DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 217

[Docket No. 201204–0326]

RIN 0648–BB38

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico

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

ACTION: Final rule.

SUMMARY: NMFS, upon request from the Bureau of Ocean Energy Management (BOEM), hereby issues regulations to govern the unintentional taking of marine mammals incidental to geophysical survey activities conducted by oil and gas industry operators, and those persons authorized to conduct activities on their behalf (collectively ''industry operators''), in Federal waters of the U.S. Gulf of Mexico (GOM) over the course of five years. These regulations, which allow for the issuance of Letters of Authorization (LOA) to industry operators for the incidental take of marine mammals during the described activities and specified timeframe, prescribe the permissible methods of taking and other means of effecting the least practicable adverse impact on marine mammal species or stocks and their habitat, as well as requirements pertaining to the monitoring and reporting of such taking.

DATES: Effective from April 19, 2021 through April 19, 2026.

ADDRESSES: Electronic copies of the application 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-gulf-mexico.* In case of problems accessing these documents, please call the contact listed below.

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

SUPPLEMENTARY INFORMATION:

Purpose and Need for Regulatory Action

These incidental take regulations (ITR) establish a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) to allow for the authorization of take of marine mammals incidental to the conduct of geophysical survey activities in the GOM. We received a petition from BOEM requesting the regulations. Subsequent LOAs may be requested by industry operators. Take is expected to occur by Level A and/or Level B harassment incidental to use of active acoustic sound sources. Please see the Background section below for definitions of harassment.

Legal Authority for the Action

Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1371(a)(5)(A)) directs the Secretary of Commerce 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 specified geographical region for up to five years if, after notice and public comment, the agency makes certain findings and issues regulations that set forth permissible methods of taking pursuant to that activity and other means of effecting the ''least practicable adverse impact'' on the affected species or stocks and their habitat (see the discussion below in the Mitigation section), as well as monitoring and reporting requirements. Section 101(a)(5)(A) of the MMPA and the implementing regulations at 50 CFR part 216, subpart I, provide the legal basis for issuing this rule containing the regulations, and for any subsequent LOAs. As directed by this legal authority, the regulations contain mitigation, monitoring, and reporting requirements.

Summary of Major Provisions Within the Regulations

Following is a summary of the major provisions of these regulations regarding geophysical survey activities. These measures include:

- Standard detection-based mitigation measures, including use of visual and acoustic observation to detect marine mammals and shut down acoustic sources in certain circumstances;
- A time-area restriction designed to avoid effects to bottlenose dolphins in times and places believed to be of particular importance;
- Vessel strike avoidance measures; and
- Monitoring and reporting requirements.

These incidental take regulations govern and allow for the subsequent issuance of letters of authorization for the take of marine mammals incidental to the specified activity described in this Notice, within the upper bounds of take that was evaluated for this rule, and prescribe measures for mitigation, monitoring, and reporting. They do not preclude a U.S. citizen from applying for an incidental take authorization for a specified activity with different parameters or required measures through a separate request and process.

Background

Section 101(a)(5)(A) 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 specified geographical region if certain findings are made, regulations are issued, and notice is provided to the public.

An authorization for incidental taking shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and 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 Request

On October 17, 2016, BOEM submitted a revised petition [1] to NMFS for rulemaking under section 101(a)(5)(A) of the MMPA to authorize take of marine mammals incidental to conducting geophysical surveys during

[1] In the notice of proposed rulemaking (83 FR 29212; June 22, 2018), NMFS provided a brief history of prior petitions received from BOEM's predecessor agencies.

oil and gas industry exploration and development activities in the GOM. This revised petition was deemed adequate and complete based on NMFS' implementing regulations at 50 CFR 216.104.

On December 8, 2016 (81 FR 88664), we published a notice of receipt of the petition in the **Federal Register**, requesting comments and information related to the request. This 30-day comment period was extended to January 23, 2017 (81 FR 92788), for a total review period of 45 days. The comments and information received during this public review period informed development of the proposed ITR, and all comments received are available online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.*

In August 2017, BOEM produced a final Programmatic Environmental Impact Statement (PEIS) to evaluate potential significant environmental effects of geological and geophysical (G&G) activities on the Outer Continental Shelf (OCS) of the GOM, pursuant to the National Environmental Policy Act (NEPA). The PEIS is available online at: *www.boem.gov/Gulf-of-Mexico-Geological-and-Geophysical-Activities-Programmatic-EIS/.* NOAA participated as a cooperating agency in the development of the PEIS.

