have been significant improvements in understanding the process by which disturbance effects are translated to the population. With recent scientific advancements (both marine mammal energetic research and the development of energetic frameworks), the relative likelihood or degree of impacts on species or stocks may typically be predicted given a detailed understanding of the activity, the environment, and the affected species or stocks. This same information is used in the development of mitigation measures and helps us understand how mitigation measures contribute to lessening effects to species or stocks. We also acknowledge that there is always the potential that new information, or a new recommendation that we had not previously considered, becomes available and necessitates re-evaluation of mitigation measures (which may be addressed through adaptive management) to see if further reductions of population impacts are possible and practicable.

In the evaluation of specific measures, the details of the specified activity will necessarily inform each of the two primary factors discussed above (expected reduction of impacts and practicability), and will be carefully considered to determine the types of mitigation that are appropriate under the least practicable adverse impact standard. Analysis of how a potential mitigation measure may reduce adverse impacts on a marine mammal stock or species and practicability of implementation are not issues that can be meaningfully evaluated through a yes/no lens. The manner in which, and the degree to which, implementation of a measure is expected to reduce impacts, as well as its practicability, can vary widely. For example, a time-area

[3] Mitigation may also be appropriate to ensure compliance with the ''small numbers'' language in MMPA sections 101(a)(5)(A) and (D).

restriction could be of very high value for decreasing population-level impacts (*e.g.,* avoiding disturbance of feeding females in an area of established biological importance) or it could be of lower value (*e.g.,* decreased disturbance in an area of high productivity but of less firmly established biological importance). Regarding practicability, a measure might involve operational restrictions that completely impede the operator's ability to acquire necessary data (higher impact), or it could mean additional incremental delays that increase operational costs but still allow the activity to be conducted (lower impact). A responsible evaluation of ''least practicable adverse impact'' will consider the factors along these realistic scales. Expected effects of the activity and of the mitigation as well as status of the stock all weigh into these considerations. Accordingly, the greater the likelihood that a measure will contribute to reducing the probability or severity of adverse impacts to the species or stock or their habitat, the greater the weight that measure is given when considered in combination with practicability to determine the appropriateness of the mitigation measure, and vice versa. We discuss consideration of these factors in greater detail below.

1. Reduction of Adverse Impacts to Marine Mammal Species or Stocks and Their Habitat [4]

The emphasis given to a measure's ability to reduce the impacts on a species or stock considers the degree, likelihood, and context of the anticipated reduction of impacts to individuals as well as the status of the species or stock.

The ultimate impact on any individual from a disturbance event (which informs the likelihood of adverse species- or stock-level effects) is dependent on the circumstances and associated contextual factors, such as duration of exposure to stressors. Though any required mitigation needs to be evaluated in the context of the specific activity and the species or stocks affected, measures with the following types of goals are expected to reduce the likelihood or severity of adverse species- or stock-level impacts: Avoiding or minimizing injury or mortality; limiting interruption of known feeding, breeding, mother/calf, or resting behaviors; minimizing the abandonment of important habitat (temporally and spatially); minimizing the number of individuals subjected to these types of disruptions; and limiting degradation of habitat. Mitigating these types of effects is intended to reduce the likelihood that the activity will result in energetic or other types of impacts that are more likely to result in reduced reproductive success or survivorship. It is also important to consider the degree of impacts that are expected in the absence of mitigation in order to assess the added value of any potential measures. Finally, because the least practicable adverse impact standard gives NMFS the discretion to weigh a variety of factors when determining what should be included as appropriate mitigation measures and because the focus is on reducing impacts at the species or stock level, it does not compel mitigation for every kind of individual take, even when practicable for implementation by the applicant.

The status of the species or stock is also relevant in evaluating the appropriateness of potential mitigation measures in the context of least practicable adverse impact. The following are examples of factors that may (either alone, or in combination) result in greater emphasis on the importance of a mitigation measure in reducing impacts on a species or stock: The stock is known to be decreasing or status is unknown, but believed to be declining; the known annual mortality (from any source) is approaching or exceeding the PBR level; the affected species or stock is a small, resident population; or the stock is involved in a UME or has other known vulnerabilities.

Habitat mitigation, particularly as it relates to rookeries, mating grounds, and areas of similar significance, is also relevant to achieving the standard and can include measures such as reducing impacts of the activity on known prey utilized in the activity area or reducing impacts on physical habitat. As with species- or stock-related mitigation, the emphasis given to a measure's ability to reduce impacts on a species or stock's habitat considers the degree, likelihood, and context of the anticipated reduction of impacts to habitat. Because habitat value is informed by marine mammal presence and use, in some cases there may be overlap in measures for the species or stock and for use of habitat.

We consider available information indicating the likelihood of any measure to accomplish its objective. If evidence shows that a measure has not typically been effective or successful, then either that measure should be modified or the potential value of the measure to reduce effects is lowered.

2. Practicability

Factors considered may include those such as cost, impact on operations, personnel safety, and practicality of implementation.

In carrying out the MMPA's mandate for these five IHAs, we apply the previously described context-specific balance between the manner in which and the degree to which measures are expected to reduce impacts to the affected species or stocks and their habitat and practicability for the applicant. The effects of concern (*i.e.,* those with the potential to adversely impact species or stocks and their habitat), addressed previously in the ''Potential Effects of the Specified Activity on Marine Mammals and Their Habitat'' section, include auditory injury, severe behavioral reactions, disruptions of critical behaviors, and to a lesser degree, masking and impacts on acoustic habitat (see discussion of this concept in the ''Anticipated Effects on Marine Mammal Habitat'' section in the Notice of Proposed IHAs). Here, we focus on measures with proven or reasonably presumed ability to avoid or reduce the intensity of acute exposures that have potential to result in these anticipated effects with an understanding of the drawbacks or costs of these requirements, as well as time-area restrictions that would avoid or reduce both acute and chronic impacts. To the extent of the information available to us, we considered practicability concerns, as well as potential undesired consequences of the measures, *e.g.,* extended periods using the acoustic source due to the need to reshoot lines. We also recognize that instantaneous protocols, such as shutdown requirements, are not capable of avoiding all acute effects, and are not suitable for avoiding many cumulative or chronic effects and do not provide targeted protection in areas of greatest importance for marine mammals. Therefore, in addition to a basic suite of seismic mitigation protocols, we also consider measures that may or may not be appropriate for other activities (*e.g.,* time-area restrictions specific to the surveys discussed herein) but that are warranted here given the spatial scope of these specified activities, potential for population-level effects and/or high magnitude of take for certain species in the absence of such mitigation (see ''Negligible Impact Analyses and

[4] We recognize the least practicable adverse impact standard requires consideration of measures that will address minimizing impacts on the availability of the species or stocks for subsistence uses where relevant. Because subsistence uses are not implicated for this action we do not discuss them. However, a similar framework would apply for evaluating those measures, taking into account the MMPA's directive that we make a finding of no unmitigable adverse impact on the availability of the species or stocks for taking for subsistence, and the relevant implementing regulations.

Determinations''), and the information we have regarding habitat for certain species.

In order to satisfy the MMPA's least practicable adverse impact standard, we evaluated a suite of basic mitigation protocols that are required regardless of the status of a stock. Additional or enhanced protections are required for species whose stocks are in poor health and/or are subject to some significant additional stressor that lessens that stock's ability to weather the effects of the specified activities without worsening its status. We reviewed the applicants' proposals, the requirements specified in BOEM's PEIS, seismic mitigation protocols required or recommended elsewhere (*e.g.,* HESS, 1999; DOC, 2013; IBAMA, 2005; Kyhn *et al.,* 2011; JNCC, 2017; DEWHA, 2008; BOEM, 2016a; DFO, 2008; GHFS, 2015; MMOA, 2015; Nowacek *et al.,* 2013; Nowacek and Southall, 2016), and the available scientific literature. We also considered recommendations given in a number of review articles (*e.g.,* Weir and Dolman, 2007; Compton *et al.,* 2008; Parsons *et al.,* 2009; Wright and Cosentino, 2015; Stone, 2015b). Certain changes from the mitigation measures described in our Notice of Proposed IHAs were made on the basis of additional information and following review of public comments. The required suite of mitigation measures differs in some cases from the measures proposed by the applicants and/or those specified by BOEM in their PEIS and Record of Decision (ROD) in order to reflect what we believe to be the most appropriate suite of measures to satisfy the requirements of the MMPA.

First, we summarize notable changes made to the mitigation requirements as a result of review of public comments and then describe mitigation prescribed in the issued IHAs. For additional detail regarding mitigation considerations, including expected efficacy and/or practicability, or descriptions of mitigation considered but not required, please see our Notice of Proposed IHAs.

Here we provide a single description of required mitigation measures, as we require the same measures of all applicants.

Changes From the Notice of Proposed IHAs

Here we summarize substantive changes to mitigation requirements from our Notice of Proposed IHAs. All changes were made on the basis of review of public comments received, including from applicants, and/or review of new information.

Time-Area Restrictions

- We spatially expanded the proposed time-area restriction for North Atlantic right whales. Our proposed restriction area was comprised of an area containing three distinct areas: (1) A 20-nmi coastal strip throughout the specific geographic region; (2) designated Seasonal Management Areas; and (3) designated critical habitat. This combined area was then buffered by 10 km, resulting in an approximate 47-km standoff distance. We received numerous public comments expressing concern regarding the adequacy of this measure and, more generally, regarding the status of the North Atlantic right whale. Also, since publication of the Notice of Proposed IHAs, the status of this population has worsened, including declaration of an ongoing UME. Given this, we considered newly available information (*e.g.,* Roberts *et al.,* 2017; Davis *et al.,* 2017) and re-evaluated the restriction. This is described in more detail under ''Comments and Responses'' as well as later in this section. Following this review, we expanded the restriction to 80 km from shore, with the same 10-km buffer, for a total 90-km restriction. As was proposed, the restriction would be in effect from November through April.

However, in lieu of this requirement, applicants may alternatively develop and submit a monitoring and mitigation plan for NMFS's approval that would be sufficient to achieve comparable protection for North Atlantic right whales. If approved, applicants would be required to maintain a minimum coastal standoff distance of 47 km from November through April while operating in adherence with the approved plan from 47 through 80 km offshore. (Note that the 80 km distance is assumed to represent to a reasonable extent right whale occurrence on the migratory pathway; therefore, under an approved plan the 10-km buffer would not be relevant.)

- We shifted the timing of the ''Hatteras and North'' time-area restriction (Area #4 in Figure 4 and Table 7; described as Area #5 in our Notice of Proposed IHAs), developed primarily to benefit beaked whales, sperm whales, and pilot whales, but also to provide seasonal protection to a notable biodiversity hotspot. The timing of this restriction, proposed as July through September (Roberts *et al.,* 2015n), is shifted to January through March on the basis of new information (Stanistreet *et al.,* 2018), as described in more detail later in this section. The restriction area remains the same.

- We eliminated the proposed (former) Area #1, which was delineated in an effort to reduce likely acoustic exposures for the species for three applicants only, as opposed to a more meaningful reduction of impacts in important habitat and/or for species expected to be more sensitive to disturbance from airgun noise. As was stated in our Notice of Proposed IHAs, ''Although there are no relevant considerations with regard to population context or specific stressors that lead us to develop mitigation focused on Atlantic spotted dolphins [. . .] we believe it appropriate to delineate a time-area restriction for the sole purpose of reducing likely acoustic exposures for the species [for three companies].'' We received comments on this proposed restriction from several commenters who provided compelling rationale to eliminate the measure. As was stated in our Notice of Proposed IHAs, Atlantic spotted dolphins display a bifurcated distribution, with a portion of the stock inhabiting the continental shelf south of Cape Hatteras inside the 200-m isobath and a portion of the stock off the shelf and north of the Gulf Stream (north of Cape Hatteras). Our proposed restriction—located in the southern, on-shelf portion of the range, which we believe to be more predictable habitat for the species—was not likely to have the intended effect, as a seasonal restriction would not necessarily reduce acoustic exposures for a species that is not known to migrate in and out of the restriction area, and because a relatively small portion of overall survey effort was planned for this area. Implementation of this restriction would also likely have meaningful practicability implications for applicants with survey lines in the area, as they would need to plan for both the seasonal restriction for spotted dolphin (proposed as July through September) as well as the right whale restriction, which overlaps the proposed spotted dolphin area and would be in effect from November through April. Therefore, the proposal would not likely provide commensurate benefit to the species to offset these concerns.

Shutdown Requirements

- In our Notice of Proposed IHAs, we proposed an exception to the general shutdown requirements for certain species of dolphins in certain circumstances. Specifically, we proposed that the exception to the shutdown requirement would apply if the animals are traveling, including approaching the vessel. Our rationale in proposing this specific exception was to avoid the perceived subjective decision-making associated with an exception based on a determination that dolphins were approaching voluntarily, while still protecting dolphins from disturbance of potentially important behaviors such as feeding or socialization, as might be indicated by the presence of dolphins engaged in behavior other than traveling (*e.g.,* milling). Although the ''bow-riding'' dolphin exception was similarly criticized when presented for public comment in BOEM's draft PEIS, we agree that our proposal (*i.e.,* based on ''traveling'' versus ''stationary'' dolphins in relation to the vessel's movement) was unclear and that it would not likely result in an improvement with regard to clarity of protected species observer (PSO) decision-making. Therefore, this proposal was properly considered impracticable, while not offering meaningfully commensurate biological benefit. While we are careful to note that we do not fully understand the reasons for and potential effects of dolphin interaction with vessels, including working survey vessels, we also understand that dolphins are unlikely to incur any degree of threshold shift due to their relative lack of sensitivity to the frequency content in an airgun signal (as well as because of potential coping mechanisms). We also recognize that, although dolphins do in fact react to airgun noise in ways that may be considered take (Barkaszi *et al.,* 2012), there is a lack of notable adverse dolphin reactions to airgun noise despite a large body of observational data. Therefore, the removal of the conditional shutdown measure for small delphinids is warranted in consideration of the available information regarding the effectiveness of such measures in mitigating impacts to small delphinids and the practicability of such measures. No shutdown is required for these species.

• We proposed a number of expanded shutdown requirements on the basis of detections of certain species deemed particularly sensitive (*e.g.,* beaked whales) or of particular circumstances deemed to warrant the expanded shutdown requirement (*e.g.,* whales with calves). These were all conditioned upon observation or detection of these species or circumstances at any distance from the vessel. We received several comments challenging the value of expanded shutdown requirements at all and, while we disagree with these comments, we agree that some reasonable distance limit should be placed on these requirements in order to better focus the observational effort of PSOs and to avoid the potential for numerous shutdowns based on uncertain detections at great distance. Therefore, as described in greater detail later in this section, we limit such expanded shutdown zones for relevant species or circumstances to 1.5 km.

• We eliminated a proposed requirement for shutdowns upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel. We received several comments indicating that this proposed requirement was unclear in terms of how it was to be implemented, and that the benefit to the species was poorly demonstrated. We agree with these comments.

• We eliminated a proposed requirement for shutdowns upon detection of fin whales at any distance (proposed for TGS only). As stated in our Notice of Proposed IHAs, this requirement was proposed only on the basis of a high predicted amount of exposures. Following review of this requirement, we recognize that it would not be effective in achieving the stated goal of reducing the overall amount of takes, as any observed fin whale would still be within the Level B harassment zone and thus taken. Therefore, this measure serves no meaningful purpose while imposing an additional practicability burden on TGS.

• We clarify that the proposed requirement to shut down upon observation of an aggregation of marine mammals applies only to large whales (*i.e.,* baleen whales and sperm whales), as was our intent. Several commenters interpreted the requirement as applying to all marine mammals and noted that this would require a significant increase in shutdowns as a result of the prevalence of observations of dolphins in groups exceeding five (most dolphin species have average group sizes larger than five). It has been common practice in prior issued IHAs for similar activities to require such a measure for whale species; however, we inadvertently omitted this key detail in describing the proposed measure. Also, we remove the language regarding ''traveling,'' which had been proposed in a similar context as was discussed above for small delphinids and which we have determined to be a poorly defined condition.

Monitoring

• We require that at least two acoustic PSOs have prior experience (minimum 90 days) working in that role, on the basis of discussion with experts who emphasized the critical importance of experience for acoustic PSOs (*e.g.,* Thode *et al.,* 2017; pers. comm., D. Epperson, BSEE). Our proposal required that only one acoustic PSO have prior experience.

Below, we describe mitigation requirements in detail.

Mitigation-Related Monitoring

Monitoring by independent, dedicated, trained marine mammal observers is required. Note that, although we discuss requirements related only to observation of marine mammals, we hereafter use the generic term ''protected species observer'' (PSO). Independent observers are employed by a third-party observer provider; vessel crew may not serve as PSOs. Dedicated observers are those who have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct the survey operator (*i.e.,* vessel captain and crew) with regard to the presence of marine mammals and mitigation requirements. Communication with the operator may include brief alerts regarding maritime hazards. Trained PSOs have successfully completed an approved PSO training course (see ''Monitoring and Reporting''), and experienced PSOs have additionally gained a minimum of 90 days at-sea experience working as a PSO during a deep penetration seismic survey, with no more than 18 months having elapsed since the conclusion of the relevant at-sea experience. Training and experience is specific to either visual or acoustic PSO duties. An experienced visual PSO must have completed approved, relevant training and must have gained the requisite experience working as a visual PSO. An experienced acoustic PSO must have completed a passive acoustic monitoring (PAM) operator training course and must have gained the requisite experience working as an acoustic PSO. Hereafter, we also refer to acoustic PSOs as PAM operators.

NMFS expects to provide informal approval for specific training courses as needed to approve PSO staffing plans. NMFS does not plan to formally administer any training program or to sanction any specific provider, but will approve courses that meet the curriculum and trainer requirements specified herein (see ''Monitoring and Reporting''). We expect to provide such approvals in context of the need to ensure that PSOs have the necessary training to carry out their duties competently while also approving applicant staffing plans quickly. In order for PSOs to be approved, NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating the PSO's successful completion of the course. Although NMFS must affirm PSO approvals, third-party observer providers and/or companies seeking PSO staffing should expect that observers having satisfactorily completed approved training and with the requisite experience (if required) will be quickly approved. A PSO may be trained and/or experienced as both a visual PSO and PAM operator and may perform either duty, pursuant to scheduling requirements. PSO watch schedules shall be devised in consideration of the following restrictions: (1) A maximum of two consecutive hours on watch followed by a break of at least one hour between watches for visual PSOs (periods typical of observation for research purposes and as used for airgun surveys in certain circumstances (Broker *et al.,* 2015)); (2) a maximum of four consecutive hours on watch followed by a break of at least two consecutive hours between watches for PAM operators; and (3) a maximum of 12 hours observation per 24-hour period. Further information regarding PSO requirements may be found in the ''Monitoring and Reporting'' section, later in this document.

During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array (see ''Ramp-ups'' below). PSOs should use NOAA's solar calculator (*www.esrl.noaa.gov/gmd/grad/solcalc/*) to determine sunrise and sunset times at their specific location. We recognize that certain daytime conditions (*e.g.,* fog, heavy rain) may reduce or eliminate effectiveness of visual observations; however, on-duty PSOs shall remain alert for marine mammal observational cues and/or a change in conditions.

All source vessels must carry a minimum of one experienced visual PSO, who shall be designated as the lead PSO, coordinate duty schedules and roles, and serve as primary point of contact for the operator. However, while it is desirable for all PSOs to be qualified through experience, we are also mindful of the need to expand the workforce by allowing opportunity for newly trained PSOs to gain experience. Therefore, the lead PSO shall devise the duty schedule such that experienced PSOs are on duty with trained PSOs (*i.e.,* those PSOs with appropriate training but who have not yet gained relevant experience) to the maximum extent practicable in order to provide necessary mentorship.

With regard to specific observational protocols, we largely follow those described in Appendix C of BOEM's PEIS (BOEM, 2014a). The lead PSO shall determine the most appropriate observation posts that will not interfere with navigation or operation of the vessel while affording an optimal, elevated view of the sea surface; these should be the highest elevation available on each vessel, with the maximum viewable range from the bow to 90 degrees to port or starboard of the vessel. PSOs shall coordinate to ensure 360° visual coverage around the vessel, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner. All source vessels must be equipped with pedestal-mounted ''bigeye'' binoculars that will be available for PSO use. Within these broad outlines, the lead PSO and PSO team will have discretion to determine the most appropriate vessel- and survey-specific system for implementing effective marine mammal observational effort. Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, should be relayed to the source vessel and to the PSO team.

All source vessels must use a towed PAM system for potential detection of marine mammals. The system must be monitored at all times during use of the acoustic source, and acoustic monitoring must begin at least 30 minutes prior to ramp-up. PAM operators must be independent, and all source vessels shall carry a minimum of two experienced PAM operators. PAM operators shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance and bearing and the degree of confidence in the determination. Further detail regarding PAM system requirements may be found in the ''Monitoring and Reporting'' section, later in this document. The effectiveness of PAM depends to a certain extent on the equipment and methods used and competency of the PAM operator, but no established standards are currently in place.