NMFS published a notice of proposed rulemaking in the **Federal Register** for a 60-day public review on June 22, 2018 (83 FR 29212). The comments and information received during this public review period informed development of the final ITR, and NMFS has responded to all comments received (see Comments and Responses).

On February 24, 2020, BOEM submitted a notice to NMFS of its ''updated proposed action and action area for the ongoing [ITR] process[.]'' This update consisted of removal of the area currently under a Congressional leasing moratorium under the Gulf of Mexico Energy Security Act (GOMESA) (Pub. L. 109–432, § 104) from consideration in the ITR. BOEM stated in its notice to NMFS that G&G activities are not likely to be proposed within the area subject to the leasing moratorium during the 5-year period of effectiveness for the ITR and, therefore, that the ''number, type, and effects of any such proposed G&G activities are simply too speculative and uncertain for BOEM to predict or meaningfully analyze.'' These Congressional leasing restrictions are in place until June 30, 2022. Based on this updated scope, BOEM on March 26, 2020, submitted revised projections of expected activity levels and corresponding changes to modeled acoustic exposure numbers. BOEM's notice and updated information are available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.* These changes are addressed as appropriate throughout this final ITR. On September 8, 2020, the President effectively extended this moratorium through withdrawal under the Outer Continental Shelf Lands Act (OCSLA) of the same area covered by the GOMESA moratorium from disposition by leasing for 10 years, beginning on July 1, 2022, and ending on June 30, 2032.

Geophysical surveys are conducted in support of hydrocarbon exploration and development in the GOM, typically by companies that provide such services to the oil and gas industry. Broadly, these surveys include (1) deep penetration surveys using large airgun arrays as the acoustic source; (2) shallow penetration surveys using a small airgun array, single airgun, or similar systems as the acoustic source; and (3) high-resolution surveys, which may use a variety of acoustic sources. Generally speaking, these surveys may occur within Federal territorial waters and waters of the U.S. Exclusive Economic Zone (EEZ) (*i.e.,* to 200 nautical miles (nmi)) within the GOM, and corresponding with BOEM's GOM OCS planning areas (*i.e.,* Western Planning Area (WPA), Central Planning Area (CPA), Eastern Planning Area (EPA)). The use of these acoustic sources is expected to produce underwater sound at levels that have the potential to result in harassment of marine mammals. Cetacean species with the potential to be present in the GOM are described below (see Table 4).

These regulations establish a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) and NMFS' implementing regulations (50 CFR 216.101 *et seq.*) to allow for the authorization, through LOAs, of take of marine mammals incidental to the conduct of geophysical surveys for oil and gas activities in the GOM. The regulations are effective for five years.

Description of the Specified Activity

Overview

The specified activity consists of geophysical surveys conducted by industry operators for a variety of reasons related to hydrocarbon exploration, development, and production. These operators are typically companies that provide geophysical services, such as data acquisition and processing, to the oil and gas industry, including exploration and production companies. The petition describes a five-year period of geophysical survey activity and provides estimates of the amount of effort by survey type and location. BOEM's PEIS (BOEM, 2017) describes a range of potential survey effort. The levels of effort in the petition (which form the basis for the modeling effort described later in the Estimated Take section) were the high-end estimates. Following BOEM's update of the petition's geographic scope, these estimates were revised accordingly. Actual total amounts of effort (including by survey type and location) would not be known in advance of receiving LOA requests from industry operators, but take in excess of what is analyzed for this rulemaking would not be authorized. As noted above, BOEM has updated the scope of the specified activity/specified geographical region by removing the area currently under leasing moratorium through GOMESA from consideration. The removed area largely covers the EPA, including areas in which NMFS had proposed time-area restrictions as mitigation, but also includes a portion of the CPA. Applicants seeking authorization for take of marine mammals incidental to survey activities within the GOMESA area during the 5-year period of effectiveness for this rule will need to pursue a separate MMPA incidental take authorization. See Figures 1 and 2.

Geophysical surveys are conducted to obtain information on marine seabed and subsurface geology for a variety of reasons, including to: (1) Obtain data for hydrocarbon and mineral exploration and production; (2) aid in siting of oil and gas structures, facilities, and pipelines; (3) identify possible seafloor or shallow depth geologic hazards; and (4) locate potential archaeological resources and benthic habitats that should be avoided. In addition, geophysical survey data inform Federal government decisions. For example, BOEM uses such data for resource estimation and bid evaluation to ensure that the government receives a fair market value for OCS leases, as well as to help to evaluate worst-case discharge for potential oil-spill analysis and to evaluate sites for potential hazards prior to drilling.