Visual monitoring must begin at least 30 minutes prior to ramp-up (described below) and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset. If any marine mammal is observed at any distance from the vessel, a PSO would record the observation and monitor the animal's position (including latitude/longitude of the vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer. A PSO would continue to observe the area to watch for the animal to resurface or for additional animals that may surface in the area. Visual PSOs shall communicate all observations to PAM operators, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

As noted previously, all source vessels must carry a minimum of one experienced visual PSO and two experienced PAM operators. The observer designated as lead PSO (including the full team of visual PSOs and PAM operators) must have experience as a visual PSO. The applicant may determine how many additional PSOs are required to adequately fulfill the requirements specified here. To summarize, these requirements are: (1) 24-hour acoustic monitoring during use of the acoustic source; (2) visual monitoring during use of the acoustic source by two PSOs during all daylight hours, with one visual PSO on-duty during nighttime ramp-ups; (3) maximum of two consecutive hours on watch followed by a minimum of one hour off watch for visual PSOs and a maximum of four consecutive hours on watch followed by a minimum of two consecutive hours off watch for PAM operators; and (4) maximum of 12 hours of observational effort per 24-hour period for any PSO, regardless of duties.

PAM Malfunction—Emulating sensible protocols described by the New Zealand Department of Conservation for airgun surveys conducted in New Zealand waters (DOC, 2013), survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

- Daylight hours and sea state is less than or equal to Beaufort sea state (BSS) 4;
- No marine mammals (excluding delphinids; see below) detected solely by PAM in the exclusion zone (see below) in the previous two hours;
- NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and
- Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

Exclusion Zone and Buffer Zone

An exclusion zone is a defined area within which occurrence of a marine mammal triggers mitigation action intended to reduce potential for certain outcomes, *e.g.,* auditory injury, more severe disruption of behavioral patterns. The PSOs shall establish and monitor a 500-m exclusion zone and additional 500-m buffer zone (total 1,000 m) during the pre-clearance period (see below) and a 500-m exclusion zone during the ramp-up and operational periods. PSOs should focus their observational effort within this 1-km zone, although animals observed at greater distances should be recorded and mitigation action taken as necessary (see below). These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown of the acoustic source. Use of the buffer zone in relation to ramp-up is discussed below under ''Ramp-up.'' Further detail regarding the exclusion zone and shutdown requirements is given under ''Exclusion Zone and Shutdown Requirements.''

Ramp-Up

Ramp-up of an acoustic source is intended to provide a gradual increase in sound levels, enabling animals to move away from the source if the signal is sufficiently aversive prior to its reaching full intensity. We infer on the basis of behavioral avoidance studies and observations that this measure results in some reduced potential for auditory injury and/or more severe behavioral reactions. Although this measure is not proven and some arguments have been made that use of ramp-up may not have the desired effect of aversion (which is itself a potentially negative impact but assumed to be better than the alternative), ramp-up remains a relatively low-cost, common-sense component of standard mitigation for airgun surveys. Ramp-up is most likely to be effective for more sensitive species (*e.g.,* beaked whales) with known behavioral responses at greater distances from an acoustic source (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Miller *et al.,* 2015).

The ramp-up procedure involves a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved. Ramp-up is required at all times as part of the activation of the acoustic source (including source tests; see ''Miscellaneous Protocols'' for more detail) and may occur at times of poor visibility, assuming appropriate acoustic monitoring with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation should only occur at night where operational planning cannot reasonably avoid such circumstances. For example, a nighttime initial ramp-up following port departure is reasonably avoidable and may not occur. Ramp-up may occur at night following acoustic source deactivation due to line turn or mechanical difficulty. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should be at least 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.

Ramp-up procedures follow the recommendations of IAGC (2015). Ramp-up would begin by activating a single airgun (*i.e.,* array element) of the smallest volume in the array. Ramp-up continues in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should not be less than approximately 20 minutes but maximum duration is not prescribed and will vary depending on the total number of stages. Von Benda-Beckmann *et al.* (2013), in a study of the effectiveness of ramp-up for sonar, found that extending the duration of ramp-up did not have a corresponding effect on mitigation benefit. There will generally be one stage in which doubling the number of elements is not possible because the total number is not even. This should be the last stage of the ramp-up sequence. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups should be scheduled so as to minimize the time spent with the source activated prior to reaching the designated run-in. This approach is intended to ensure a perceptible increase in sound output per increment while employing increments that produce similar degrees of increase at each step.

PSOs must monitor a 1,000-m zone (or to the distance visible if less than 1,000 m) for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance). The pre-clearance period may occur during any vessel activity (*i.e.,* transit, line turn). Ramp-up must be planned to occur during periods of good visibility when possible; operators may not target the period just after visual PSOs have gone off duty. Following deactivation of the source for reasons other than mitigation, the operator must communicate the near-term operational plan to the lead PSO with justification for any planned nighttime ramp-up. Any suspected patterns of abuse must be reported by the lead PSO to be investigated by NMFS. Ramp-up may not be initiated if any marine mammal is within the designated 1,000-m zone. If a marine mammal is observed within the zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs will monitor the 500-m exclusion zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the zone.

Exclusion Zone and Shutdown Requirements

The PSOs must establish a minimum exclusion zone with a 500-m radius as a perimeter around the outer extent of the airgun array (rather than being delineated around the center of the array or the vessel itself). If a marine mammal (other than the small delphinid species discussed below) appears within or enters this zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the PAM operator is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement (see below).

The 500-m radial distance of the standard exclusion zone is expected to contain sound levels exceeding peak pressure injury criteria for all hearing groups other than, potentially, high-frequency cetaceans, while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. Although significantly greater distances may be observed from an elevated platform under good conditions, we believe that 500 m is likely regularly attainable for PSOs using the naked eye during typical conditions. In addition, an exclusion zone is expected to be helpful in avoiding more severe behavioral responses. Behavioral response to an acoustic stimulus is determined not only by received level but by context (*e.g.,* activity state) including, importantly, proximity to the source (*e.g.,* Southall *et al.,* 2007; Ellison *et al.,* 2012; DeRuiter *et al.,* 2013). In prescribing an exclusion zone, we seek not only to avoid most potential auditory injury but also to reduce the likely severity of the behavioral response at a given received level of sound.

As discussed in our Notice of Proposed IHAs, use of monitoring and shutdown measures within defined exclusion zone distances is inherently an essentially instantaneous proposition—a rule or set of rules that requires mitigation action upon detection of an animal. This indicates that defining an exclusion zone on the basis of cSEL thresholds, which require that an animal accumulate some level of sound energy exposure over some period of time (*e.g.,* 24 hours), has questionable relevance as a standard protocol for mobile sources, given the relative motion of the source and the animals. A PSO aboard a mobile source will typically have no ability to monitor an animal's position relative to the acoustic source over relevant time periods for purposes of understanding whether auditory injury is likely to occur on the basis of cumulative sound exposure and, therefore, whether action should be taken to avoid such potential.

Cumulative SEL thresholds are more relevant for purposes of modeling the potential for auditory injury than they are for dictating real-time mitigation, though they can be informative (especially in a relative sense). We recognize the importance of the accumulation of sound energy to an understanding of the potential for auditory injury and that it is likely that, at least for low-frequency cetaceans, some potential auditory injury is likely impossible to fully avoid and should be considered for authorization.

Considering both the dual-metric thresholds described previously (and shown in Table 3) and hearing group-specific marine mammal auditory weighting functions in the context of the airgun sources considered here, auditory injury zones indicated by the peak pressure metric are expected to be predominant for both mid- and high-frequency cetaceans, while zones indicated by cSEL criteria are expected to be predominant for low-frequency cetaceans. Assuming source levels provided by the applicants and indicated in Table 1 and spherical spreading propagation, distances for exceedance of group-specific peak injury thresholds were calculated and are shown in Table 5.

Consideration of auditory injury zones based on cSEL criteria are dependent on the animal's generalized hearing range and how that overlaps with the frequencies produced by the sound source of interest in relation to marine mammal auditory weighting functions (NMFS, 2018). As noted above, these are expected to be predominant for low-frequency cetaceans because their most susceptible hearing range overlaps the low frequencies produced by airguns, while the modeling indicates that zones based on peak pressure criteria dominate for mid- and high-frequency cetaceans. As described in detail in our Notice of Proposed IHAs, we obtained unweighted spectrum data (modeled in 1 Hz bands) for a reasonably equivalent acoustic source (*i.e.,* a 36-airgun array with total volume of 6,600 in^3) in order to evaluate notional zone sizes and to incorporate NMFS's technical guidance weighting functions over an airgun array's full acoustic band. Using NMFS's associated User Spreadsheet with hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 4.5 kn, shot intervals specified by the applicants, and pulse duration of 100 ms, we calculated potential radial distances to auditory injury zones (shown in Table 5).

Therefore, our 500-m exclusion zone contains the entirety of any potential injury zone for mid-frequency cetaceans (realistically, there is no such zone, as discussed above in ''Estimated Take''), while the zones within which injury could occur may be larger for high-frequency cetaceans (on the basis of peak pressure and depending on the specific array) and for low-frequency cetaceans (on the basis of cumulative sound exposure). Only three species of high-frequency cetacean could occur in the planned survey areas: The harbor porpoise and two species of the Family Kogiidae. Harbor porpoise are expected to occur rarely and only in the northern portion of the survey area. However, we require an extended shutdown measure for *Kogia* spp. to address these potential injury concerns (described later in this section).

In summary, our goal in prescribing a standard exclusion zone distance is to (1) encompass zones for most species within which auditory injury could occur on the basis of instantaneous exposure; (2) provide protection from the potential for more severe behavioral reactions (*e.g.,* panic, antipredator response) for marine mammals at relatively close range to the acoustic source; (3) enable more effective implementation of required mitigation by providing consistency and ease of implementation for PSOs, who need to monitor and implement the exclusion zone; and (4) to define a distance within which detection probabilities are reasonably high for most species under typical conditions. Our use of 500 m as the zone is not based directly on any quantitative understanding of the range at which auditory injury would be entirely precluded or any range specifically related to disruption of behavioral patterns. Rather, we believe it is a reasonable combination of factors. This zone has been proven as a feasible measure through past implementation by operators in the Gulf of Mexico (GOM; as regulated by BOEM pursuant to the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 1331–1356)). In summary, a practicable criterion such as this has the advantage of familiarity and simplicity while still providing in most cases a zone larger than relevant auditory injury zones, given realistic movement of source and receiver. Increased shutdowns, without a firm idea of the outcome the measure seeks to avoid, simply displace survey activity in time and increase the total duration of acoustic influence as well as total sound energy in the water (due to additional ramp-up and overlap where data acquisition was interrupted).

Dolphin Exception—The shutdown requirement described above is in place for all marine mammals, with the exception of small delphinids. As defined here, the small delphinid group is intended to encompass those members of the Family Delphinidae most likely to voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array (*e.g.,* bow-riding). This exception to the shutdown requirement applies solely to specific genera of small dolphins—*Steno, Tursiops, Stenella, Delphinus, Lagenorhynchus,* and *Lagenodelphis* (see Table 2)—and applies under all circumstances, regardless of what the perception of the animal(s) behavior or intent may be. Variations of this measure that include exceptions based on animal behavior—including that described in our Notice of Proposed IHAs, in which an exception was proposed to be applied only to ''traveling'' dolphins—have been proposed by both NMFS and BOEM and have been criticized, in part due to the subjective on-the-spot decision-making this scheme would require of PSOs. If the mitigation requirements are not sufficiently clear and objective, the outcome may be differential implementation across surveys as informed by individual PSOs' experience, background, and/or training. The exception described here is based on several factors: The lack of evidence of or presumed potential for the types of effects to these species of small delphinid that our shutdown requirement for other species seeks to avoid, the uncertainty and subjectivity introduced by such a decision framework, and the practicability concern presented by the operational impacts. Despite a large volume of observational effort during airgun surveys, including in locations where dolphin shutdowns have not previously been required (*i.e.,* the U.S. GOM and United Kingdom (UK) waters), we are not aware of accounts of notable adverse dolphin reactions to airgun noise (Stone, 2015a; Barkaszi *et al.,* 2012) other than one isolated incident (Gray and Van Waerebeek, 2011). Dolphins have a relatively high threshold for the onset of auditory injury (*i.e.,* PTS) and more severe adverse behavioral responses seem less likely given the evidence of purposeful approach and/or maintenance of proximity to vessels with operating airguns.

The best available scientific evidence indicates that auditory injury as a result of airgun sources is extremely unlikely for mid-frequency cetaceans, primarily due to a relative lack of sensitivity and susceptibility to noise-induced hearing loss at the frequency range output by airguns (*i.e.,* most sound below 500 Hz) as shown by the mid-frequency cetacean auditory weighting function (NMFS, 2018). Criteria for TTS in mid-frequency cetaceans for impulsive sounds were derived by experimental measurement of TTS in beluga whales exposed to pulses from a seismic watergun; dolphins exposed to the same stimuli in this study did not display TTS (Finneran *et al.,* 2002). Moreover, when the experimental watergun signal was weighted appropriately for mid-frequency cetaceans, less energy was filtered than would be the case for an airgun signal. More recently, Finneran *et al.* (2015) exposed bottlenose dolphins to repeated pulses from an airgun and measured no TTS.

We caution that, while dolphins are observed voluntarily approaching source vessels (*e.g.,* bow-riding or interacting with towed gear), the reasons for the behavior are unknown. In context of an active airgun array, the behavior cannot be assumed to be harmless. Although bow-riding comprises approximately 30 percent of behavioral observations in the GOM, there is a much lower incidence of the behavior when the acoustic source is active (Barkaszi *et al.,* 2012), and this finding was replicated by Stone (2015a) for surveys occurring in UK waters. There appears to be evidence of aversive behavior by dolphins during firing of airguns. Barkaszi *et al.* (2012) found that the median closest distance of approach to the acoustic source was at significantly greater distances during times of full-power source operation when compared to silence, while Stone (2015a) and Stone and Tasker (2006) reported that behavioral responses, including avoidance and changes in swimming or surfacing behavior, were evident for dolphins during firing of large arrays. Goold and Fish (1998) described a ''general pattern of localized disturbance'' for dolphins in the vicinity of an airgun survey. However, while these general findings—typically, dolphins will display increased distance from the acoustic source, decreased prevalence of ''bow-riding'' activities, and increases in surface-active behaviors—are indicative of adverse or aversive responses that may rise to the level of ''take'' (as defined by the MMPA), they are not indicative of any response of a severity such that the need to avoid it outweighs the impact on practicability for the industry and operators.

Additionally, increased shutdowns resulting from such a measure would require source vessels to revisit the missed track line to reacquire data, resulting in an overall increase in the total sound energy input to the marine environment and an increase in the total duration over which the survey is active in a given area. Therefore, the removal of such measures for small delphinids is warranted in consideration of the available information regarding the effectiveness of such measures in mitigating impacts to small delphinids and the practicability of such measures.

Although other mid-frequency hearing specialists (*e.g.,* large delphinids) are considered no more likely to incur auditory injury than are small delphinids, they are more typically deep divers, meaning that there is some increased potential for more severe effects from a behavioral reaction, as discussed in greater detail in ''Comments and Responses.'' Therefore, we anticipate benefit from a shutdown requirement for large delphinids in that it is likely to preclude more severe behavioral reactions for any such animals in close proximity to the source vessel as well as any potential for physiological effects.

At the same time, large delphinids are much less likely to approach vessels. Therefore, a shutdown requirement for large delphinids would not have similar impacts as a small delphinid shutdown in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water.

Other Shutdown Requirements—Shutdown of the acoustic source is also required in the event of certain other observations beyond the standard 500-m exclusion zone. In our Notice of Proposed IHAs, we proposed to condition these shutdowns upon detection of the relevant species or circumstances at any distance. Following review of public comments, we determined it appropriate to limit such shutdown requirements to within a reasonable detection radius of 1.5 km. This maintains the intent of the measures as originally proposed, *i.e.,* to provide for additional real-time protection by limiting the intensity and duration of acoustic exposures for certain species or in certain circumstances, while reducing the area over which PSOs must maintain observational effort. As for normal shutdowns within the standard 500-m exclusion zone, shutdowns at extended distance should be made on the basis of confirmed detections (visual or acoustic) within the zone.

We determined an appropriate distance on the basis of available information regarding detection functions for relevant species, but note that, while based on quantitative data, the distance is an approximate limit that is merely intended to encompass the region within which we would expect a relatively high degree of success in sighting certain species while also improving PSO efficacy by removing the potential that a PSO might interpret these requirements as demanding a focus on areas further from the vessel. For each modeled taxon, Roberts *et al.* (2016) fitted detection functions that modeled the detectability of the taxon according to distance from the trackline and other covariates (*i.e.,* the probability of detecting an animal given its distance from the transect). These functions were based on nearly 1.1 million linear km of line-transect survey effort conducted from 1992–2014, with surveys arranged in aerial and shipboard hierarchies and further grouped according to similarity of observation protocol and platform. Where a taxon was sighted infrequently, a detection function was fit to pooled sightings of suitable proxy species. For example, for the North Atlantic right whale and shipboard binocular surveys (*i.e.,* the relevant combination of platform and protocol), a detection function was fit using pooled sightings of right whales and other mysticete species (Roberts *et al.,* 2015p). The resulting detection function shows a slightly more than 20 percent probability of detecting right whales at 2 km, with a mean effective strip half-width (ESHW) (which provides a measure of how far animals are seen from the transect line; Buckland *et al.,* 2001) of 1,309 m (Roberts *et al.,* 2015p). Similarly, Barlow *et al.* (2011) reported mean ESHWs for various mysticete species ranging from approximately 1.5–2 km. The detection function used in modeling density for beaked whales provided a mean ESHW of 1,587 m (Roberts *et al.,* 2015l). Therefore, we set the shutdown radius for special circumstances (described below) at 1.5 km.

Comments disagreeing with our proposal to require shutdowns upon certain detections at any distance also suggested that the measures did not have commensurate benefit for the relevant species. However, it must be noted that any such observations would still be within range of where behavioral disturbance of some form and degree would be likely to occur (Table 4). While visual PSOs should focus observational effort within the vicinity of the acoustic source and vessel, this does not preclude them from periodic scanning of the remainder of the visible area or from noting observations at greater distances, and there is no reason to believe that such periodic scans by professional PSOs would hamper the ability to maintain observation of areas closer to the source and vessel. Circumstances justifying shutdown at extended distance (*i.e.,* within 1.5 km) include:

- Upon detection of a right whale. Recent data concerning the North Atlantic right whale, one of the most endangered whale species (Best *et al.,* 2001), indicate uncertainty regarding the population's recovery and a possibility of decline (see discussion under ''Description of Marine Mammals in the Area of the Specified Activities''). We believe it appropriate to eliminate potential effects to individual right whales to the extent possible;
- Upon visual observation of a large whale (*i.e.,* sperm whale or any baleen whale) with calf, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult. Groups of whales are likely to be more susceptible to disturbance when calves are present (*e.g.,* Bauer *et al.,* 1993), and disturbance of cow-calf pairs could potentially result in separation of vulnerable calves from adults. Separation, if it occurred, could be exacerbated by airgun signals masking communication between adults and the separated calf (Videsen *et al.,* 2017). Absent separation, airgun signals can disrupt or mask vocalizations essential to mother-calf interactions. Given the consequences of potential loss of calves in the context of ongoing UMEs for multiple mysticete species, as well as the functional sensitivity of the mysticete whales to frequencies associated with airgun survey activity, we believe this measure is warranted;
- Upon detection of a beaked whale or *Kogia* spp. These species are behaviorally sensitive deep divers and it is possible that disturbance could provoke a severe behavioral response leading to injury (*e.g.,* Wursig *et al.,* 1998; Cox *et al.,* 2006). We recognize that there are generally low detection probabilities for beaked whales and *Kogia* spp., meaning that many animals of these species may go undetected. Barlow (1999) estimates such probabilities at 0.23 to 0.45 for Cuvier's and Mesoplodont beaked whales, respectively. However, Barlow and Gisiner (2006) predict a roughly 24–48 percent reduction in the probability of detecting beaked whales during seismic mitigation monitoring efforts as compared with typical research survey efforts, and Moore and Barlow (2013) noted a decrease in *g*(0) for Cuvier's beaked whales from 0.23 at BSS 0 (calm) to 0.024 at BSS 5. Similar detection probabilities have been noted for *Kogia* spp., though they typically travel in smaller groups and are less vocal, thus making detection more difficult (Barlow and Forney, 2007). As discussed previously in this document (see ''Estimated Take''), there are high levels of predicted exposures for beaked whales in particular. Additionally for high-frequency cetaceans such as *Kogia* spp., auditory injury zones relative to peak pressure thresholds may range from approximately 350–1,550 m from the acoustic source, depending on the specific array characteristics (NMFS, 2018); and
- Upon visual observation of an aggregation (defined as six or more animals) of large whales of any species. Under these circumstances, we assume that the animals are engaged in some important behavior (*e.g.,* feeding, socializing) that should not be disturbed.

Shutdown Implementation Protocols—Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source. When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch; hand-held UHF radios are recommended. When both visual PSOs and PAM operators are on duty, all detections must be immediately communicated to the remainder of the on-duty team for potential verification of visual observations by the PAM operator or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately.

Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further detection of the animal(s). For harbor porpoise—the only small odontocete for which shutdown is required—this clearance period is limited to 15 minutes.

If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. We define ''brief periods'' in keeping with other clearance watch periods and to avoid unnecessary complexity in protocols for PSOs. For any longer shutdown (*e.g.,* during line turns), pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

Power-Down

Power-down, as defined here, refers to reducing the array to a single element as a substitute for full shutdown. Use of a single airgun as a ''mitigation source,'' *e.g.,* during extended line turns, is not allowed. In a power-down scenario, it is assumed that reducing the size of the array to a single element reduces the ensonified area such that an observed animal is outside of any area within which injury or more severe behavioral reactions could occur. Here, power-down is not allowed for any reason (*e.g.,* to avoid pre-clearance and/or ramp-up).

Miscellaneous Protocols

The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source should be avoided. Firing of the acoustic source at any volume above the stated production volume is not authorized for these IHAs; the operator must provide information to the lead PSO at regular intervals confirming the firing volume. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented for reporting. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

Restriction Areas

Below we provide discussion of various time-area restrictions. Because the purpose of these areas is to reduce the likelihood of exposing animals within the designated areas to noise from airgun surveys that is likely to result in harassment, we require that source vessels maintain minimum standoff distances (*i.e.,* buffers) from the areas. Sound propagation modeling results provided for a notional large airgun array in BOEM's PEIS indicate that a 10 km distance would likely contain received levels of sound exceeding 160 dB rms under a wide variety of conditions (*e.g.,* 21 scenarios encompassing four depth regimes, four seasons, two bottom types). See Appendix D of BOEM's PEIS for more detail. The 95 percent ranges (*i.e.,* the radius of a circle encompassing 95 percent of grid points equal to or greater than the 160 dB threshold value) provided in Table D–22 of BOEM's PEIS range from 4,959–9,122 m, with mean of 6,838 m. We adopt a standard 10-km buffer distance to avoid ensonification above 160 dB rms of restricted areas under most circumstances.

Coastal Restriction—No survey effort may occur within 30 km of the coast. The intent of this restriction is to provide additional protection for coastal stocks of bottlenose dolphin, all of which are designated as depleted under the MMPA. This designation for all current coastal stocks is retained from the originally delineated single coastal migratory stock, which was revised to recognize the existence of multiple stocks in 2002 (Waring *et al.,* 2016). The prior single coastal stock was designated as depleted because it was determined to be below the optimum sustainable population level (*i.e.,* the number of animals that will result in the maximum productivity of the population, keeping in mind the carrying capacity of their ecosystem) (Waring *et al.,* 2001). Already designated as depleted, a UME affected bottlenose dolphins along the Atlantic coast, from New York to Florida, from 2013–15. Genetic analyses performed to date indicate that 99 percent of dolphins impacted were of the coastal ecotype, which may be expected to typically occur within 20 km of the coast. As described above, a 10 km buffer is provided to encompass the area within which sound exceeding 160 dB rms would reasonably be expected to occur. Further discussion of this UME is provided under ''Description of Marine Mammals in the Area of the Specified Activity.''

North Atlantic Right Whale—From November through April, no survey effort may occur within 90 km of the coast. In our Notice of Proposed IHAs, we proposed a similar restriction out to 47 km. The proposed 47-km seasonal restriction of survey effort was intended to avoid ensonification by levels of sound expected to result in behavioral harassment of particular areas of expected importance for North Atlantic right whales, including designated critical habitat, vessel speed limit seasonal management areas (SMAs), a coastal strip containing SMAs, and vessel speed limit dynamic management areas (DMAs). This area was expected to provide substantial protection of right whales within the migratory corridor and calving and nursery grounds. However, following review of comments received from the Marine Mammal Commission, as well as other public comments received and as a result of the continued deterioration of the status of this population (described previously in ''Description of Marine Mammals in the Area of the Specified Activity''), we considered new information regarding predicted right whale distribution (*e.g.,* Roberts *et al.,* 2017; Davis *et al.,* 2017) and re-evaluated the proposed right whale time-area restriction.

Specifically, we became aware of an effort by Roberts *et al.* to update the 2015 North Atlantic right whale density models. As described in Roberts *et al.* (2017), the updates greatly expanded the dataset used to derive density outputs, especially within the planned survey area, as they incorporated a key dataset that was not included in the 2015 model version: Aerial surveys conducted over multiple years by several organizations in the southeast United States. In addition, the AMAPPS survey data were incorporated into the revised models. By including these additional data sources, the number of right whale sightings used to inform the model within the planned survey area increased by approximately 2,500 sightings (approximately 40 sightings informing the 2015 models versus approximately 2,560 sightings informing the updated 2017 models). In addition, these models incorporated several improvements to minimize known biases and used an improved seasonal definition that more closely aligns with right whale biology. Importantly, the revised models showed a strong relationship between right whale abundance in the mid-Atlantic during the winter (December-March) and distance to shore out to approximately 80 km (Roberts *et al.,* 2017), which was previously estimated out to approximately 50 km (Roberts *et al.,* 2015p). As described above, a 10 km buffer is provided to encompass the area within which sound exceeding 160 dB rms would reasonably be expected to occur. Mid-Atlantic SMAs for vessel speed limits are in effect from November 1 through April 30, while southeast SMAs are in effect from November 15 through April 15 (see 50 CFR 224.105). Therefore, the area discussed here for spatial mitigation would be in effect from November 1 through April 30.

While we acknowledge that some whales may be present at distances further offshore during the November through April restriction—though whales are not likely to occur in waters deeper than 1,500 m—and that there may be whales present during months outside the restriction (*e.g.,* Davis *et al.,* 2017; Krzystan *et al.,* 2018), we have accounted for the best available information in reasonably limiting the potential for acoustic exposure of right whales to levels exceeding harassment thresholds. When coupled with the expanded shutdown provision described previously for right whales, the prescribed mitigation may reasonably be expected to eliminate most potential for behavioral harassment of right whales.

However, as discussed above, in lieu of this requirement, applicants may alternatively develop and submit a monitoring and mitigation plan for NMFS's approval that would be sufficient to achieve comparable protection for North Atlantic right whales. If approved, applicants would be required to maintain a minimum coastal standoff distance of 47 km from November through April while operating in adherence with the approved plan from 47 through 80 km offshore. (Note that the 80 km distance is assumed to represent to a reasonable extent right whale occurrence on the migratory pathway; therefore, under an approved plan the 10-km buffer would not be relevant.)

DMAs are associated with a scheme established by the final rule for vessel speed limits (73 FR 60173; October 10, 2008; extended by 78 FR 73726; December 9, 2013) to reduce the risk of ship strike for right whales. In association with those regulations, NMFS established a program whereby vessels are requested, but not required, to abide by speed restrictions or avoid locations when certain aggregations of right whales are detected outside SMAs. Generally, the DMA construct is intended to acknowledge that right whales can occur outside of areas where they predictably and consistently occur due to, *e.g.,* varying oceanographic conditions that dictate prey concentrations. NMFS establishes DMAs by surveying right whale habitat and, when a specific aggregation is sighted, creating a temporary zone (*i.e.,* DMA) around the aggregation. DMAs are in effect for 15 days when designated and automatically expire at the end of the period, but may be extended if whales are re-sighted in the same area.

NMFS issues announcements of DMAs to mariners via its customary maritime communication media (*e.g.,* NOAA Weather radio, websites, email and fax distribution lists) and any other available media outlets. Information on the possibility of establishment of such zones is provided to mariners through written media such as *U.S. Coast Pilots* and *Notice to Mariners* including, in particular, information on the media mariners should monitor for notification of the establishment of a DMA. Upon notice via the above media of DMA designation, survey operators must cease operation within 24 hours if within 10 km of the boundary of a designated DMA and may not conduct survey operations within 10 km of a designated DMA during the period in which the DMA is active. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

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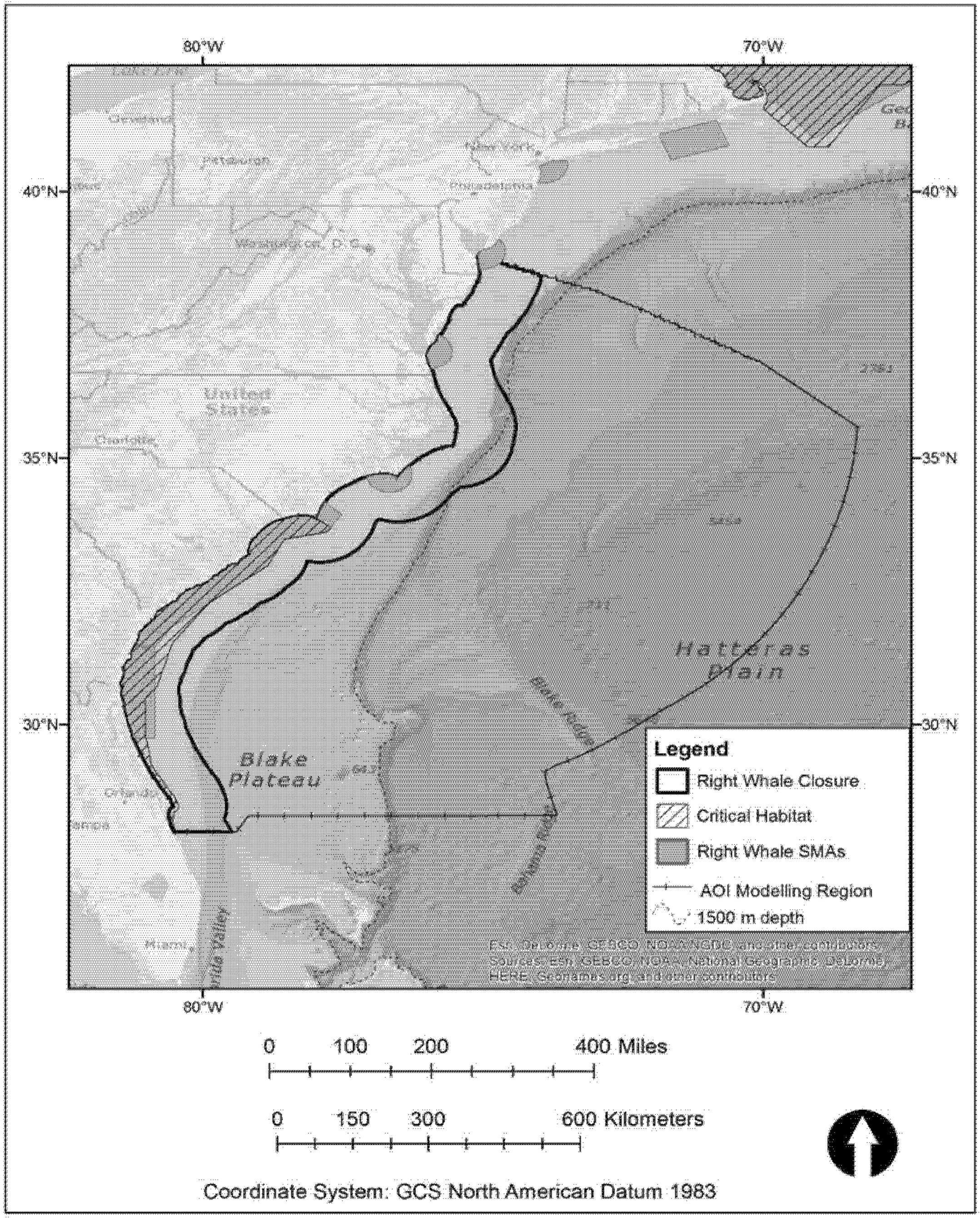

Figure 3. Time-Area Restriction for North Atlantic Right Whales in Relation to Existing Areas Designated for Right Whale Protection.

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Other Species—Predicted acoustic exposures are moderate to high for certain potentially affected marine mammal species (see Table 6) and, regardless of the absolute numbers of predicted exposures, the scope of planned activities (*i.e.,* survey activity throughout substantial portions of many species range and for substantial portions of the year) gives rise to concern regarding the impact on certain potentially affected stocks. Therefore, we take the necessary step of identifying additional spatiotemporal restrictions on survey effort, as described here (Figure 4 and Table 7). In response to public comment, where possible we conducted a quantitative assessment of take avoided (described previously in ''Estimated Take''). Our qualitative assessment leads us to believe that implementation of these measures is expected to provide biologically meaningful benefit for the affected animals by restricting survey activity and the effects of the sound produced in areas of residency and/or preferred habitat that support higher densities for the stocks during substantial portions of the year.

The restrictions described here are primarily targeted towards protection of sperm whales, beaked whales (*i.e.,* Cuvier's beaked whale or *Mesoplodon* spp. but not the northern bottlenose whale; see ''Description of Marine Mammals in the Area of the Specified Activity''), and pilot whales. For all three species or guilds, the amount of predicted exposures is moderate to high. The moderate to high amount of predicted exposures in conjunction with other contextual elements provides the impetus to develop appropriate restrictions. Beaked whales are considered to be a particularly acoustically sensitive species. The sperm whale is an endangered species, also considered to be acoustically sensitive and potentially subject to significant disturbance of important foraging behavior. Pilot whale populations in U.S. waters of the Atlantic are considered vulnerable due to high levels of mortality in commercial fisheries, and are therefore likely to be less resilient to other stressors, such as disturbance from the planned surveys.

In some cases, we expect substantial subsidiary benefit for additional species that also find preferred habitat in the designated area of restriction. In particular, Area #4 (Figure 4), although delineated in order to specifically provide an area of anticipated benefit to beaked whales, sperm whales, and pilot whales, is expected to host a diverse cetacean fauna (*e.g.,* McAlarney *et al.,* 2015). Our analysis (described below) indicates that species most likely to derive subsidiary benefit from this time-area restriction include the bottlenose dolphin, Risso's dolphin, and common dolphin. For species with density predicted through stratified models, similar analysis is not possible and assumptions regarding potential benefit of time-area restrictions are based on known ecology of the species and sightings patterns and are less robust. Nevertheless, subsidiary benefit for Areas #1–3 (Figure 4) should be expected for species known to be present in these areas (*e.g.,* assumed affinity for slope/abyss areas off Cape Hatteras): *Kogia* spp., pantropical spotted dolphin, Clymene dolphin, and rough-toothed dolphin.

We described our rationale for and development of these time-area restrictions in detail in our Notice of Proposed IHAs; please see that document for more detail. Literature newly available since publication of the Notice of Proposed IHAs provides additional support for the importance of these areas. For example, McLellan *et al.* (2018), reporting the results of aerial surveys conducted from 2011–2015, provide additional confirmation that a portion of the region described below as Area #4 (''Hatteras and North'') hosts high densities of beaked whales, concluding that the area off Cape Hatteras at the convergence of the Labrador Current and Gulf Stream is a particularly important habitat for several species of beaked whales. Stanistreet *et al.* (2017) report the results of a multi-year (2011–2015) passive acoustic monitoring effort to assess year-round marine mammal occurrence along the continental slope, including four locations within the planned survey area (*i.e.,* Norfolk Canyon, Cape Hatteras, Onslow Bay, and Jacksonville) and, in this paper, they further document the presence of beaked whales in Area #4. Stanistreet *et al.* (2018) report the results of this study for sperm whale occurrence at the same sites along the continental slope. These results showed that sperm whales were present frequently at the first three sites, with few detections at Jacksonville. The greatest monitoring effort was conducted at the Cape Hatteras site, where detections were made on 65 percent of 734 recording days across all seasons. In addition to having the highest detection rate of sites within the specific geographic region (in conjunction with roughly double the amount of recording effort compared with the next highest site), Cape Hatteras exhibited the most distinct seasonal pattern of any recording site (Stanistreet *et al.,* 2018). The authors reported consistently higher sperm whale occurrence at Cape Hatteras during the winter than any other season. On the basis of this new information, we shifted the timing of the seasonal restriction in Area #4 from July through September (as proposed) to January through March (*i.e.,* ''winter''; Stanistreet *et al.,* 2018). Our previously proposed timing of the seasonal restriction was based on barely discernable distribution shifts based on monthly model predictions (Roberts *et al.,* 2016). However, the revised timing, as indicated by Stanistreet *et al.* (2018), is generally consistent with the seasonal shift in sperm whale concentrations previously described in the western North Atlantic (Perry *et al.,* 1999, Waring *et al.,* 2014).

Please note that, following review of public comments, former Area #1 was eliminated from consideration (discussed in greater detail under ''Comments and Responses''). Therefore, numbering of areas described here has shifted down by one as compared with the discussion presented in our Notice of Proposed IHAs, *i.e.,* former Area #5 is now Area #4, etc. In order to consider potential restriction of survey effort in time and space, we considered the outputs of habitat-based predictive density models (Roberts *et al.,* 2016) as well as available information concerning focused marine mammal studies within the survey areas, *e.g.,* photo-identification, telemetry, acoustic monitoring. The latter information was used primarily to provide verification for some of the areas and times considered, and helps to confirm that areas of high predicted density are in fact preferred habitat for these species. We used the density model outputs by creating core abundance areas, *i.e.,* an area that contains some percentage of predicted abundance for a given species or species group. We were not able to consider core abundance areas for species with stratified models showing uniform density; however, this information informs us as to whether those species may receive subsidiary benefit from a given time-area restriction.

A core abundance area is the smallest area that represents a given percentage of abundance. As described in our Notice of Proposed IHAs, we created a range of core abundance areas for each species of interest and determined that in most cases the 25 percent core abundance area best balanced adequate protection for the target species with concerns regarding practicability for applicants. The larger the percentage of abundance captured, the larger the area. However, Area #4 was designed as a conglomerate by merging areas indicated to be important through the core abundance analysis and available scientific literature for beaked whales, pilot whales, and sperm whales. In particular, for sperm whales (which are predicted to be broadly distributed on the slope throughout the year), we included an area predicted to consistently host higher relative densities in all months (corresponding with the five percent core abundance threshold). We assessed different levels of core abundance in order to define a relatively restricted area of preferred habitat across all seasons. This area in the vicinity of the shelf break to the north of Cape Hatteras (which forms the conglomerate Area #4), together with spatially separated canyon features contained within the 25 percent core abundance areas and previously identified as preferred habitat for beaked whales, form the basis for our time-area restriction for sperm whales. Core abundance maps are provided online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.*

In summary, we require the following time-area restrictions:

• In order to protect coastal bottlenose dolphins, a 30-km coastal strip (20 km plus 10 km buffer) would be closed to use of the acoustic source year-round;

• In order to protect the North Atlantic right whale, a 90-km coastal strip (80 km plus 10 km buffer) would be closed to use of the acoustic source from November through April (Figure 3) (or comparable protection would be provided through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore). Dynamic management areas (buffered by 10 km) are also closed to use of the acoustic source when in effect;

The 10-km buffer is built into the areas defined below and in Table 7. Therefore, we do not separately mention the addition of the buffer.

• Deepwater canyon areas. Areas #1–3 (Figure 4) are defined in Table 7 and will be closed to use of the acoustic source year-round. Although they may be protective of additional species (*e.g., Kogia* spp.), Area #1 is expected to be particularly beneficial for beaked whales and Areas #2–3 are expected to be particularly beneficial for both beaked whales and sperm whales;

• Shelf break off Cape Hatteras and to the north (''Hatteras and North''), including slope waters around ''The Point.'' Area #4 is defined in Table 7 and will be closed to use of the acoustic source from January through March. Although this closure is expected to be beneficial for a diverse species assemblage, Area #4 is expected to be particularly beneficial for beaked whales, sperm whales, and pilot whales.