Deep penetration seismic surveys using airgun arrays as an acoustic source (sound sources are described in the ''Detailed Description of Activities'' section) are a primary method of obtaining geophysical data used to characterize subsurface structure. These surveys are designed to illuminate deeper subsurface structures and formations that may be of economic interest as a reservoir for oil and gas exploitation. 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 shallow penetration or high resolution geophysical (HRG) survey that may be intended to evaluate shallow subsurface formations or the seafloor itself (*e.g.,* for hazards).

Deep penetration surveys may be two-dimensional (2D) or three-dimensional (3D) (see Figure 1–2 of the petition), and there are a variety of survey methodologies designed to provide the specific data of interest. 2D surveys are designed to acquire data over large areas (thousands of square miles) in order to screen for potential hydrocarbon prospectivity, and provide a cross-sectional image of the structure. In contrast, 3D surveys may use similar acoustic sources but are designed to cover smaller areas with greater resolution (*e.g.,* with closer survey line spacing), providing a volumetric image of underlying geological structures. Repeated 3D surveys are referred to as four-dimensional (4D), or time-lapse, surveys that assess the depletion of a reservoir.

Shallow penetration and high-resolution surveys are designed to highlight seabed and near-surface potential obstructions, archaeology, and geohazards that may have safety implications during rig installation or well and development facility siting. Shallow penetration surveys may use a small airgun array, single airgun, or similar sources, while high-resolution surveys (which are limited to imaging the seafloor itself) may use a variety of sources, such as sub-bottom profilers, single or multibeam echosounders, or side-scan sonars.

Dates and Duration

The specified activities may occur at any time during the five-year period of validity of these regulations. Actual dates and duration of individual surveys are not known. Survey activities are generally 24-hour operations. However, BOEM estimates that a typical seismic survey involves approximately 20 to 30 percent of non-operational downtime due to a variety of factors, including technical or mechanical problems, standby for weather or other interferences, and implementation of mitigation measures.

Specified Geographical Region

The OCS planning areas are depicted in Figure 1, and the overlap of the GOMESA moratorium area with the planning areas (as well as with the modeling zones, see discussion of modeling zones below) is depicted in Figure 2, showing the updated specified geographical region.

Only the northern portion of the GOM contains Federal waters. BOEM manages development of U.S. Federal OCS energy and mineral resources within OCS regions, which are divided into planning areas. Within planning areas are lease blocks, on which specific production activities may occur. Geophysical survey activities may occur on scales ranging from entire planning areas to multiple or specific lease blocks, or could occur at specific potential or existing facilities within a lease block. NMFS provided a detailed discussion of the specified geographical region in the notice of proposed rulemaking (83 FR 29212; June 22, 2018).

The prospective survey activities may occur in the U.S. waters of the GOM, within BOEM's Western, Central, and Eastern GOM OCS planning areas (approximately within the U.S. EEZ; Figure 1), but excluding the GOMESA moratorium area (Figure 2). Although survey activity in the GOMESA moratorium area is no longer being considered, the region has not changed compared with what was described, nor has substantive new information regarding the region become available. Therefore, we do not reprint that discussion here and refer the reader to that notice of proposed rulemaking for additional detail.