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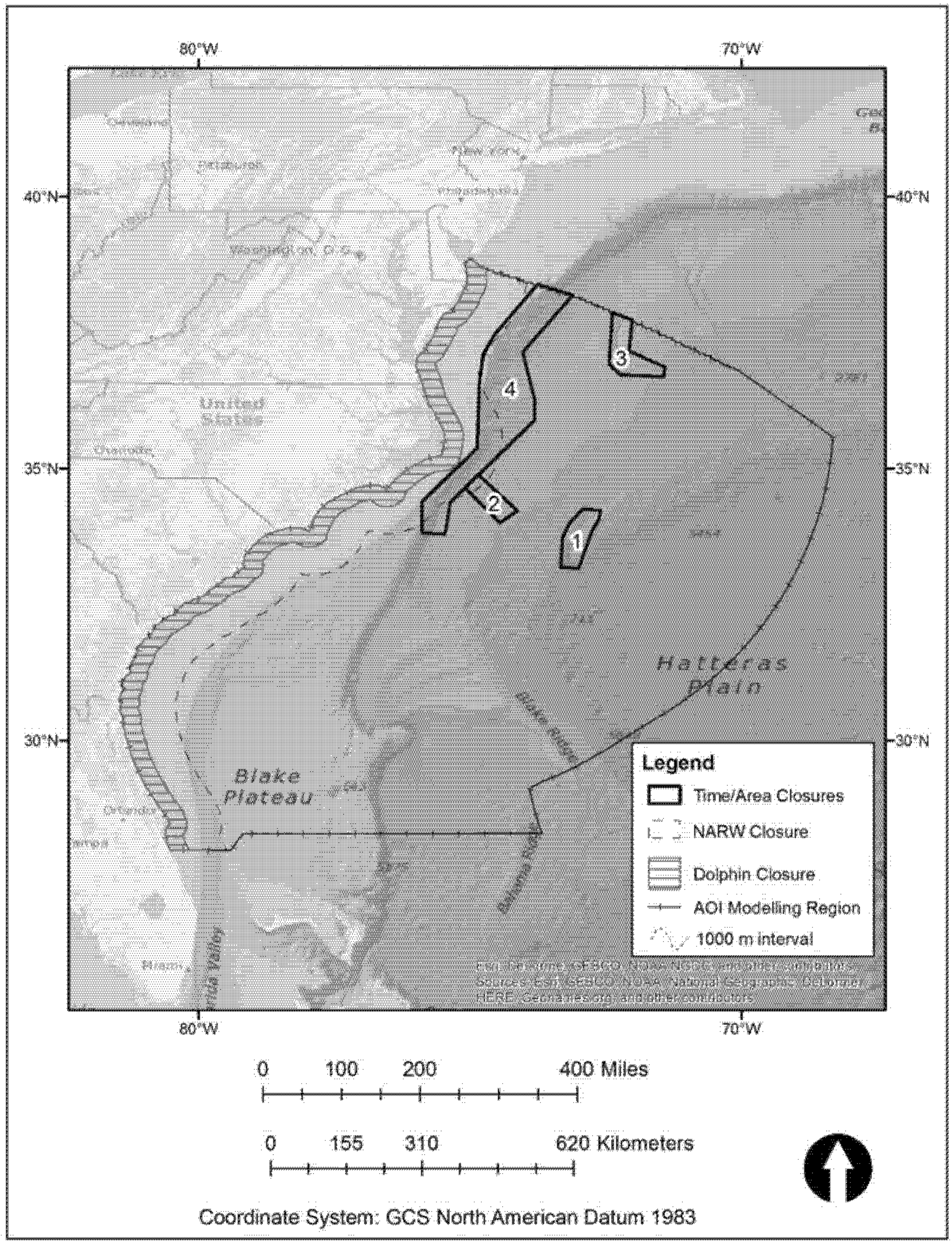

Figure 4. Time-Area Restrictions.

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TABLE 7—BOUNDARIES OF TIME-AREA RESTRICTIONS DEPICTED IN FIGURE 4

Area	Latitude	Longitude
1	33°31′16″ N	72°52′07″ W
1	33°10′05″ N	72°59′59″ W
1	33°11′23″ N	73°19′36″ W
1	33°43′34″ N	73°17′43″ W
1	33°59′43″ N	73°10′16″ W
1	34°15′10″ N	72°55′37″ W
1	34°14′02″ N	72°36′00″ W
1	34°03′33″ N	72°37′27″ W
1	33°53′00″ N	72°44′31″ W
2	34°13′21″ N	74°07′33″ W
2	34°00′07″ N	74°26′41″ W
2	34°38′40″ N	75°05′52″ W
2	34°53′24″ N	74°51′11″ W
3	36°41′17″ N	71°25′47″ W
3	36°43′20″ N	72°13′25″ W
3	36°55′20″ N	72°26′18″ W
3	37°52′21″ N	72°22′31″ W
3	37°43′54″ N	72°00′40″ W
3	37°09′52″ N	72°04′31″ W
3	36°52′01″ N	71°24′31″ W
4	37°08′30″ N	74°01′42″ W
4	36°15′12″ N	73°48′37″ W
4	35°53′14″ N	73°49′02″ W
4	34°23′07″ N	75°21′33″ W
4	33°47′37″ N	75°27′25″ W
4	33°48′31″ N	75°52′58″ W
4	34°23′57″ N	75°52′50″ W
4	35°22′29″ N	74°51′50″ W
4	36°32′31″ N	74°49′31″ W
4	37°05′39″ N	74°45′37″ W
4	37°27′53″ N	74°32′40″ W
4	38°23′15″ N	73°45′06″ W
4	38°11′17″ N	73°06′36″ W

Vessel Strike Avoidance

These measures apply to all vessels associated with the planned survey activity (*e.g.,* source vessels, chase vessels, supply vessels); however, we note that these requirements do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply. These measures include the following:

1. Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A single marine mammal at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should be exercised when an animal is observed. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (specific distances detailed below), to ensure the potential for strike is minimized. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal to broad taxonomic group (*i.e.,* as a right whale, other whale, or other marine mammal). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales;

2. All vessels, regardless of size, must observe the 10 kn speed restriction in specific areas designated for the protection of North Atlantic right whales: Any DMAs when in effect, the Mid-Atlantic SMAs (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15). See *www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales* for more information on these areas;

3. Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of any marine mammal are observed near a vessel;

4. All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action;

5. All vessels must maintain a minimum separation distance of 100 m from sperm whales and all other baleen whales;

6. All vessels must attempt to maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel; and

7. When marine mammals are sighted while a vessel is underway, the vessel should take action as necessary to avoid violating the relevant separation distance (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If marine mammals are sighted within the relevant separation distance, the vessel should reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This recommendation does not apply to any vessel towing gear.

General Measures

All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

We have carefully evaluated the suite of mitigation measures described here and considered a range of other measures in the context of ensuring that we prescribe the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Based on our evaluation of these measures, we have determined that the required mitigation measures provide the means of effecting the least practicable adverse impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of the authorized taking. NMFS's MMPA implementing regulations further describe the information that an applicant should provide when requesting an authorization (50 CFR 216.104(a)(13)), including the means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and the level of taking or impacts on populations of marine mammals. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

• Occurrence of marine mammal species in action area (*e.g.,* presence, abundance, distribution, density);

• Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) Action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving or feeding areas);

• Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors;

- How anticipated responses to stressors impact either: (1) Long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks;
- Effects on marine mammal habitat (*e.g.,* marine mammal prey species, acoustic habitat, or important physical components of marine mammal habitat); and
- Mitigation and monitoring effectiveness.

Changes From the Notice of Proposed IHAs

Here we summarize substantive changes to monitoring and reporting requirements from our Notice of Proposed IHAs. All changes were made on the basis of review of public comments received and/or review of new information.

- As described in our Notice of Proposed IHAs, we preliminarily reached small numbers findings for some species on the basis of the proposed limitation of authorized take to approximately one-third of the abundance estimate deemed at the time to be most appropriate. In order to ensure that IHA-holders would not exceed this cap without limiting the planned survey activity, we proposed to require interim reporting in which IHA-holders would report all observations of marine mammals as well as corrected numbers of marine mammals ''taken.'' We received information from several commenters—including several of the applicants—strongly indicating that such a de facto limitation, coupled with a novel reporting requirement, was impracticable. In summary, commenters noted that such surveys are multi-million dollar endeavors and stated that the surveys would simply not be conducted rather than commit such costs to the survey in the face of significant uncertainty as to whether the survey might be suddenly shut down as a result of reaching a pre-determined cap on the basis of novel modeling of ''corrected'' takes. We also received many comments indicating that our small numbers analyses were flawed and, as described in detail later in this notice (see ''Small Numbers Analyses'') we reconsidered the available information and re-evaluated our analyses in response to these comments. As a result of our revised small numbers analyses, such a cap coupled with reporting scheme is not necessary. Further, we agree with commenters that the proposal presented significant practicability concerns. Therefore, the proposed ''interim'' reporting requirement is eliminated.
- Separately, while we recognize the importance of producing the most accurate estimates of actual take possible, we agree that the proposed approach to correcting observations to produce estimates of actual takes was (1) not the best available approach; (2) is novel in that it has not been previously required of applicants conducting similar activities; and (3) may not be appropriate for application to observations conducted from working source vessels. We have adopted a different approach to performing these ''corrections,'' as recommended through comment from the Marine Mammal Commission, but in this case we will perform these corrections upon submission of reports from IHA-holders and evaluate the appropriateness of this approach and the validity of the results prior to requiring it for future IHAs.
- As a result of concerns expressed through public comment, we have revised requirements relating to reporting of injured or dead marine mammals and have added newly crafted requirements relating to actions that should be taken in response to stranding events in certain circumstances.

Monitoring requirements are the same for all applicants, and a single discussion is provided here.

PSO Eligibility and Qualifications

All PSO resumes must be submitted to NMFS and PSOs must be approved by NMFS after a review of their qualifications. These qualifications include whether the individual has successfully completed the necessary training (see ''Training,'' below) and, if relevant, whether the individual has the requisite experience (and is in good standing). PSOs should provide a current resume and information related to PSO training; submitted resumes should not include superfluous information. Information related to PSO training should include (1) a course information packet that includes the name and qualifications (*e.g.,* experience, training, or education) of the instructor(s), the course outline or syllabus, and course reference material; and (2) a document stating the PSO's successful completion of the course. PSOs must be trained biologists, with the following minimum qualifications:

- A bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics;
- Experience and ability to conduct field observations and collect data according to assigned protocols (may include academic experience) and experience with data entry on computers;
- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target (required for visual PSOs only);
- Experience or training in the field identification of marine mammals, including the identification of behaviors (required for visual PSOs only);
- Sufficient training, orientation, or experience with the survey operation to ensure personal safety during observations;
- Writing skills sufficient to prepare a report of observations (*e.g.,* description, summary, interpretation, analysis) including but not limited to the number and species of marine mammals observed; marine mammal behavior; and descriptions of activity conducted and implementation of mitigation;
- Ability to communicate orally, by radio or in person, with survey personnel to provide real-time information on marine mammals detected in the area as necessary; and
- Successful completion of relevant training (described below), including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification, and prospective PSOs granted waivers must satisfy training requirements described below. Alternate experience that may be considered includes, but is not limited to, the following:

- Secondary education and/or experience comparable to PSO duties;
- Previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; and
- Previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

Training—NMFS does not currently approve specific training programs; however, acceptable training may include training previously approved by BSEE, or training that adheres generally to the recommendations provided by ''*National Standards for a Protected Species Observer and Data Management*

Program: A Model Using Geological and Geophysical Surveys'' (Baker *et al.,* 2013). Those recommendations include the following topics for training programs:

- Life at sea, duties, and authorities;
- Ethics, conflicts of interest, standards of conduct, and data confidentiality;
- Offshore survival and safety training;
- Overview of oil and gas activities (including geophysical data acquisition operations, theory, and principles) and types of relevant sound source technology and equipment;
- Overview of the MMPA and ESA as they relate to protection of marine mammals;
- Mitigation, monitoring, and reporting requirements as they pertain to geophysical surveys;
- Marine mammal identification, biology and behavior;
- Background on underwater sound;
- Visual surveying protocols, distance calculations and determination, cues, and search methods for locating and tracking different marine mammal species (visual PSOs only);
- Optimized deployment and configuration of PAM equipment to ensure effective detections of cetaceans for mitigation purposes (PAM operators only);
- Detection and identification of vocalizing species or cetacean groups (PAM operators only);
- Measuring distance and bearing of vocalizing cetaceans while accounting for vessel movement (PAM operators only);
- Data recording and protocols, including standard forms and reports, determining range, distance, direction, and bearing of marine mammals and vessels; recording GPS location coordinates, weather conditions, Beaufort wind force and sea state, etc.;
- Proficiency with relevant software tools;
- Field communication/support with appropriate personnel, and using communication devices (*e.g.,* two-way radios, satellite phones, internet, email, facsimile);
- Reporting of violations, noncompliance, and coercion; and
- Conflict resolution.

PAM operators should regularly refresh their detection skills through practice with simulation-modeling software, and should keep up to date with training on the latest software/hardware advances.

Visual Monitoring

The lead PSO is responsible for establishing and maintaining clear lines of communication with vessel crew. The vessel operator shall work with the lead PSO to accomplish this and shall ensure any necessary briefings are provided for vessel crew to understand mitigation requirements and protocols. While on duty, PSOs will continually scan the water surface in all directions around the acoustic source and vessel for presence of marine mammals, using a combination of the naked eye and high-quality binoculars, from optimum vantage points for unimpaired visual observations with minimum distractions. PSOs will collect observational data for all marine mammals observed, regardless of distance from the vessel, including species, group size, presence of calves, distance from vessel and direction of travel, and any observed behavior (including an assessment of behavioral responses to survey activity). Upon observation of marine mammal(s), a PSO will record the observation and monitor the animal's position (including latitude/longitude of the vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer, and a PSO will continue to observe the area to watch for the animal to resurface or for additional animals that may surface in the area. PSOs will also record environmental conditions at the beginning and end of the observation period and at the time of any observations, as well as whenever conditions change significantly in the judgment of the PSO on duty.

The vessel operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*e.g.,* Fujinon or equivalent) solely for PSO use. These should be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. NVDs may include night vision binoculars or monocular or forward-looking infrared device (*e.g.,* Exelis PVS–7 night vision goggles; Night Optics D–300 night vision monocular; FLIR M324XP thermal imaging camera or equivalents). At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations. Other required equipment, which should be made available to PSOs by the third-party observer provider, includes reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*e.g.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*e.g.,* Canon or equivalent), compass, and any other tools necessary to adequately perform the tasks described above, including accurate determination of distance and bearing to observed marine mammals.

Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. Monitoring biologists will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Specifically, implementation of shutdown requirements will be made on the basis of the PSO's best professional judgment. While PSOs should not insert undue ''precaution'' into decision-making, it is expected that PSOs may call for mitigation action on the basis of reasonable certainty regarding the need for such action, as informed by professional judgment. Any modifications to protocol will be coordinated between NMFS and the applicant.

Acoustic Monitoring

Monitoring of a towed PAM system is required at all times, from 30 minutes prior to ramp-up and throughout all use of the acoustic source. Towed PAM systems generally consist of hardware (*e.g.,* hydrophone array, cables) and software (*e.g.,* data processing and monitoring system). Some type of automated detection software must be used; while not required, we recommend use of industry standard software (*e.g.,* PAMguard, which is open source). Hydrophone signals are processed for output to the PAM operator with software designed to detect marine mammal vocalizations. Current PAM technology has some limitations (*e.g.,* limited directional capabilities and detection range, masking of signals due to noise from the vessel, source, and/or flow, localization) and there are no formal guidelines currently in place regarding specifications for hardware, software, or operator training requirements.

Our requirement to use PAM refers to the use of calibrated hydrophone arrays with full system redundancy to detect, identify, and estimate distance and bearing to vocalizing cetaceans, to the extent possible. With regard to calibration, the PAM system should have at least one calibrated hydrophone, sufficient for determining whether background noise levels on the towed PAM system are sufficiently low to meet performance expectations. Additionally, if multiple hydrophone types occur in a system (*i.e.,* monitor different bandwidths), then one hydrophone from each such type should be calibrated, and whenever sets of hydrophones (of the same type) are sufficiently spatially separated such that they would be expected to experience ambient noise environments that differ by 6 dB or more across any integrated species cluster bandwidth, then at least one hydrophone from each set should be calibrated. The arrays should incorporate appropriate hydrophone elements (1 Hz to 180 kHz range) and sound data acquisition card technology for sampling relevant frequencies (*i.e.,* to 360 kHz). This hardware should be coupled with appropriate software to aid monitoring and listening by a PAM operator skilled in bioacoustics analysis and computer system specifications capable of running appropriate software.

Applicant-specific PAM plans were made available for review either in individual applications or as separate documents online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.* As recommended by Thode *et al.* (2017), PAM plans should, at minimum, adequately address and describe (1) the hardware and software planned for use, including a hardware performance diagram demonstrating that the sensitivity and dynamic range of the hardware is appropriate for the operation; (2) deployment methodology, including target depth/tow distance; (3) definitions of expected operational conditions, used to summarize background noise statistics; (4) proposed detection-classification-localization methodology, including anticipated species clusters (using a cluster definition table), target minimum detection range for each cluster, and the proposed localization method for each cluster; (5) operation plans, including the background noise sampling schedule; (6) array design considerations for noise abatement; and (7) cluster-specific details regarding which real-time displays and automated detectors the operator would monitor.

In coordination with vessel crew, the lead PAM operator will be responsible for deployment, retrieval, and testing and optimization of the hydrophone array. While on duty, the PAM operator must diligently listen to received signals and/or monitoring display screens in order to detect vocalizing cetaceans, except as required to attend to PAM equipment. The PAM operator must use appropriate sample analysis and filtering techniques and, as described below, must report all cetacean detections. While not required prior to development of formal standards for PAM use, we recommend that vessel self-noise assessments are undertaken during mobilization in order to optimize PAM array configuration according to the specific noise characteristics of the vessel and equipment involved, and to refine expectations for distance/bearing estimations for cetacean species during the survey. Copies of any vessel self-noise assessment reports must be included with the summary trip report.

Data Collection

PSOs must use standardized data forms, whether hard copy or electronic. PSOs will record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

- Vessel names (source vessel and other vessels associated with survey) and call signs;
- PSO names and affiliations;
- Dates of departures and returns to port with port name;
- Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;
- Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts;
- Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;
- Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon;
- Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.,* vessel traffic, equipment malfunctions);
- Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.);
- If a marine mammal is sighted, the following information should be recorded:
    - Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
    - PSO who sighted the animal;
    - Time of sighting;
    - Vessel location at time of sighting;
    - Water depth;
    - Direction of vessel's travel (compass direction);
    - Direction of animal's travel relative to the vessel;
    - Pace of the animal;
    - Estimated distance to the animal and its heading relative to vessel at initial sighting;
    - Identification of the animal (*e.g.,* genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;
    - Estimated number of animals (high/low/best);
    - Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
    - Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
    - Detailed behavior observations (*e.g.,* number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
    - Animal's closest point of approach (CPA) and/or closest distance from the acoustic source;
    - Platform activity at time of sighting (*e.g.,* deploying, recovering, testing, shooting, data acquisition, other); and
    - Description of any actions implemented in response to the sighting (*e.g.,* delays, shutdown, ramp-up, speed or course alteration, etc.); time and location of the action should also be recorded;
- If a marine mammal is detected while using the PAM system, the following information should be recorded:
    - An acoustic encounter identification number, and whether the detection was linked with a visual sighting;
    - Time when first and last heard;
    - Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.); and

◦ Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

Reporting

Applicants must submit a draft comprehensive report to NMFS within 90 days of the completion of survey effort or expiration of the IHA (whichever comes first), and must include all information described above under ''Data Collection.'' If a subsequent IHA request is planned, a report must be submitted a minimum of 75 days prior to the requested date of issuance for the subsequent IHA. The report must describe the operations conducted and sightings of marine mammals near the operations; provide full documentation of methods, results, and interpretation pertaining to all monitoring; summarize the dates and locations of survey operations, and all marine mammal sightings (dates, times, locations, activities, associated survey activities); and provide information regarding locations where the acoustic source was used. The IHA-holder shall provide geo-referenced time-stamped vessel tracklines for all time periods in which airguns (full array or single) were operating. Tracklines should include points recording any change in airgun status (*e.g.,* when the airguns began operating, when they were turned off). GIS files shall be provided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates should be referenced to the WGS84 geographic coordinate system. In addition to the report, all raw observational data shall be made available to NMFS. This report must also include a validation document concerning the use of PAM, which should include necessary noise validation diagrams and demonstrate whether background noise levels on the PAM deployment limited achievement of the planned detection goals. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report. A final report must be submitted within 30 days following resolution of any NMFS comments on the draft report.

In association with the final comprehensive reports, NMFS will calculate and make available estimates of the number of takes based on the observations and in consideration of the detectability of the marine mammal species observed (as described below). PSO effort, survey details, and sightings data should be recorded continuously during surveys and reports prepared each day during which survey effort is conducted. As described below, NMFS will use these observational data to calculate corrected numbers of marine mammals taken.

There are multiple reasons why marine mammals may be present and yet be undetected by observers. Animals are missed because they are underwater (availability bias) or because they are available to be seen, but are missed by observers (perception and detection biases) (*e.g.,* Marsh and Sinclair, 1989). Negative bias on perception or detection of an available animal may result from environmental conditions, limitations inherent to the observation platform, or observer ability. In this case, we do not have prior knowledge of any potential negative bias on detection probability due to observation platform or observer ability. Therefore, observational data corrections must be made with respect to assumed species-specific detection probability as evaluated through consideration of environmental factors (*e.g., f*(0)). In order to make these corrections, we plan to use a method recommended by the Marine Mammal Commission (MMC) for estimating the number of cetaceans in the vicinity of the surveys based on the number of groups detected. This method is described in full in the MMC's comment letter for these actions, which is available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.*

Reporting Injured or Dead Marine Mammals

Discovery of Injured or Dead Marine Mammal—In the event that personnel involved in the survey activities covered by the authorization discover an injured or dead marine mammal, the IHA-holder shall report the incident to the Office of Protected Resources (OPR), NMFS and to regional stranding coordinators as soon as feasible. The report must include the following information:

• Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
• Species identification (if known) or description of the animal(s) involved;
• Condition of the animal(s) (including carcass condition if the animal is dead);
• Observed behaviors of the animal(s), if alive;
• If available, photographs or video footage of the animal(s); and
• General circumstances under which the animal was discovered.

Vessel Strike—In the event of a ship strike of a marine mammal by any vessel involved in the activities covered by the authorization, the IHA-holder shall report the incident to OPR, NMFS and to regional stranding coordinators as soon as feasible. The report must include the following information:

• Time, date, and location (latitude/longitude) of the incident;
• Species identification (if known) or description of the animal(s) involved;
• Vessel's speed during and leading up to the incident;
• Vessel's course/heading and what operations were being conducted (if applicable);
• Status of all sound sources in use;
• Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
• Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;
• Estimated size and length of animal that was struck;
• Description of the behavior of the marine mammal immediately preceding and following the strike;
• If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
• Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
• To the extent practicable, photographs or video footage of the animal(s).

Actions To Minimize Additional Harm to Live-Stranded (or Milling) Marine Mammals

In the event of a live stranding (or near-shore atypical milling) event within 50 km of the survey operations, where the NMFS stranding network is engaged in herding or other interventions to return animals to the water, the Director of OPR, NMFS (or designee) will advise the IHA-holder of the need to implement shutdown procedures for all active acoustic sources operating within 50 km of the stranding. Shutdown procedures for live stranding or milling marine mammals include the following:

• If at any time, the marine mammals die or are euthanized, or if herding/intervention efforts are stopped, the Director of OPR, NMFS (or designee) will advise the IHA-holder that the shutdown around the animals' location is no longer needed.

• Otherwise, shutdown procedures will remain in effect until the Director of OPR, NMFS (or designee) determines and advises the IHA-holder that all live animals involved have left the area (either of their own volition or following an intervention).

• If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the IHA-holder will be required to determine what measures are necessary to minimize that likelihood (*e.g.,* extending the shutdown or moving operations farther away) and to implement those measures as appropriate.

Shutdown procedures are not related to the investigation of the cause of the stranding and their implementation is not intended to imply that the specified activity is the cause of the stranding. Rather, shutdown procedures are intended to protect marine mammals exhibiting indicators of distress by minimizing their exposure to possible additional stressors, regardless of the factors that contributed to the stranding.

Additional Information Requests—If NMFS determines that the circumstances of any marine mammal stranding found in the vicinity of the activity suggest investigation of the association with survey activities is warranted (example circumstances noted below), and an investigation into the stranding is being pursued, NMFS will submit a written request to the IHA-holder indicating that the following initial available information must be provided as soon as possible, but no later than 7 business days after the request for information.

• Status of all sound source use in the 48 hours preceding the estimated time of stranding and within 50 km of the discovery/notification of the stranding by NMFS; and

• If available, description of the behavior of any marine mammal(s) observed preceding (*i.e.,* within 48 hours and 50 km) and immediately after the discovery of the stranding.

Examples of circumstances that could trigger the additional information request include, but are not limited to, the following:

• Atypical nearshore milling events of live cetaceans;

• Mass strandings of cetaceans (two or more individuals, not including cow/calf pairs);

• Beaked whale strandings;

• Necropsies with findings of pathologies that are unusual for the species or area; or

• Stranded animals with findings consistent with blast trauma.

In the event that the investigation is still inconclusive, the investigation of the association of the survey activities is still warranted, and the investigation is still being pursued, NMFS may provide additional information requests, in writing, regarding the nature and location of survey operations prior to the time period above.

Negligible Impact Analyses and Determinations

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base a negligible impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' by mortality, serious injury, and Level A or Level B harassment, we consider other factors, such as the type of take, the likely nature of any behavioral responses (*e.g.,* intensity, duration), the context of any such responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into these analyses via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality).

We first provide a generic description of our approach to the negligible impact analyses for these actions, which incorporates elements of the assessment methodology described by Wood *et al.* (2012), before providing applicant-specific analysis. For each potential activity-related stressor, we consider the potential effects to marine mammals and the likely significance of those effects to the species or stock as a whole. Potential risk due to vessel collision and related mitigation measures as well as potential risk due to entanglement and contaminant spills were addressed under ''Mitigation'' and in the ''Potential Effects of the Specified Activity on Marine Mammals'' section of our Notice of Proposed IHAs and are not discussed further, as there are minimal risks expected from these potential stressors.

Our analyses incorporate a simple matrix assessment approach to generate relative impact ratings that couple potential magnitude of effect on a stock and likely consequences of those effects for individuals, given biologically relevant information (*e.g.,* compensatory ability). These impact ratings are then combined with consideration of contextual information, such as the status of the stock or species, in conjunction with our required mitigation strategy, to ultimately inform our negligible impact determinations. Figure 5 provides an overview of this framework. Elements of this approach are subjective and relative within the context of these particular actions and, overall, these analyses necessarily require the application of professional judgment. As shown in Figure 5, it is important to be clear that the ''impact rating'' does not equate to the ultimate assessment of impact to the species or stock, *i.e.,* the negligible impact determination. The ''impact rating'' is considered in conjunction with relevant contextual factors to inform the overall assessment of impact to the species or stock.

Changes From the Notice of Proposed IHAs

Following review of public comments, we largely retain the negligible impact analysis framework and specific analyses described in our Notice of Proposed IHAs. However, we have made several adjustments on the basis of our review.

• As a result of our revised take estimates (''Estimated Take'') and reconsideration of available information (''Description of Marine Mammals in the Area of the Specified Activities'' and ''Small Numbers Analyses''), the amount of take has changed for some species for some applicants. In some cases, this leads to a change in overall magnitude rating.

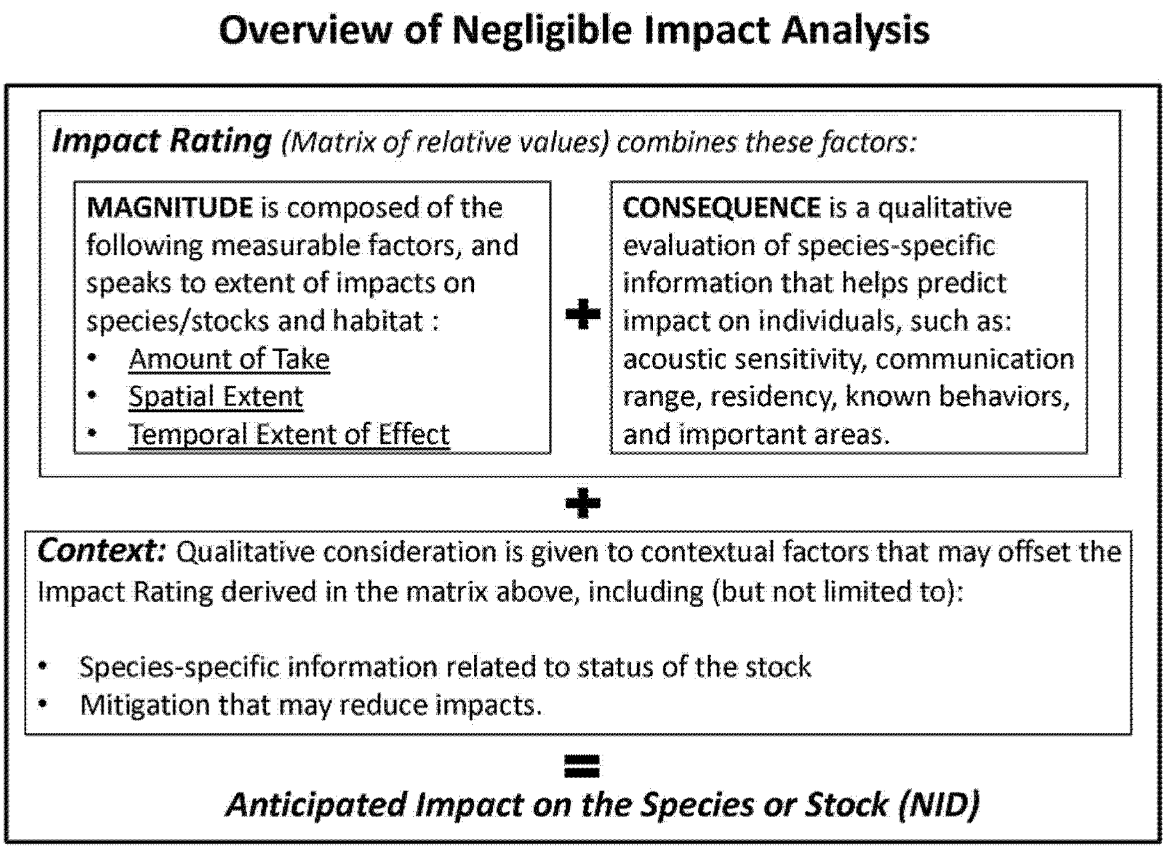

Figure 5. Overview of Negligible Impact Analysis Structure.

• We agree with commenters who pointed out that a de minimis magnitude rating should not render consequences for individuals irrelevant to the impact rating. Rather, the assessed level of consequences pairs with the magnitude rating to produce the overall impact rating. In our preliminary negligible impact analyses, for example, mysticete whales with a de minimis amount of take were assigned an overall de minimis impact rating, as consequences were considered not applicable in cases where a de minimis magnitude rating was assigned. However, the assessed level of potential consequences for individual mysticetes of ''medium''—which is related to inherent vulnerabilities of the taxon, and is therefore not dependent on the specific magnitude rating—would still exist, regardless of the amount of take/ magnitude rating. Therefore, under our revised approach, a mysticete whale with a de minimis magnitude rating is now assigned a low impact rating.

In order to reflect the change described in the preceding paragraph, we have adjusted the impact rating scheme (Table 9). Whereas before a de minimis magnitude rating previously resulted in a de minimis impact rating regardless of assessed potential consequences to individuals, a de minimis magnitude rating now leads to a de minimis impact rating only if the assessed consequences are low; the de minimis impact rating with medium assessed potential consequences for individuals would lead to an impact rating of low.

Impact Rating

Magnitude—We consider magnitude of effect as a semi-quantitative evaluation of measurable factors presented as relative ratings that address the spatiotemporal extent of expected effects to a species or stock and their habitat. Magnitude ratings are developed as a combination of measurable factors: The amount of take, the spatial extent of the effects in the context of the species range, and the duration of effects.

Amount of Take

We consider authorized take by Level B harassment of less than five percent of the most appropriate population abundance to be de minimis, while authorized Level B harassment taking between 5–15 percent is low. A moderate amount of authorized taking by Level B harassment would be from 15–25 percent, and high above 25 percent.

Although we do not define quantitative metrics relating to amount of potential take by Level A harassment, for all applicant companies the expected potential for Level A harassment and, therefore, the authorized taking, is very low (Table 6). For these specified activities, as described in detail in ''Estimated Take,'' the best available science indicates that there is no reasonable potential for Level A harassment of mid-frequency cetaceans, while there is only limited potential for Level A harassment of low-frequency cetaceans when considering that Level A harassment is dependent on accumulation of energy from a mobile acoustic source. Similarly, estimated takes by Level A harassment are very low for all high-frequency cetacean species.

Overall, while these limited incidents of Level A harassment would result in permanent hearing loss, the effects of such hearing loss are expected to be minor for several reasons. First, the acoustic thresholds used in our exposure analysis represent thresholds for the onset of PTS (*i.e.,* the minimum sound levels at which minor PTS could occur; NMFS, 2018), not thresholds for moderate or severe PTS. In order to determine the likelihood of moderate or severe PTS, one needs to consider the actual level of exposure (for high-frequency cetaceans) or, for low-frequency cetaceans, the duration of exposure at the PTS onset threshold distances from the airgun arrays or closer. High-frequency cetaceans that may be present (*i.e.,* harbor porpoise and *Kogia* spp.) are known to be behaviorally sensitive to acoustic disturbance and are unlikely to approach source vessels at distances that might lead to more severe PTS. Similarly, mysticete whales are known to display avoidance behaviors in the vicinity of airgun surveys (*e.g.,* Ellison *et al.,* 2016) and, when considered in conjunction with the estimated distances to the thresholds for the onset of PTS (Table 5), it is likely that such PTS exposure would be brief and at or near PTS onset levels. For example, a recent study analyzing 16 years of PSO data consisting of marine mammal observations during seismic surveys in waters off the United Kingdom found that the median closest approach by fin whales during active airgun use was 1,225 m (Stone *et al.,* 2017), a distance well beyond the PTS onset threshold distances estimated for these specific airgun arrays. The degree of PTS would be further minimized through use of the ramp-up procedure, which will alert animals to the source prior to its achieving full power, and through shutdown requirements, which will not necessarily prevent exposure but are expected to reduce the intensity and duration of exposure. Available data suggest that such PTS would primarily occur at frequencies where the majority of the energy from airgun sounds occurs (below 500 Hz). For high-frequency cetaceans, any PTS would therefore occur at frequencies well outside their estimated range of maximum sensitivity. For low-frequency cetaceans, these frequencies overlap with the frequencies used for communication and so may interfere somewhat with their ability to communicate, though still below the estimated range of maximum sensitivity for these species. The expected mild PTS would not likely meaningfully impact the affected high-frequency cetaceans, and may have minor effects on the ability of affected low-frequency cetaceans to hear conspecific calls and/or other environmental cues. For all applicants, the expected effects of Level A harassment on all stocks to which such take may occur is appropriately considered de minimis.

Spatial Extent

Spatial extent relates to overlap of the expected range of the affected stock with the expected footprint of the stressor. While we do not define quantitative metrics relative to assessment of spatial extent, a relatively low impact is defined here as a localized effect on the stock's range, a relatively moderate impact is defined as a regional-scale effect (meaning that the overlap between stressor and range was partial), and a relatively high impact is one in which the degree of overlap between stressor and range is near total. For a mobile activity occurring over a relatively large, regional-scale area, this categorization is made largely on the basis of the stock range in relation to the action area. For example, the harbor porpoise is expected to occur almost entirely outside of the planned survey areas (Hayes *et al.,* 2017; Roberts *et al.,* 2016) and therefore despite the large extent of planned survey activity, the spatial extent of potential stressor effect would be low. A medium degree of effect would be expected for a species such as the Risso's dolphin, which has a distribution in shelf and slope waters along the majority of the U.S. Atlantic coast, and which also would be expected to have greater abundance in mid-Atlantic waters north of the survey areas in the summer (Hayes *et al.,* 2018a; Roberts *et al.,* 2016). This means that the extent of potential stressor for this species would at all times be expected to have some overlap with a portion of the stock, while some portion (increasing in summer and fall months) would at all times be outside the stressor footprint. A higher degree of impact with regard to spatial extent would be expected for a species such as the Clymene dolphin, which is expected to have a generally more southerly distribution (Waring *et al.,* 2014; Roberts *et al.,* 2016) and thus more nearly complete overlap with the expected stressor footprint in the specific geographic region.

In Tables 10–14 below, spatial extent is presented as a range for certain species with known migratory patterns. We expect spatial extent (overlap of stock range with planned survey area) to be low for right whales from May through October but moderate from November through April, due to right whale movements into southeastern shelf waters in the winter for calving. The overlap is considered moderate during winter because not all right whales make this winter migration, and those that do are largely found in shallow waters where little survey effort is planned (and when/where we prescribe a spatial restriction that would largely preclude any potential overlap between right whales and effects of the survey activities). Spatial extent for humpback whales is expected to be low for most of the year, but likely moderate during winter, while spatial extent for minke whales is likely low in summer, moderate in spring and fall, and high in winter. While we consider spatial extent to be low year-round for fin whales, their range overlap with the planned survey area does vary across the seasons and is closer to moderate in winter and spring. We expect spatial extent for common dolphins to be lower in fall but generally moderate. Similarly, we expect spatial extent for Risso's dolphins to be lower in summer but generally moderate. Although survey plans differ across applicants, all cover large spatial scales that extend throughout much of the specific geographic region, and we do not expect meaningful differences across surveys with regard to spatial extent.

Temporal Extent

The temporal aspect of the stressor is measured through consideration of duration and frequency. Duration describes how long the effects of the stressor last. Temporal frequency may range from continuous to isolated (may occur one or two times), or may be intermittent. We consider a temporary effect lasting up to one month (prior to the animal or habitat reverting to a "normal" condition) to be short-term, whereas long-term effects are more permanent, lasting beyond one season (with animals or habitat potentially reverting to a "normal" condition). Moderate-term is defined as between 1–3 months. These metrics and their potential combinations help to derive the ratings summarized in Table 8. Temporal extent is not indicated in Tables 10–14 below, as it did not affect the magnitude rating for any applicant's specified activity.

With regard to the duration of each estimated instance of exposure, we are unable to produce estimates specific to the specified activities due to the temporal and spatial uncertainty of vessel and cetacean movements within the geographic region. However, given the constant movement of vessels and animals, all exposures are expected to be less than a single day in duration. For example, based on modeling of similar activities in the Gulf of Mexico, we assume that most instances of exposure would only last for a few minutes (see Table 26–27 of Zeddies *et al.,* 2015; available online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico*), especially in the case of animals migrating through the immediate vicinity of the source vessel (*e.g.,* Costa *et al.,* 2016).

TABLE 8—MAGNITUDE RATING

Amount of take	Spatial extent	Duration and frequency	Magnitude rating
High	Any	Any	High.
Any except de minimis	High	Any	
Moderate	Moderate	Any except short-term/isolated	
Moderate	Moderate	Short-term/isolated	Medium.
Moderate	Low	Any	
Low	Moderate	Any	
Low	Low	Any except short-term/intermittent or isolated	
Low	Low	Short-term/intermittent or isolated	Low.
De minimis	Any	Any	De minimis.

Adapted from Table 3.4 of Wood *et al.* (2012).

Consequences—Considerations of amount, extent, and duration give an understanding of expected magnitude of effect for the stock or species and their habitat, which is next considered in context of the likely consequences of those effects for individuals. We consider likely relative consequences through a qualitative evaluation of species-specific information that helps predict the consequences of the information addressed through the magnitude rating, *i.e.,* expected effects. The likely consequences of a given effect to individuals is independent of the magnitude of effect, *i.e.,* although we recognize that the ultimate impact is to some degree scaled to the magnitude of effect, the extent to which a species is inherently vulnerable to harm from the effects (and therefore sensitive to magnitude) is captured by the ‘‘consequences’’ factor. This evaluation considers factors including acoustic sensitivity, communication range, known aspects of behavior relevant to a consideration of consequences of effects, and assumed compensatory abilities to engage in important behaviors (*e.g.,* breeding, foraging) in alternate areas. The magnitude rating and likely consequences are combined to produce an ‘‘impact rating’’ (Table 9).

For example, if a delphinid species is predicted to have a high amount of disturbance and over a high degree of spatial extent, that stock would receive a high magnitude rating for that particular survey. However, we may then assess that the species may have a high degree of compensatory ability among individuals; therefore, our conclusion would be that the consequences of any effects on individuals are likely low. The overall impact rating in this scenario would be moderate. Table 9 summarizes impact rating scenarios.

TABLE 9—IMPACT RATING

Magnitude rating	Consequences (for individuals)	Impact rating (for species or stock)
High	High/medium	High.
High	Low	Moderate.
Medium	High/medium	
Low	High	
Medium	Low	Low.
Low	Medium/low	
De minimis	Medium	
De minimis	Low	De minimis.

Adapted from Table 3.5 of Wood *et al.* (2012).

Likely consequences, as presented in Tables 10–14 below, are considered medium for each species of mysticete whales (low-frequency hearing specialists), due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Likely consequences are considered medium for sperm whales due to potential for survey noise to disrupt foraging activity (*e.g.,* Miller *et al.,* 2009; Farmer *et al.,* 2018). The likely consequences are considered high for beaked whales due to the combination of known acoustic sensitivity and expected residency patterns, as we expect that compensatory ability for beaked whales will be low due to presumed residency in certain shelf break and deepwater canyon areas covered by the planned survey areas. Similarly, *Kogia* spp. are presumed to be more acoustically sensitive species, but unlike beaked whales we expect that *Kogia* spp. would have a reasonable compensatory ability to perform important behavior in alternate areas, as they are expected to occur broadly over the continental slope (*e.g.,* Bloodworth and Odell, 2008)—therefore, we assume that consequences would be low for *Kogia* spp. generally. Consequences are also considered low for harbor porpoise; although they are considered to be an acoustically sensitive species and potentially vulnerable to limited instances of auditory injury (as are *Kogia* spp.), we have no information to suggest that porpoises are resident within the specific geographic region or that the expected disturbance events would significantly impede their ability to engage in critical behaviors.

Consequences are considered low for most delphinids, as it is unlikely 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. However, for pilot whales we believe likely consequences to be medium due to expected residency in areas of importance and, therefore, lack of compensatory ability. Because the nature of the stressor is the same across applicants, we do not expect meaningful differences with regard to likely consequences.

Context

In addition to our initial impact ratings, we then also consider additional relevant contextual factors in a qualitative fashion. This important consideration of context is applied to a given impact rating in order to produce a final assessment of impact to the stock or species, *i.e.,* our negligible impact determinations. Relevant contextual factors include population status, other stressors (including impacts on prey and other habitat), and required mitigation.