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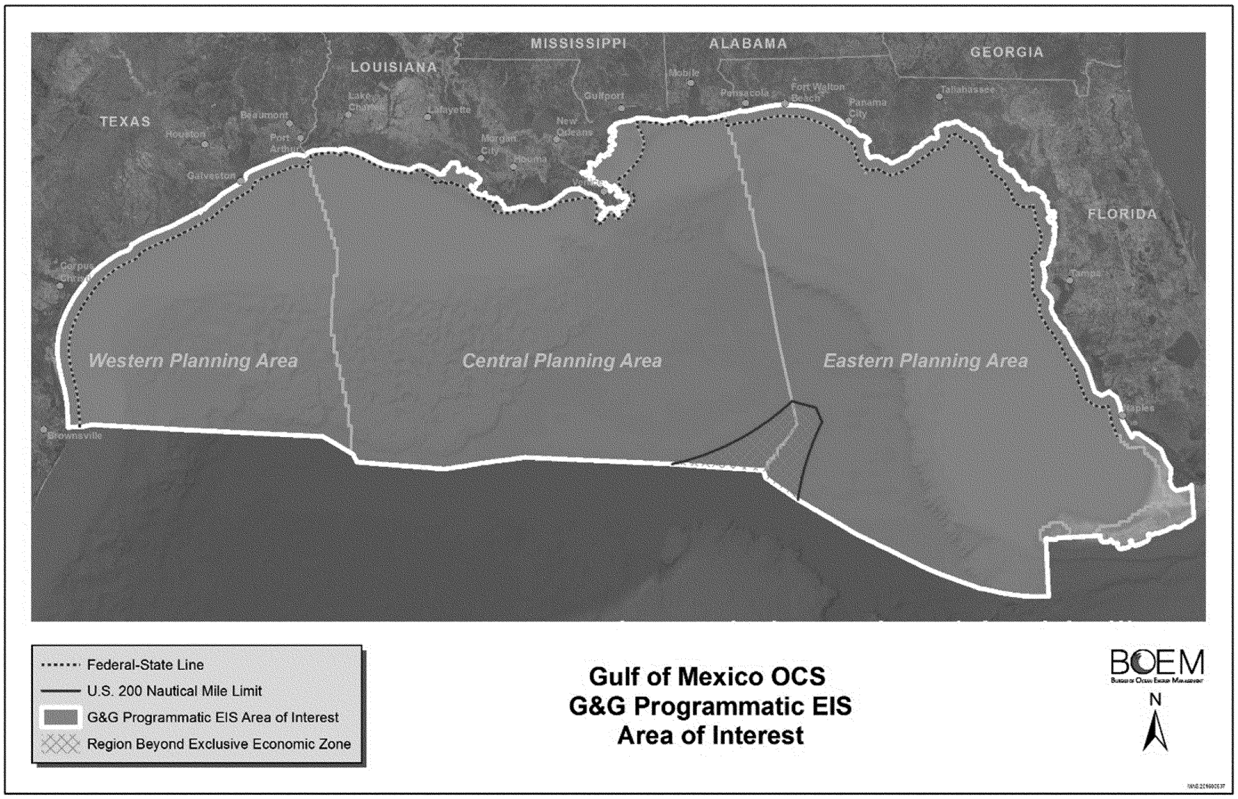

Figure 1. BOEM Planning Areas.