Here, we reiterate discussion relating to our development of targeted mitigation measures and note certain contextual factors, which are applicable to negligible impact analyses for all five applicants. Applicant-specific analyses are provided later.

- We developed mitigation requirements (*i.e.,* time-area restrictions) designed specifically to provide benefit to certain species or stocks for which we predict a relatively moderate to high amount of exposure to survey noise and/or which have contextual factors that we believe necessitate special consideration. Time-area restrictions, described in detail in ''Mitigation'' and depicted in Figures 3–4, are designed specifically to provide benefit to the North Atlantic right whale, bottlenose dolphin, sperm whale, beaked whales, and pilot whales. In addition, we expect these areas to provide some subsidiary benefit to additional species that may be present. In particular, Area #4 (Figure 4), although delineated in order to specifically provide an area of anticipated benefit to beaked whales, sperm whales, and pilot whales, is expected to host a diverse assemblage of cetacean species. The output of the Roberts *et al.* (2016) models, as used in core abundance area analyses (described in detail in ''Mitigation''), indicates that species most likely to derive subsidiary benefit from this time-area restriction include the bottlenose dolphin (offshore stock), Risso's dolphin, and common dolphin. For species with density predicted through stratified models, core abundance analysis is not possible and assumptions regarding potential benefit of time-area restrictions are based on known ecology of the species and sightings patterns and are less robust. Nevertheless, subsidiary benefit for Areas #1–4 (Figure 4) should be expected for species known to be present in these areas (*e.g.,* assumed affinity for shelf/slope/abyss areas off Cape Hatteras): *Kogia* spp., pantropical spotted dolphin, Clymene dolphin, and rough-toothed dolphin.

These mitigation measures benefit both the primary species for which they were designed and the species that may benefit secondarily by reducing impacts to marine mammal habitat and by reducing the numbers of individuals likely to be exposed to survey noise. For resident species in areas where seasonal closures are required, we also expect reduction in the numbers of times that individuals are exposed to survey noise (also discussed in ''Small Numbers Analyses,'' below). Perhaps of greater importance, we expect that these restrictions will reduce disturbance of these species in the places most important to them for critical behaviors such as foraging and socialization. Area #1 (Figure 4), which is a year-round closure, is assumed to be an area important for beaked whale foraging, while Areas #2–3 (also year-round closures) are assumed to provide important foraging opportunities for sperm whales as well as beaked whales. Area #4, a seasonal closure, is comprised of shelf-edge habitat where beaked whales and pilot whales are believed to be year-round residents as well as slope and abyss habitat predicted to contain high abundance of sperm whales during the period of closure. Further detail regarding rationale for these closures is provided under ''Mitigation.''

- The North Atlantic right whale, sei whale, fin whale, blue whale, and sperm whale are listed as endangered under the Endangered Species Act, and all coastal stocks of bottlenose dolphin are designated as depleted under the MMPA (and have recently experienced an Unusual Mortality Event, described earlier in this document). However, sei whales and blue whales are unlikely to be meaningfully impacted by the specified activities (see ''Rare Species'' below). All four mysticete species are also classified as endangered (*i.e.,* ''considered to be facing a very high risk of extinction in the wild'') on the International Union for Conservation of Nature Red List of Threatened Species, whereas the sperm whale is classified as vulnerable (*i.e.,* ''considered to be facing a high risk of extinction in the wild'') (IUCN, 2017). Our required mitigation is designed to avoid impacts to the right whale and to depleted stocks of bottlenose dolphin. Survey activities must avoid all areas where the right whale and coastal stocks of bottlenose dolphin are reasonably expected to occur (or, for the right whale, comparable protection would be achieved through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore; see ''Mitigation''), and we require shutdown of the acoustic source upon observation of any right whale at extended distance compared with the standard shutdown requirement. If the observed right whale is within the behavioral harassment zone, it would still be considered taken, but by immediately shutting down the acoustic source the duration of harassment is minimized and the significance of the harassment event reduced as much as possible.

Although listed as endangered, the primary threat faced by the sperm whale (*i.e.,* commercial whaling) has been eliminated and, further, sperm whales in the western North Atlantic were little affected by modern whaling (Taylor *et al.,* 2008). Current potential threats to the species globally include vessel strikes, entanglement in fishing gear, anthropogenic noise, exposure to contaminants, climate change, and marine debris. However, for the North Atlantic stock, the most recent estimate of annual human-caused mortality and serious injury (M/SI) is 22 percent of the potential biological removal (PBR) level for the stock. As described previously, PBR is defined as ''the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.'' For depleted stocks, levels of human-caused mortality and serious injury exceeding the PBR level are likely to delay restoration of the stock to OSP level by more than ten percent in comparison with recovery time in the absence of human-caused M/SI.

The most recent status review for the species stated that existing regulatory mechanisms appear to minimize threats to sperm whales and that, despite uncertainty regarding threats such as climate change, contaminants, and anthropogenic noise, the significance of threat facing the species should be considered low to moderate (NMFS, 2015b). Nevertheless, existing empirical data (*e.g.,* Miller *et al.,* 2009; Farmer *et al.,* 2018) highlight the potential for seismic survey activity to negatively impact foraging behavior of sperm whales. In consideration of this likelihood, the species status, and the relatively high amount of predicted exposures to survey noise, we have given special consideration to mitigation focused on sperm whales and have defined time-area restrictions (see ''Mitigation'' and Figure 4) specifically designed to reduce such impacts on sperm whales in areas expected to be of greatest importance (*i.e.,* slope habitat and deepwater canyons).

Although the primary direct threat to fin whales was addressed through the moratorium on commercial whaling, vessel strike and entanglement in commercial fishing gear remain as substantial direct threats for the species in the western North Atlantic. As noted below, the most recent estimate of annual average human-caused mortality for the fin whale in U.S. waters is equal to the PBR value (Table 2). In addition, mysticete whales are particularly sensitive to sound in the frequency range output from use of airgun arrays (*e.g.,* NMFS, 2018). However, there is conflicting evidence regarding the degree to which this sound source may significantly disrupt the behavior of mysticete whales. Generally speaking, mysticete whales have been observed to react to seismic vessels but have also been observed continuing normal behavior in the presence of seismic vessels, and behavioral context at the time of acoustic exposure may be influential in the degree to which whales display significant behavioral reactions. In addition, while Edwards *et al.* (2015) found that fin whales were likely present in all seasons in U.S. waters north of 35° N, most important habitat areas are not expected to occur in the planned survey areas. Primary feeding areas are outside the project area in the Gulf of Maine and off Long Island (LaBrecque *et al.,* 2015) and, while Hain *et al.* (1992) suggested that calving occurs during winter in the mid-Atlantic, Hayes *et al.* (2017) state that it is unknown where calving, mating, and wintering occur for most of the population. Further, fin whales are not considered to engage in regular mass movements along well-defined migratory corridors (NMFS, 2010b). The models described by Roberts *et al.* (2016), which predicted density at a monthly time step, suggest an expectation that, while fin whales may be present year-round in shelf and slope waters north of Cape Hatteras, the large majority of predicted abundance in U.S. waters would be found outside the planned survey areas to the north. Very few fin whales are likely present in the planned survey areas in summer months. Therefore, we have determined that development of time-area restriction specific to fin whales is not warranted. However, fin whales present along the shelf break north of Cape Hatteras during the closure period associated with Area #4 (Figure 4) would be expected to benefit from the time-area restriction designed primarily to benefit pilot whales, beaked whales, and sperm whales.

• Critical habitat is designated only for the North Atlantic right whale, and there are no biologically important areas (BIA) described within the region (other than for the right whale, and the described BIA is similar to designated critical habitat). Our required mitigation is designed to avoid impacts to important habitat for the North Atlantic right whale (or achieve comparable protection through implementation of a NMFS-approved mitigation and monitoring plan at distances between 47–80 km offshore; see ''Mitigation'').

• High levels of average annual human-caused M/SI (approaching or exceeding the PBR level) are ongoing for the North Atlantic right whale, sei whale, fin whale, and for both long-finned and short-finned pilot whales (see Table 2). Average annual M/SI is considered unknown for the blue whale and the false killer whale (PBR is undetermined for a number of other species (Table 2), but average annual human-caused M/SI is zero for all of these). Separately, there are ongoing UMEs for humpback whales and minke whales (as well as for the right whale), as discussed previously in this notice. Although threats are considered poorly known for North Atlantic blue whales, PBR is less than one and ship strike is a known cause of mortality for all mysticete whales. The most recent record of ship strike mortality for a blue whale in the U.S. EEZ is from 1998 (Waring *et al.,* 2010). False killer whales also have a low PBR value (2.1), and may be susceptible to mortality in commercial fisheries. One false killer whale was reported as entangled in the pelagic longline fishery in 2011, but was released alive and not seriously injured. Separately, a stranded false killer whale in 2009 was classified as due to a fishery interaction. Incidental take of the sei whale, blue whale, false killer whale, and long-finned pilot whale is considered unlikely and we authorize take by behavioral harassment only for a single group of each of the first three species as a precaution. Although long-finned pilot whales are unlikely to occur in the action area in significant numbers, the density models that inform our exposure estimates consider pilot whales as a guild. It is important to note that our discussion of M/SI in relation to PBR values provides necessary contextual information related to the status of stocks; we do not equate harassment with M/SI.

We addressed our consideration of specific mitigation efforts for the right whale and fin whale above. For minke whales, although the ongoing UME is under investigation (as occurs for all UMEs), this event does not provide cause for concern regarding population-level impacts, as the likely population abundance is greater than 20,000 whales. Even though the PBR value is based on an abundance for U.S. waters that is negatively biased and a small fraction of the true population abundance, annual M/SI does not exceed the calculated PBR value for minke whales.

With regard to humpback whales, the UME does not yet provide cause for concern regarding population-level impacts. Despite the UME, the relevant population of humpback whales (the West Indies breeding population, or distinct population segment (DPS)) remains healthy. Prior to 2016, humpback whales were listed under the ESA as an endangered species worldwide. Following a 2015 global status review (Bettridge *et al.,* 2015), NMFS established 14 DPSs with different listing statuses (81 FR 62259; September 8, 2016) pursuant to the ESA. The West Indies DPS, which consists of the whales whose breeding range includes the Atlantic margin of the Antilles from Cuba to northern Venezuela, and whose feeding range primarily includes the Gulf of Maine, eastern Canada, and western Greenland, was delisted. The status review identified harmful algal blooms, vessel collisions, and fishing gear entanglements as relevant threats for this DPS, but noted that all other threats are considered likely to have no or minor impact on population size or the growth rate of this DPS (Bettridge *et al.,* 2015). As described in Bettridge *et al.* (2015), the West Indies DPS has a substantial population size (*i.e.,* approximately 10,000; Stevick *et al.,* 2003; Smith *et al.,* 1999; Bettridge *et al.,* 2015), and appears to be experiencing consistent growth.

In response to this population context concern for pilot whales, in conjunction with relatively medium to high amount of predicted exposures to survey noise for pilot whales, we have given special consideration to mitigation focused on pilot whales and have defined time-area restrictions (see ''Mitigation'' and Figure 4) specifically designed to reduce such impacts on pilot whales in areas expected to be of greatest importance (*i.e.,* shelf edge north of Cape Hatteras).

• Beaked whales are considered to be particularly acoustically sensitive (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Stimpert *et al.,* 2014; Miller *et al.,* 2015). Considering this sensitivity in conjunction with the relatively high amount of predicted exposures to survey noise, we have given special consideration to mitigation focused on beaked whales and have defined time-area restrictions (see ''Mitigation'' and Figure 4) specifically designed to reduce such impacts on beaked whales in areas expected to be of greatest importance (*i.e.,* shelf edge south of Cape Hatteras and deepwater canyon areas).

• Given the current declining population status of North Atlantic right whales, it is important to understand the likely demographics of the expected taking. Therefore, we obtained data from the North Atlantic Right Whale Consortium Database (pers. comm., T.A. Gowan to E. Patterson, November 8, 2017), consisting of standardized sighting records of right whales from 2005 to 2013 from South Carolina to Florida. Because of the low total number of expected exposure for right whales, we could not reasonably apply this information on an applicant-specific basis and therefore present these findings for the total expected taking across all applicants. Based on this information, of the total 23 takes of North Atlantic right whales (now revised downward to 19 takes on the basis of Spectrum's modified survey plan; see ''Spectrum Survey Plan Modification''), it should be expected that four exposures could be of adult females with calves, two of adult females without calves, five of adult males, 11 of juveniles of either sex, three of calves of either sex, one of an adult of unknown sex, and two of animals of unknown age and sex. It is important to note that age class estimates sum to greater than the originally expected total of 23 due to conservative rounding up in presenting the maximum number of each age-sex class that might be exposed; this should not be construed as an assumption that there would be more total takes of right whales than are authorized across all applicants. Each of these exposures represents a single instance of Level B harassment and is therefore not considered as a meaningful impact to individuals that could lead to population-level impacts.

Rare Species

As described previously, there are multiple species that should be considered rare in the survey areas and for which we authorize only nominal and precautionary take of a single group for each applicant survey. Specific to each of the five applicant companies, we do not expect meaningful impacts to these species (*i.e.,* sei whale, Bryde's whale, blue whale, killer whale, false killer whale, pygmy killer whale, melon-headed whale, northern bottlenose whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin) and find that the take from each of the specified activities will have a negligible impact on these marine mammal species. We do not discuss these 11 species further in these analyses.

Spectrum

Spectrum originally planned a 165-day survey program, or 45 percent of the year (approximately two seasons). The original survey plan would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 1 of Spectrum's application). Therefore, although that survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 10 displays relevant information leading to impact ratings for each species resulting from Spectrum's original survey plan. In general, we note that although the temporal and spatial scale of the planned survey activity is large, it is not occupying the spatial extent all at one time. The fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that more individuals may receive limited exposure to survey noise, versus fewer individuals receiving more intense exposure and/or for longer periods of time. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited. Please see ''Spectrum Survey Plan Modification,'' below, for additional information describing the modified survey plan, findings made in context of the analysis presented below, and authorized take for Spectrum (Table 17).

TABLE 10—MAGNITUDE AND IMPACT RATINGS, SPECTRUM

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
North Atlantic right whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Humpback whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Minke whale	De minimis	Low-High	De minimis	Medium	Low.
Fin whale	Low	Low	Medium	Medium	Moderate.
Sperm whale	Low	Moderate	Medium	Medium	Moderate.
Kogia spp	Low	High	High	Low	Moderate.
Beaked whales	Low	Moderate	Medium	High	Moderate.
Rough-toothed dolphin	Moderate	High	High	Low	Moderate.
Bottlenose dolphin	High	High	High	Low	Moderate.
Clymene dolphin	High	High	High	Low	Moderate.
Atlantic spotted dolphin	Moderate	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	Moderate	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Common dolphin	Low	Low-moderate	Medium	Low	Low.
Risso's dolphin	De minimis	Low-moderate	De minimis	Low	De minimus.
Pilot whales	Low	Moderate	Medium	Medium	Moderate.
Harbor porpoise	De minimis	Low	De minimis	Low	De minimis.

[1] Impact rating does not indicate whether overall impact to the species or stock is negligible, but is considered with relevant contextual factors (described generally above and specifically below) in order to ultimately determine whether the effects of the specified activity on the affected species or stock are negligible.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of even a low impact rating, we believe that the required mitigation described previously is critically important in order for us to make the necessary finding and it is with consideration of this mitigation that we find the take from Spectrum's survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a moderate impact rating overall, but we expect that for two seasons (summer and fall) almost no fin whales will be present in the survey area. For the remainder of the year, it is likely that less than one quarter of the population will be present within the survey area (Roberts *et al.,* 2016), meaning that despite medium rankings for magnitude and likely consequences, these impacts would be experienced by only a small subset of the overall population. In consideration of the moderate impact rating, the likely proportion of the population that may be affected by the specified activities, and the lack of evidence that the survey area is host to important behaviors that may be disrupted, we find the take from Spectrum's survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale and beaked whales are medium; however, consequence factors are medium and high, respectively. Magnitude rating for pilot whales is medium, but similar to beaked whales, we expect that compensatory ability will be low (high consequence rating) due to presumed residency in areas targeted by the planned survey. These factors lead to moderate impact ratings for all three species/species groups. However, regardless of impact rating, the consideration of likely consequences and contextual factors for all three taxa leads us to conclude that targeted mitigation is important to support a finding that the effects of the survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we require shutdown of the acoustic source upon detection of a beaked whale at extended distance from the source vessel. In consideration of the required mitigation, we find the take from Spectrum's survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the required mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we require shutdown of the acoustic source upon observation of *Kogia* spp. at extended distance from the source vessel. In consideration of these factors—likely population increase and required mitigation—we find the take from Spectrum's survey activities will have a negligible impact on *Kogia* spp.

As described in the introduction to this analysis, it is assumed that likely consequences are somewhat higher for species of mysticete whales (low-frequency hearing specialists) due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Therefore, despite de minimis magnitude ratings, we expect some consequences to individual humpback and minke whales, *i.e.,* leading to a low impact rating. However, given the minimal amount of interaction expected between these species and the survey activities, and in consideration of the overall low impact ratings, we find the take from Spectrum's planned survey activities will have a negligible impact on the humpback whale and minke whale.

Despite medium to high magnitude ratings, remaining delphinid species receive low to moderate impact ratings due to low consequences rating relating to a lack of propensity for behavioral disruption due to airgun survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, contextually these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the survey area would likely be little affected at the population level by the activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2014; Hayes *et al.,* 2017; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our required mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin. We also expect that meaningful subsidiary benefit will accrue to certain species from the mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and context including required mitigation—we find the take from Spectrum's planned survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, and Clymene dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we find the take from Spectrum's survey activities will have a negligible impact on the Risso's dolphin and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from Spectrum's survey activities will have a negligible impact on all affected marine mammal species or stocks.

TGS—TGS has planned a 308-day survey program, or 84 percent of the year (slightly more than three seasons). However, the planned survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figures 1–1 to 1–4 of TGS's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. We note that TGS plans to deploy two independent source vessels, which would in effect increase the spatial extent of survey noise at any one time but, because the vessels would not be operating within the same area or reshooting lines already covered, this would not be expected to increase the duration or frequency of exposure experienced by individual animals. Table 11 displays relevant information leading to impact ratings for each species resulting from TGS's survey. In general, we note that although the temporal and spatial scale of the planned survey activity is large, the fact that these mobile acoustic sources would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that more individuals may receive limited exposure to survey noise, versus fewer individuals receiving more intense exposure and/or for longer periods of time. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 11—MAGNITUDE AND IMPACT RATINGS, TGS

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
North Atlantic right whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Humpback whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Minke whale	De minimis	Low-High	De minimis	Medium	Low.
Fin whale	Moderate	Low	Medium	Medium	Moderate.
Sperm whale	High	Moderate	High	Medium	High.
Kogia spp	High	High	High	Low	Moderate.
Beaked whales	High	Moderate	High	High	High.
Rough-toothed dolphin	High	High	High	Low	Moderate.
Bottlenose dolphin	High	High	High	Low	Moderate.
Clymene dolphin	De minimis	High	De minimis	Low	De minimis.
Atlantic spotted dolphin	High	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	Moderate	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Common dolphin	High	Low-moderate	High	Low	Moderate.
Risso's dolphin	Moderate	Low-moderate	High	Low	Moderate.
Pilot whales	High	Moderate	High	Medium	High.
Harbor porpoise	De minimis	Low	De minimis	Low	De minimis.

[1] Impact rating does not indicate whether overall impact to the species or stock is negligible, but is considered with relevant contextual factors (described generally above and specifically below) in order to ultimately determine whether the effects of the specified activity on the affected species or stock are negligible.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of even a low impact rating, we believe that the required mitigation described previously is critically important in order for us to make the necessary finding and it is with consideration of this mitigation that we find the take from TGS's survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a moderate impact rating overall, but we expect that for two seasons (summer and fall) almost no fin whales will be present in the survey area. For the remainder of the year, it is likely that less than one quarter of the population will be present within the survey area (Roberts *et al.,* 2016), meaning that despite medium rankings for magnitude and likely consequences, these impacts would be experienced by only a small subset of the overall population. In consideration of the moderate impact rating, the likely proportion of the population that may be affected by the specified activities, and the lack of evidence that the survey area is host to important behaviors that may be disrupted, we find the take from TGS's survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale, beaked whales, and pilot whales are high and, further, consequence factors reinforce high impact ratings for all three. In addition, 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 survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability and, therefore, high consequence rating), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have required shutdown of the acoustic source upon observation of a beaked whale at extended distance from the source vessel. In consideration of the required mitigation, we find the take from TGS's survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have required shutdown of the acoustic source upon observation of *Kogia* spp. at extended distance from the source vessel. In consideration of these factors—likely population increase and required mitigation—we find the take from TGS's survey activities will have a negligible impact on *Kogia* spp.

As described in the introduction to this analysis, it is assumed that likely consequences are somewhat higher for species of mysticete whales (low-frequency hearing specialists) due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Therefore, despite de minimis magnitude ratings, we expect some consequences to individual humpback and minke whales, *i.e.,* leading to a low impact rating. However, given the minimal amount of interaction expected between these species and the survey activities, and in consideration of the overall low impact ratings, we find the take from TGS's planned survey activities will have a negligible impact on the humpback whale and minke whale.

Despite high magnitude ratings, most remaining delphinid species receive moderate impact ratings (with the exception of the striped dolphin, with medium magnitude rating and low impact rating), due to low consequences rating relating to a lack of propensity for behavioral disruption due to airgun survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, contextually these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the survey area would likely be little affected at the population level by the specified activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2014; Hayes *et al.,* 2017; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our required mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin. We also expect that meaningful subsidiary benefit will accrue to certain species from the mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and context including required mitigation—we find the take from TGS's survey activities will have a negligible impact on most remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we find the take from TGS's survey activities will have a negligible impact on the Clymene dolphin and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from TGS's survey activities will have a negligible impact on all affected marine mammal species or stocks.

ION—ION has planned a 70-day survey program, or 19 percent of the year (slightly less than one season). However, the planned survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 1 of ION's application). Therefore, although the survey would be moderate-term (*i.e.,* from 1–3 months) in total duration, we would not expect the duration of effect to be greater than short and isolated to intermittent in any given area. Table 12 displays relevant information leading to impact ratings for each species resulting from ION's survey. In general, we note that although the temporal and spatial scale of the planned survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that more individuals may receive limited exposure to survey noise, versus fewer individuals receiving more intense exposure and/or for longer periods of time. The nature of such potentially transitory exposure means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 12—MAGNITUDE AND IMPACT RATINGS, ION

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
North Atlantic right whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Humpback whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Minke whale	De minimis	Low-High	De minimis	Medium	Low.
Fin whale	De minimis	Low	De minimis	Medium	Low.
Sperm whale	De minimis	Moderate	De minimis	Medium	Low.
Kogia spp	De minimis	High	De minimis	Low	De minimis.
Beaked whales	De minimis	Moderate	De minimis	High	Low.
Rough-toothed dolphin	De minimis	High	De minimis	Low	De minimis.
Bottlenose dolphin	De minimis	High	De minimis	Low	De minimis.
Clymene dolphin	De minimis	High	De minimis	Low	De minimis.
Atlantic spotted dolphin	De minimis	Moderate	De minimis	Low	De minimis.
Pantropical spotted dolphin	De minimis	High	De minimis	Low	De minimis.
Striped dolphin	De minimis	Low	De minimis	Low	De minimis.
Common dolphin	De minimis	Low-moderate	De minimis	Low	De minimis.
Risso's dolphin	De minimis	Low-moderate	De minimis	Low	De minimis.
Pilot whales	De minimis	Moderate	De minimis	Medium	Low.
Harbor porpoise	De minimis	Low	De minimis	Low	De minimis.

[1] Impact rating does not indicate whether overall impact to the species or stock is negligible, but is considered with relevant contextual factors (described generally above and specifically below) in order to ultimately determine whether the effects of the specified activity on the affected species or stock are negligible.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the required mitigation described previously is critically important in order for us to make the necessary finding and it is with consideration of this mitigation that we find the take from ION's planned survey activities will have a negligible impact on the North Atlantic right whale.

Also regardless of impact rating, consideration of assumed behavioral susceptibility and lack of compensatory ability (*i.e.,* consequence factors) as well as additional contextual factors leads us to conclude that the required targeted time-area mitigation described previously is important to support a finding that the effects of the planned survey will have a negligible impact for the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.). As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive, and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries. Further, we expect that compensatory ability for beaked whales will be low due to presumed residency in certain shelf break and deepwater canyon areas covered by the survey area and that compensatory ability for pilot whales will also be low due to presumed residency in areas targeted by the planned survey (when compensatory ability is assumed to be low, we assign a high consequence factor). *Kogia* spp. are also considered to have heightened acoustic sensitivity and therefore we have required shutdown of the acoustic source upon observation of a beaked whale or a *Kogia* spp. at extended distance from the source vessel. In consideration of the required mitigation, we find the take from ION's survey activities will have a negligible impact on the sperm whale, beaked whales, pilot whales, and *Kogia* spp.

As described in the introduction to this analysis, it is assumed that likely consequences are somewhat higher for species of mysticete whales (low-frequency hearing specialists) due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Therefore, despite de minimis magnitude ratings, we expect some consequences to individual humpback, fin, and minke whales, *i.e.,* leading to a low impact rating. However, given the minimal amount of interaction expected between these species and the survey activities, and in consideration of the overall low impact ratings, we find the take from ION's planned survey activities will have a negligible impact on the humpback whale, fin whale, and minke whale.

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we find the take from ION's planned survey activities will have a negligible impact on all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, Clymene dolphin, Risso's dolphin, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from ION's survey activities will have a negligible impact on all affected marine mammal species or stocks.

Western—Western has planned a 208-day survey program, or 57 percent of the year (slightly more than two seasons). However, the planned survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figures 1–1 to 1–4 of Western's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 13 displays relevant information leading to impact ratings for each species resulting from Western's survey. In general, we note that although the temporal and spatial scale of the planned survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that more individuals may receive limited exposure to survey noise, versus fewer individuals receiving more intense exposure and/or for longer periods of time. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 13—MAGNITUDE AND IMPACT RATINGS, WESTERN

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
North Atlantic right whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Humpback whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Minke whale	De minimis	Low-High	De minimis	Medium	Low.
Fin whale	Low	Low	Medium	Medium	Moderate.
Sperm whale	Moderate	Moderate	High	Medium	High.
Kogia spp	Moderate	High	High	Low	Moderate.
Beaked whales	Moderate	Moderate	High	High	High.
Rough-toothed dolphin	Low	High	High	Low	Moderate.
Bottlenose dolphin	Moderate	High	High	Low	Moderate.
Clymene dolphin	De minimis	High	De minimis	Low	De minimis.
Atlantic spotted dolphin	Moderate	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	Low	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Common dolphin	Low	Low-moderate	Medium	Low	Low.
Risso's dolphin	Low	Low-moderate	Medium	Low	Low.
Pilot whales	Low	Moderate	Medium	Medium	Moderate.

TABLE 13—MAGNITUDE AND IMPACT RATINGS, WESTERN—Continued

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
Harbor porpoise	De minimis	Low	De minimis	Low	De minimis

[1] Impact rating does not indicate whether overall impact to the species or stock is negligible, but is considered with relevant contextual factors (described generally above and specifically below) in order to ultimately determine whether the effects of the specified activity on the affected species or stock are negligible.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the required mitigation described previously is critically important in order for us to make the necessary finding and it is with consideration of this mitigation that we find the take from Western's survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a moderate impact rating overall, but we expect that for two seasons (summer and fall) almost no fin whales will be present in the survey area. For the remainder of the year, it is likely that less than one quarter of the population will be present within the survey area (Roberts *et al.,* 2016), meaning that despite medium rankings for magnitude and likely consequences, these impacts would be experienced by only a small subset of the overall population. In consideration of the moderate impact rating, the likely proportion of the population that may be affected by the specified activities, and the lack of evidence that the survey area is host to important behaviors that may be disrupted, we find the take from Western's survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale and beaked whales are high and, further, consequence factors reinforce high impact ratings for both. Magnitude rating for pilot whales is medium but, similar to beaked whales, we expect that compensatory ability will be low (high consequence rating) due to presumed residency in areas targeted by the planned survey—leading to a moderate impact rating. However, regardless of impact rating, the consideration of likely consequences and contextual factors for all three taxa leads us to conclude that targeted mitigation is important to support a finding that the effects of the survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have required shutdown of the acoustic source upon observation of a beaked whale at extended distance from the source vessel. In consideration of the required mitigation, we find the take from Western's survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have required shutdown of the acoustic source upon observation of *Kogia* spp. at extended distance from the source vessel. In consideration of these factors—likely population increase and required mitigation—we find the take from Western's survey activities will have a negligible impact on *Kogia* spp.

As described in the introduction to this analysis, it is assumed that likely consequences are somewhat higher for species of mysticete whales (low-frequency hearing specialists) due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Therefore, despite de minimis magnitude ratings, we expect some consequences to individual humpback and minke whales, *i.e.,* leading to a low impact rating. However, given the minimal amount of interaction expected between these species and the survey activities, and in consideration of the overall low impact ratings, we find the take from Western's planned survey activities will have a negligible impact on the humpback whale and minke whale.

Despite medium to high magnitude ratings (with the exception of the Clymene dolphin), remaining delphinid species receive low to moderate impact ratings due to consequences relating to a lack of propensity for behavioral disruption due to airgun survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, contextually these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the survey area would likely be little affected at the population level by the specified activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2014; Hayes *et al.,* 2017; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our required mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin. We also expect that meaningful subsidiary benefit will accrue to certain species from the mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and context including required mitigation—we find the take from Western's survey activities will have a negligible impact on most remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we find the take from Western's survey activities will have a negligible impact on the Clymene dolphin and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from Western's survey activities will have a negligible impact on all affected marine mammal species or stocks.

CGG—CGG has planned an approximately 155-day survey program, or 42 percent of the year (approximately two seasons). However, the planned survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 3 of CGG's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 14 displays relevant information leading to impact ratings for each species resulting from CGG's survey. In general, we note that although the temporal and spatial scale of the planned survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that more individuals may receive limited exposure to survey noise, versus fewer individuals receiving more intense exposure and/or for longer periods of time. The nature of such potentially transitory exposure means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 14—MAGNITUDE AND IMPACT RATINGS, CGG

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating [1]
North Atlantic right whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Humpback whale	De minimis	Low-Moderate	De minimis	Medium	Low.
Minke whale	De minimis	Low-High	De minimis	Medium	Low.
Fin whale	De minimis	Low	De minimis	Medium	Low.
Sperm whale	Low	Moderate	Medium	Medium	Moderate.
Kogia spp	Low	High	High	Low	Moderate.
Beaked whales	Low	Moderate	Medium	High	Moderate.
Rough-toothed dolphin	Moderate	High	High	Low	Moderate.
Bottlenose dolphin	Low	High	High	Low	Moderate.
Clymene dolphin	High	High	High	Low	Moderate.
Atlantic spotted dolphin	Low	Moderate	Medium	Low	Low.
Pantropical spotted dolphin	Moderate	High	High	Low	Moderate.
Striped dolphin	De minimis	Low	De minimis	Low	De minimis.
Common dolphin	De minimis	Low-moderate	De minimis	Low	De minimis.
Risso's dolphin	De minimis	Low-moderate	De minimis	Low	De minimis.
Pilot whales	Low	Moderate	Medium	Medium	Moderate.
Harbor porpoise	De minimis	Low	De minimis	Low	De minimis.

[1] Impact rating does not indicate whether overall impact to the species or stock is negligible, but is considered with relevant contextual factors (described generally above and specifically below) in order to ultimately determine whether the effects of the specified activity on the affected species or stock are negligible.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the required mitigation described previously is critically important in order for us to make the necessary finding and it is with consideration of this mitigation that we find the take from CGG's survey activities will have a negligible impact on the North Atlantic right whale.

Magnitude ratings for the sperm whale and beaked whales are medium; however, consequence factors are medium and high, respectively. Magnitude rating for pilot whales is medium but, similar to beaked whales, we expect that compensatory ability will be low (high consequence rating) due to presumed residency in areas targeted by the planned survey—leading to a moderate impact rating. However, regardless of impact rating, the consideration of likely consequences and contextual factors for all three taxa leads us to conclude that targeted mitigation is important to support a finding that the effects of the survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we require shutdown of the acoustic source upon detection of a beaked whale at extended distance from the source vessel. In consideration of the required mitigation, we find the take from CGG's survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the required mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have required shutdown of the acoustic source upon observation of *Kogia* spp. at extended distance from the source vessel. In consideration of these factors—likely population increase and required mitigation—we find the take from CGG's survey activities will have a negligible impact on *Kogia* spp.

As described in the introduction to this analysis, it is assumed that likely consequences are somewhat higher for species of mysticete whales (low-frequency hearing specialists) due to the greater potential for masking impacts at longer ranges than other taxa and at frequencies that overlap a larger portion of both their hearing and vocalization ranges. Therefore, despite de minimis magnitude ratings, we expect some consequences to individual humpback, fin, and minke whales, *i.e.,* leading to a low impact rating. However, given the minimal amount of interaction expected between these species and the survey activities, and in consideration of the overall low impact ratings, we find the take from CGG's planned survey activities will have a negligible impact on the humpback whale, fin whale, and minke whale.

Despite medium to high magnitude ratings (with some exceptions), most remaining delphinid species receive low to moderate impact ratings due to consequences relating to a lack of propensity for behavioral disruption due to airgun survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, contextually these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the survey area would likely be little affected at the population level by the specified activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2014; Hayes *et al.,* 2017; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our required mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin. We also expect that meaningful subsidiary benefit will accrue to certain species from the mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins). In consideration of these factors—overall impact ratings and context including required mitigation—we find the take from CGG's survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, and Clymene dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we find the take from CGG's survey activities will have a negligible impact on the common dolphin, striped dolphin, Risso's dolphin, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from CGG's survey activities will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers Analyses

The MMPA does not define ''small numbers.'' NMFS's and the U.S. Fish and Wildlife Service's 1989 implementing regulations defined small numbers as a portion of a marine mammal species or stock whose taking would have a negligible impact on that species or stock. This definition was invalidated in *Natural Resources Defense Council* v. *Evans,* 279 F.Supp.2d 1129 (2003) (N.D. Cal. 2003), based on the court's determination that the regulatory definition of small numbers was improperly conflated with the regulatory definition of ''negligible impact,'' which rendered the small numbers standard superfluous. As the court observed, ''the plain language indicates that small numbers is a separate requirement from negligible impact.'' Since that time, NMFS has not applied the definition found in its regulations. Rather, consistent with Congress' pronouncement that small numbers is not a concept that can be expressed in absolute terms (House Committee on Merchant Marine and Fisheries Report No. 97–228 (September 16, 1981)), NMFS makes its small numbers findings based on an analysis of whether the number of individuals authorized to be taken annually from a specified activity is small relative to the stock or population size. The Ninth Circuit has upheld a similar approach. See *Center for Biological Diversity* v. *Salazar,* No. 10–35123, 2012 WL 3570667 (9th Cir. Aug. 21, 2012). However, we have not historically indicated what we believe the upper limit of small numbers is.

To maintain an interpretation of small numbers as a proportion of a species or stock that does not conflate with negligible impact, we use the following framework. A plain reading of ''small'' implies as corollary that there also could be ''medium'' or ''large'' numbers of animals from the species or stock taken. We therefore use a simple approach that establishes equal bins corresponding to small, medium, and large proportions of the population abundance.

NMFS's practice for making small numbers determinations is to compare the number of individuals estimated and authorized to be taken (often using estimates of total instances of take, without regard to whether individuals are exposed more than once) against the best available abundance estimate for that species or stock. We note, however, that although NMFS's implementing regulations require applications for incidental take to include an estimate of the marine mammals to be taken, there is nothing in paragraphs (A) or (D) of section 101(a)(5) that requires NMFS to quantify or estimate numbers of marine mammals to be taken for purposes of evaluating whether the number is small. (See *CBD* v. *Salazar.*) While it can be challenging to predict the numbers of individual marine mammals that will be taken by an activity (again, many models calculate instances of take and are unable to account for repeated exposures of individuals), in some cases we are able to generate a reasonable estimate utilizing a combination of quantitative tools and qualitative information. When it is possible to predict with relative confidence the number of individual marine mammals of each species or stock that are likely to be taken, the small numbers determination should be based directly upon whether or not these estimates exceed one third of the stock abundance. In other words, consistent with past practice, when the estimated number of individual animals taken (which may or may not be assumed as equal to the total number of takes, depending on the available information) is up to, but not greater than, one third of the species or stock abundance, NMFS will determine that the numbers of marine mammals taken of a species or stock are small.

Another circumstance in which NMFS considers it appropriate to make a small numbers finding is in the case of a species or stock that may potentially be taken but is either rarely encountered or only expected to be taken on rare occasions. In that circumstance, one or two assumed encounters with a group of animals (meaning a group that is traveling together or aggregated, and thus exposed to a stressor at the same approximate time) should reasonably be considered small numbers, regardless of consideration of the proportion of the stock (if known), as rare encounters resulting in take of one or two groups should be considered small relative to the range and distribution of any stock.

In summary, when quantitative take estimates of individual marine mammals are available or inferable through consideration of additional factors, and the number of animals taken is one third or less of the best available abundance estimate for the species or stock, NMFS considers it to be of small numbers. NMFS may appropriately find that one or two predicted group encounters will result in small numbers of take relative to the range and distribution of a species, regardless of the estimated proportion of the abundance.

Please see Table 15 for information relating to the basis for our small numbers analyses. For the sei whale, Bryde's whale, blue whale, northern bottlenose whale, Fraser's dolphin, melon-headed whale, false killer whale, pygmy killer whale, killer whale, spinner dolphin, and white-sided dolphin, we authorize take resulting from a single exposure of one group of each species or stock, as appropriate (using average group size), for each applicant. We believe that a single incident of take of one group of any of these species represents take of small numbers for that species. Therefore, for each applicant, based on the analyses contained herein of their specified activity, we find that small numbers of marine mammals will be taken for each of these 11 affected species or stocks for each specified activity. We do not discuss these 11 species further in the applicant-specific analyses that follow.

TABLE 15—TOTAL INSTANCES OF TAKE AUTHORIZED [1] AND PROPORTION OF BEST ABUNDANCE ESTIMATE [2]

Common name	Abundance estimate [4]	Spectrum [8]		TGS [3]		ION		Western		CGG	
		Take	%	Take	%	Take	%	Take	%	Take	%
North Atlantic right whale	458	6	1	9	2	2	<1	4	1	2	<1
Humpback whale	[5] 2,002	45	2	60	3	7	<1	49	2	7	<1
Minke whale	20,741	423	2	212	1	12	<1	100	<1	128	1
Fin whale	[5] 6,582	337	5	1,144	17	5	<1	537	8	49	1
Sperm whale	[5] 9,649	1,077	11	3,579	37	16	<1	1,941	20	1,304	14
Kogia spp	3,785	205	5	1,221	32	30	1	572	15	240	6
Beaked whales	[6] 25,284	3,357	13	12,072	48	490	2	4,960	20	3,511	14
Rough-toothed dolphin	[7] 845	201	24	261	31	14	2	123	15	177	21
Bottlenose dolphin	[5] 149,785	37,562	25	40,595	27	2,599	2	23,600	16	9,063	6
Clymene dolphin	[7] 24,018	6,459	27	821	3	252	1	391	2	6,382	27
Atlantic spotted dolphin	[6] 107,100	16,926	16	41,222	38	568	1	18,724	17	6,596	6
Pantropical spotted dolphin	[7] 7,217	1,632	23	1,470	20	78	1	690	10	1,566	22
Striped dolphin	[6] 158,258	8,022	5	23,418	15	162	<1	8,845	6	6,328	4
Common dolphin	173,486	11,087	6	52,728	30	372	<1	20,683	12	6,026	3
Risso's dolphin	[5] 19,437	755	4	3,241	17	90	<1	1,608	8	809	4
Globicephala spp	[6] 34,531	2,765	8	8,902	26	199	1	4,682	14	1,964	6
Harbor porpoise	[5] 50,406	627	1	325	1	21	<1	155	<1	30	<1

[1] Total take authorized includes take by Level A and Level B harassment. Please see Table 6 for details.
[2] Species for which take resulting from a single exposure of one group of each species or stock are not included in this table. Please see discussion preceding this table.
[3] Additional analysis was conducted to specify the number of individuals taken for TGS. Please see discussion below and Table 16.
[4] Best abundance estimate; please see discussion under "Description of Marine Mammals in the Area of the Specified Activities." For most taxa, the best abundance estimate for purposes of comparison with take estimates is considered here to be the model-predicted abundance (Roberts *et al.,* 2016). For these taxa, model-predicted abundances within the EEZ and estimates for the portion of the specific geographic region beyond the EEZ are combined to obtain the total abundance. For those taxa where a density surface model was produced, maximum monthly abundance was considered appropriate for some, and for others the maximum mean seasonal abundance was used as a precaution. For those taxa where only a stratified model was produced, only mean annual abundance is available. For several taxa, other abundance estimates were deemed most appropriate, as described previously in this notice.
[5] Maximum monthly abundance.
[6] Maximum seasonal abundance.
[7] Mean annual abundance.
[8] Small numbers analyses were completed prior to receipt of a modified survey plan from Spectrum and subsequent revision of authorized take numbers reflecting the modification. Here, we retain the original take estimates for Spectrum in context of the small numbers analysis described below. Please see "Spectrum Survey Plan Modification," below, for additional information describing the modified survey plan, findings made in context of the analysis presented below, and authorized take for Spectrum (Table 17).

As discussed previously, the MMPA does not define small numbers. NMFS compares the estimated numbers of individuals expected to be taken (when available; often take estimates are presented as estimated instances of take) to the most appropriate estimation of the relevant species or stock size in our determination of whether an authorization is limited to small numbers of marine mammals, *i.e.,* less than one-third of the most appropriate abundance estimate (Table 15). In the Notice of Proposed Authorization, we proposed to limit the authorization of take to approximately one-third of the most appropriate stock abundance estimate, assuming no other relevant factors that provide more context for the estimate (*e.g.,* information that the take estimate numbers represent instances of multiple exposures of the same animals). Further, we proposed that, in order to limit actual take to this proportion of estimated stock abundance, we would require monthly reporting from those applicants with predicted exposures of any species exceeding this threshold. Those interim reports would include corrected numbers of marine mammals "taken" and, upon reaching the pre-determined take threshold, any issued IHA would be withdrawn.

However, as discussed elsewhere in this notice (including in "Comments and Responses"), we received numerous comments criticizing this approach. Notably, comments indicated that the pre-determined threshold (described in our Notice of Proposed IHAs as30 percent) was arbitrary and not rooted in any meaningful biological consideration, and that the proposal—*i.e.,* to limit the actual take authorization to less than what was estimated in terms of potential exposures, require a novel reporting scheme, and potentially withdraw IHAs if the threshold was crossed—was impracticable. However, in this Notice we have more fully described and clarified our approach to small numbers, and used this approach for issuance of the IHAs. As a result of the concerns presented by applicants and commenters regarding the justification for and practicability of our proposal, we reconsidered the available information and re-evaluated and refined our small numbers analyses, as described next. With regard to use of the most appropriate population abundance (Table 15), please see additional discussion under ''Description of Marine Mammals in the Area of the Specified Activities.''

The number of exposures presented in Table 15 represent the estimated number of instantaneous instances in which an individual from each species or stock would be exposed to sound fields from airgun surveys at or above the 160 dB rms threshold. They do not necessarily represent the estimated number of individuals of each species that would be exposed, nor do they provide information on the duration of the exposure. In this case, the likelihood that any individual of a given species is exposed more than once is low due to the movement of both the vessels and the animals themselves. That said, for species where the estimated exposure numbers are higher compared to the population abundance, we assume that some individuals may be exposed more than once, meaning the exposures given in Table 15 overestimate the numbers of individuals that would be exposed. Applicant-specific analyses follow.

Spectrum—The total amount of taking assessed for all affected stocks on the basis of Spectrum's original survey plan ranges from 1 to 27 percent of the most appropriate population abundance estimate, and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). These proportions are considered overestimates with regard to the small numbers findings, as they likely represent multiple exposures of some of the same individuals for some stocks. However, we do not have sufficient information on which to base an estimate of individuals taken versus instances of take. Please see ''Spectrum Survey Plan Modification,'' below, for additional information describing the modified survey plan, findings made in context of the analysis presented here, and authorized take for Spectrum (Table 17).

Based on the analysis contained herein of Spectrum's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

TGS—The total amount of taking (in consideration of instances of take) authorized for a majority of affected stocks ranges from 1 to 32 percent of the most appropriate population abundance estimate, and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). The total amount of taking (in consideration of instances of take) authorized for the sperm whale, beaked whales, and the Atlantic spotted dolphin is higher than the threshold. In this case, we have information available to distinguish between an estimate of individuals taken versus instances of take.

TGS is the only applicant that provided an analysis of estimated individuals exposed versus instances of exposure (see Table 6–5 of TGS's application). As described in the introduction to this section, the number of individuals taken (versus total instances of take), is the relevant metric for comparison to population abundance in a small numbers analysis. We note, though, that total instances of take are routinely used to evaluate small numbers when data to distinguish individuals is not available, and we further note the conservativeness of the assumption, as the number of total instances of take equates to the highest possible number of individuals. For example, in some cases the total number of takes may exceed the number of individuals in a population abundance, meaning there are multiple exposures of at least some animals.

We do not typically attempt to quantitatively assess this comparison of individuals taken versus instances of take when we do not have direct information regarding individuals exposed (*e.g.,* we know that only a specific sub-population is potentially exposed or we know that uniquely identified individuals are exposed); therefore, we did not initially make use of the information provided by TGS in their application, instead proposing the take cap and reporting scheme described in the introduction to this section. As described above, commenters indicated that our proposed approach was flawed and, therefore, we further evaluated the available information.

The conceptual approach to the analysis involves a comparison of total ensonified area to the portion of that total area that is ensonified more than once. For TGS, 84 percent of the total ensonified area is area that is ensonified more than once, *i.e.,* ''overlap.'' In a static density model, the same animals occur in the overlap regardless of the time elapsed between the first and second exposure. If animals are static in space in the model, they are re-exposed in the model every time there is overlap. When overlap is counted toward the evaluation of small numbers (*i.e.,* percent of the abundance that is ''taken''), it effectively raises the total abundance possible in the model, creating a situation in which one could theoretically take more than the abundance to which one is comparing. This does not make sense from the perspective of comparing numbers of individuals taken to total abundance. Although portions of the overlap may be ensonified more than twice, we conservatively assume a maximum of one repeat ensonification.

The number of individuals potentially taken (versus total incidents of take) can then be determined using the following equation: (Numerical Output of the Model) − (0.84 * Numerical Output of the Model) + 0.5 * (0.84 * Numerical Output of the Model). This may be simplified as: 0.58 * Numerical Output of the Model. ''Numerical output of the model'' refers to the estimated total incidents of take. As we stated in the introduction to this section, where there are relatively few total takes, it is more likely that all takes occur to new individuals, though this is dependent on actual distribution and movement of animals in relation to the survey vessel. While there is no clear threshold as to what level of total takes indicates a likelihood of repeat taking of individuals, here we assume that total taking of a moderate or high magnitude (consistent with our approach to assessing magnitude in the negligible impact analysis framework; see ''Negligible Impact Analyses and Determinations''), *i.e.,* greater than 15 percent, is required for repeat taking of individuals to be likely and applied this analysis only to those stocks.

TABLE 16—ANALYSIS OF INDIVIDUALS TAKEN VERSUS TOTAL TAKES, TGS

Common name	Abundance estimate	Total take	%	Individuals taken	%	Individuals taken once	Individuals taken twice
Fin whale	6,582	1,144	17	664	10	480	184

TABLE 16—ANALYSIS OF INDIVIDUALS TAKEN VERSUS TOTAL TAKES, TGS—Continued

Common name	Abundance estimate	Total take	%	Individuals taken	%	Individuals taken once	Individuals taken twice
Sperm whale	9,649	3,579	37	2,076	22	1,503	573
Kogia spp.	3,785	1,221	32	708	19	513	195
Beaked whales	25,284	12,072	48	7,002	28	5,070	1,932
Rough-toothed dolphin	845	261	31	151	18	110	42
Bottlenose dolphin	149,785	40,595	27	23,545	16	17,050	6,495
Atlantic spotted dolphin	107,100	41,222	38	23,909	22	17,313	6,596
Pantropical spotted dolphin	7,217	1,470	20	853	12	617	235
Common dolphin	173,486	52,728	30	30,582	18	22,146	8,436
Risso's dolphin	19,437	3,241	17	1,880	10	1,361	519
Globicephala spp.	34,531	8,902	26	5,163	15	3,739	1,424

This approach also allows us to estimate the number of individuals that we assume to be taken once and the number assumed to be taken twice. As we noted previously, although it is possible that some individuals may be taken more than twice, we assume a maximum of one repeat ensonification (a conservative assumption in this small numbers analysis context). For example, if there are 1,144 total takes of fin whales, with 664 total individuals taken, and where:

a = number of animals with single take; b = number of animals with double take,

then: $a + b = 664$ and $2*a + b = 1{,}144$ and, therefore, $2*a + 664 - a = 1{,}144$. In this example for fin whales, we assume that 480 individuals are taken twice and 184 individuals are taken once. (Note that values given in Table 16 for individuals taken once versus twice may not sum to the value given for total individuals taken due to rounding.)

In summary, for those stocks for which we assume each authorized take represents a new individual, the total amount of taking authorized ranges from 1 to 15 percent of the most appropriate population abundance estimate (Table 15), and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). For those stocks for which we assessed the number of expected individuals taken, the total amount of taking authorized ranges from 10 to 28 percent of the most appropriate population abundance estimate (Table 16), and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). Based on the analysis contained herein of TGS's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

ION—The total amount of taking authorized for all affected stocks ranges from less than 1 to 4 percent of the most appropriate population abundance estimate, and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate).

Based on the analysis contained herein of ION's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

Western—The total amount of taking authorized for all affected stocks ranges from less than 1 to 20 percent of the most appropriate population abundance estimate, and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). These proportions are considered overestimates with regard to the small numbers findings, as they likely represent multiple exposures of some of the same individuals for some stocks. However, we do not have sufficient information on which to base an estimate of individuals taken versus instances of take.

Based on the analysis contained herein of Western's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

CGG—The total amount of taking authorized for all affected stocks ranges from less than 1 to 27 percent of the most appropriate population abundance estimate, and is therefore less than the appropriate small numbers threshold (*i.e.,* one-third of the most appropriate population abundance estimate). These proportions are considered overestimates with regard to the small numbers findings, as they likely represent multiple exposures of some of the same individuals for some stocks. However, we do not have sufficient information on which to base an estimate of individuals taken versus instances of take.

Based on the analysis contained herein of CGG's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by these actions. Therefore, relevant to the Spectrum, TGS, ION, CGG, and Western IHAs, we have determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Spectrum Survey Plan Modification

As described earlier in this notice, Spectrum's proposed survey plan described in our Notice of Proposed IHAs included ~21,635 km of survey line (see Figure 1 of Spectrum's application). However, on June 4, 2018, Spectrum notified NMFS of a modification to their survey plan. NMFS's understanding is this modification is based on a voluntary collaborative effort between Spectrum and TGS, another IHA applicant, to reduce duplication of effort and expense. Subsequently, on June 26, 2018, Spectrum submitted a final, revised modified survey plan. The modified survey plan occurs roughly within the same survey ''footprint'' and consists of ~13,766 km of survey line (see Figure provided on p. 2 of Spectrum's letter notifying us of their intent to modify their survey plan). Therefore, the modified survey plan represents an approximate 36 percent decrease in total survey line. With this reduction in survey effort, Spectrum now estimates that the survey plan will require approximately 108 days of operations (previously estimated as 165 days of operations).

The changes to the survey plan, in summary, include the following: (1) Rotated the survey grid by approximately 5 degrees; (2) trimmed lines from most time-area restrictions; (3) removed certain lines; and (4) shifted certain lines. The figure provided on p. 3 of Spectrum's letter notifying us of their intent to modify their survey plan shows an overlay of the modified survey plan (red lines) with the previously proposed survey plan (black lines).

Following receipt of the notification from Spectrum, we evaluated the potential effect of the change through use of a spatial analysis. In summary, we compared marine mammal densities within assumed ensonified areas associated with the original survey tracklines and associated with the modified survey tracklines. This allowed us to produce a ratio of the expected takes by Level B harassment from the modified survey to the original survey and, therefore, to evaluate the degree of change in terms of take. In conducting this evaluation, we used mean marine mammal densities over the 21 modeling areas or zones (extracted from Roberts *et al.* (2016)), as described previously in ''Estimated Take.'' Detailed steps of the evaluation are as follows:

- Obtain trackline lengths for each relevant season and zone for proposed (*i.e.,* the original) and modified Spectrum tracklines;
- Multiply trackline lengths by mean buffer widths for each zone to get area surveyed for both proposed and modified tracklines;
- Multiply these areas surveyed within each zone by each species density to get raw take by zone for proposed and modified tracklines for each species (accounting for implementation of North Atlantic right whale time-area restriction, in effect out to 90 km from shore from November through April);
- Create ratio of the expected take from the modified tracklines to the proposed tracklines; and
- Multiply this ratio by the originally proposed take numbers to obtain revised take numbers.

However, note that we did not follow this process (*i.e.,* developing a ratio for use in ''correcting'' the original take number) for North Atlantic right whales. Instead, we performed an identical analysis as that described previously in ''Description of Exposure Estimates—North Atlantic Right Whale,'' producing a new take estimate for this species (Table 17).

The results of this evaluation in terms of take numbers are shown in Table 17. Our analysis of the potential for auditory injury of mid-frequency cetaceans remains the same and, therefore, the amount of take by Level A harassment for these species is unchanged. For low-frequency cetaceans, the reduction in total survey line reduces the likely potential that take by Level A harassment would occur. The total amount of survey line in the modified survey plan is similar to that proposed by ION and, in fact, Spectrum's estimated auditory injury zone for low-frequency cetaceans is slightly smaller than ION's. Therefore, we adopt the logic presented previously for ION in revising the authorized take by Level A harassment for low-frequency cetaceans (see ''Estimated Take'' for more detail). For high-frequency cetaceans, we revise the take authorized by Level A harassment according to the same procedure described previously in ''Estimated Take.'' For rarely occurring species (*i.e.,* sei whale, Bryde's whale, blue whale, northern bottlenose whale, Fraser's dolphin, melon-headed whale, false killer whale, pygmy killer whale, killer whale, spinner dolphin, and white-sided dolphin), we retain our take authorization of a single exposure of one group of each species or stock, as appropriate (using average group size). Therefore, our original analysis is retained for these species or stocks and we do not address them here.

TABLE 17—TAKE ESTIMATES ASSOCIATED WITH PROPOSED AND MODIFIED TRACKLINES AND PROPORTION OF BEST ABUNDANCE ESTIMATE

Common name	Proposed tracklines			Modified tracklines			Reduction in total authorized take (%)
	Level A	Level B	%	Level A	Level B	%	
North Atlantic right whale	0	6	1	0	2	<1	67
Humpback whale	4	41	2	2	19	1	53
Minke whale	4	419	2	2	252	1	40
Fin whale	4	333	5	2	163	3	51
Sperm whale	0	1,077	11	0	684	7	36
Kogia spp.	5	200	5	3	125	3	38
Beaked whales	0	3,357	13	0	2,291	9	32
Rough-toothed dolphin	0	201	24	0	117	14	42
Common bottlenose dolphin	0	37,562	25	0	14,938	10	60
Clymene dolphin	0	6,459	27	0	4,045	17	37
Atlantic spotted dolphin	0	16,926	16	0	8,466	8	50
Pantropical spotted dolphin	0	1,632	23	0	1,017	14	38
Striped dolphin	0	8,022	5	0	5,144	3	36
Common dolphin	0	11,087	6	0	6,008	3	46
Risso's dolphin	0	755	4	0	414	2	45
Pilot whales	0	2,765	8	0	1,591	5	42
Harbor porpoise	16	611	1	8	355	1	42

Total authorized take for all species shown in Table 17 decreased. The modified survey plan largely remains within the footprint of the proposed survey plan, with the only notable change being the reduction of total survey line and the removal of survey line from certain areas within that footprint, including, importantly, the total removal of lines from within our designated seasonal ''Hatteras and North'' time-area restriction along the shelf break off of Cape Hatteras (Area #4; Figure 4). This area constitutes some of the most important marine mammal habitat within the specific geographical region.

As previously described in ''Negligible Impact Analyses and Determinations,'' we have determined on the basis of Spectrum's proposed survey plan that the likely effects of the (previously described) specified activity on marine mammals and their habitat due to the total marine mammal take from Spectrum's survey activities would have a negligible impact on all affected marine mammal species or stocks. Based on our evaluation of Spectrum's modified survey plan, we affirm that this conclusion remains valid, and we authorize the revised take numbers shown in Table 17. Similarly, as previously described in ''Small Numbers Analyses,'' we have determined that the take of marine mammals incidental to Spectrum's specified activity would represent small numbers of marine mammals relative to the population sizes of the affected species or stocks. All authorized take numbers for Spectrum have decreased from what we considered in that small numbers analysis and, therefore, we affirm that this conclusion remains valid.

In conclusion, we affirm and restate our findings for Spectrum:

- All previously described mitigation, monitoring, and reporting requirements remain the same. Based on our evaluation of these measures, we have determined that the required mitigation measures provide the means of effecting the least practicable adverse impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.
- With regard to the negligible impact analysis, we refer the reader to the analysis presented previously. In addition, our evaluation of the modified survey plan shows (1) total survey line is reduced by approximately one-third; (2) the modified survey plan does not include new areas not originally considered in our assessment of the effects of Spectrum's specified activity; (3) Spectrum has removed lines from portions of the survey area, including important habitat for marine mammals; and (4) authorized take for all taxa has been reduced. Therefore, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, we find that the total marine mammal take from Spectrum's survey activities will have a negligible impact on the affected marine mammal species or stocks.
- With regard to the small numbers analysis, we refer the reader to the analysis presented previously. Our evaluation of Spectrum's modified survey plan results in a reduction of authorized take for all taxa. Therefore, based on the analysis contained herein of Spectrum's specified activity, the required monitoring and mitigation measures, and the anticipated take of marine mammals, we find that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

Endangered Species Act (ESA)

Section 7 of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must consult with NMFS for actions that may affect species under NMFS's jurisdiction listed as threatened or endangered or critical habitat designated for such species.

At the conclusion of consultation, the consulting agency provides an opinion stating whether the Federal agency's action is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat.

NMFS's issuance of IHAs to the five companies is subject to the requirements of Section 7 of the ESA. Therefore, NMFS's Office of Protected Resources (OPR), Permits and Conservation Division requested initiation of a formal consultation with the NMFS OPR, ESA Interagency Cooperation Division on the proposed issuance of IHAs on June 5, 2017. The formal consultation concluded in November 2018 and a final Biological Opinion (BiOp) was issued. The BiOp found that the Permits and Conservation Division's proposed action of issuing the five IHAs is not likely to jeopardize the continued existence or recovery of blue whales, fin whales, North Atlantic right whales, sei whales, or sperm whales. Furthermore, the BiOp found that the proposed action is also not likely to adversely affect designated critical habitat for North Atlantic right whales.

National Environmental Policy Act

In 2014, the BOEM produced a final Programmatic Environmental Impact Statement (PEIS) to evaluate the direct, indirect, and cumulative impacts of geological and geophysical survey activities on the Mid- and South Atlantic OCS, pursuant to requirements of NEPA. These activities include geophysical surveys in support of hydrocarbon exploration, as were proposed in the MMPA applications before NMFS. The PEIS is available at: *www.boem.gov/Atlantic-G-G-PEIS/.* NOAA, through NMFS, participated in preparation of the PEIS as a cooperating agency due to its legal jurisdiction and special expertise in conservation and management of marine mammals, including its responsibility to authorize incidental take of marine mammals under the MMPA.

NEPA, Council on Environmental Quality (CEQ) regulations, and NOAA's NEPA implementing procedures (NOAA Administrative Order (NAO) 216–6A) encourage the use of programmatic NEPA documents and tiering to streamline decision-making in staged decision-making processes that progress from programmatic analyses to site-specific reviews. NMFS reviewed the Final PEIS and determined that it meets the requirements of the CEQ regulations (40 CFR part 1500–1508) and NAO 216–6A. NMFS further determined, after independent review, that the Final PEIS satisfied NMFS's comments and suggestions in the NEPA process. In our Notice of Proposed IHAs, we stated our intention to adopt BOEM's analysis in order to assess the impacts to the human environment of issuance of the subject IHAs, and that we would review all comments submitted in response to the notice as we completed the NEPA process, including a final decision of whether to adopt BOEM's PEIS and sign a Record of Decision related to issuance of IHAs. Following review of public comments received, we confirmed that it would be appropriate to adopt BOEM's analysis in order to support our assessment of the impacts to the human environment of issuance of the subject IHAs. Therefore, on February 23, 2018, NMFS signed a Record of Decision for the following purposes: (1) To adopt the Final PEIS to support NMFS's analysis associated with issuance of incidental take authorizations pursuant to sections 101(a)(5)(A) or (D) of the MMPA and the regulations governing the taking and importing of marine mammals (50 CFR part 216), and (2) in accordance with 40 CFR 1505.2, to announce and explain the basis for our decision to review and potentially issue incidental take authorizations under the MMPA on a case-by-case basis, if appropriate.

Following review of public comment, we also determined that conducting additional NEPA review and preparing a tiered Environmental Assessment (EA) is appropriate to analyze environmental impacts associated with NMFS's issuance of separate IHAs to five different applicants. Through the description and analysis of NMFS's activity provided in the EA as well as the analyses incorporated by reference from the Notice of Proposed IHAs and BOEM's PEIS, NMFS found that authorizing take of marine mammals by issuing individual IHAs to the five applicants will not result in significant direct, indirect, or cumulative impacts to the human environment. Accordingly, NMFS determined that issuance of IHAs to the five applicants would not significantly impact the quality of the human environment and signed a Finding of No Significant Impact (FONSI). NMFS's ROD, EA, and FONSI are available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-atlantic.*

Authorizations

As a result of these determinations, NMFS has issued five separate IHAs to the aforementioned applicant companies for conducting the described geophysical survey activities in the Atlantic Ocean within the specific geographic region, incorporating the previously mentioned mitigation, monitoring, and reporting requirements.

Dated: November 30, 2018.

Donna S. Wieting,

Director, Office of Protected Resources, National Marine Fisheries Service.

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