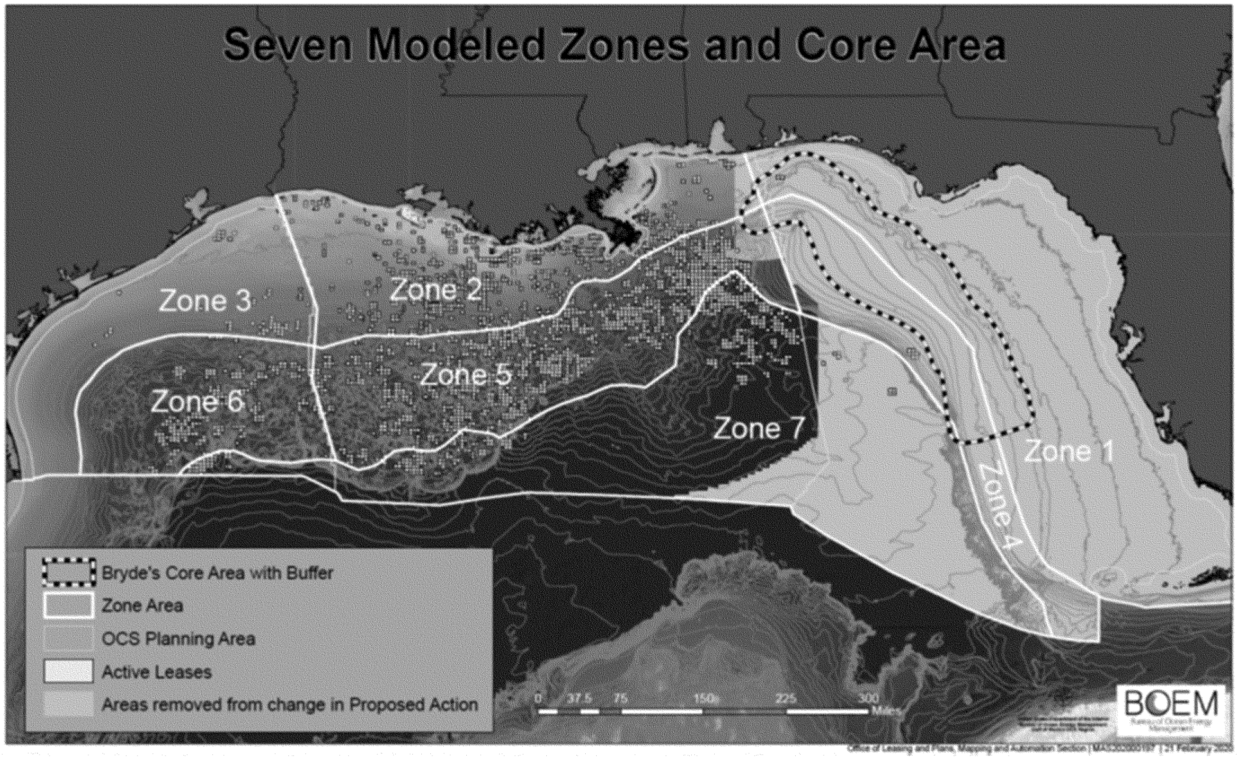

Figure 2. Specified Geographical Region.

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Detailed Description of Activities

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. There are different types of airguns; differences between types of airguns are generally in the mechanical parts that release the pressurized air, and the bubble and acoustic energy released are effectively the same. Airguns are typically operated at a firing pressure of 2,000 pounds per square inch (psi). Release of the compressed air into the water column generates a signal that reflects (or refracts) off the seafloor and/or subsurface layers having acoustic impedance contrast. 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.

Airgun arrays are typically configured in subarrays of 6–12 airguns each. Towed hydrophone streamers (described below) may follow the array by 100–200 m and can be 5–12 kilometer (km) long. The airgun array and streamers are typically towed at a speed of approximately 4.5 to 5 knots (kn). BOEM notes that arrays used for deep penetration surveys typically have between 20–80 individual elements, with a total volume of 1,500–8,460 in^3. The output of an airgun array is directly proportional to airgun firing pressure or to the number of airguns, and is expressed as the cube root of the total volume of the array.

Airguns are considered to be low-frequency acoustic sources, producing sound with energy in a frequency range from less than 10 Hz to 2 kHz (though there may be energy at higher frequencies), with most energy radiated at frequencies below 500 Hz. Frequencies of interest to industry are below approximately 100 Hz. The amplitude of the acoustic wave emitted from the source is equal in all directions (*i.e.,* omnidirectional) for a single airgun, but airgun arrays do possess some directionality due to 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.

When fired, a brief (~0.1 second) pulse of sound is emitted by all airguns in an array nearly simultaneously, in order to increase the amplitude of the overall source pressure signal. The combined signal amplitude and directivity is dependent on the number and sizes of individual airguns and their geometric positions within the array. The airguns are silent during the intervening periods, with the array typically fired on a fixed distance (or shot point) interval. The intervals are optimized for water depth and the distance of important geological features below seafloor, but a typical interval in relatively deep water might be approximately every 10–20 seconds (or 25–50 m, depending on vessel speed). The return signal is recorded by a listening device, and later analyzed with computer interpretation and mapping systems used to depict the subsurface. There must be enough time between shots for the sound signals to propagate down to and reflect from the feature of interest, and then to propagate upward to be received on hydrophones or geophones. Reverberation of sound from previous shots must also be given time to dissipate. The receiving hydrophones can be towed behind or in front of the airgun array (may be towed from the source vessel or from a separate receiver vessel), or geophone receivers can be deployed on the seabed. Receivers may be displaced several kilometers horizontally away from the source, so horizontal propagation time is also considered in setting the interval between shots.

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 predetermined 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—in the far field—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 (Caldwell and Dragoset (2000) define the far field as greater than 250 m). Therefore, back-calculated source levels are not typically considered to be accurate indicators of the true maximum amplitude of the output in the far field, which is what is typically of concern in assessing potential impacts to marine mammals. 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 (*e.g.,* 15–24 decibels (dB); Caldwell and Dragoset, 2000) 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(s) (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 some cases, data is acquired as the source vessel(s) turns continuously rather than moving on a linear track (*i.e.,* coil surveys). The spacing between track lines and the length of track lines can vary greatly, depending on the objectives of a survey. 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 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 (*e.g.,* half the distance of the acquisition streamer behind the source vessel, when used) to ensure that all data along the trackline are collected by the streamer. Line turns can require two to six hours when towed hydrophones are used, due to the long trailing streamers, but may be much faster when streamers are not used. Spacing and length of tracks varies by survey. Survey operations often involve the source vessel(s), supported by a chase vessel. Chase vessels typically support the source vessel(s) by protecting the long hydrophone streamer (when used) 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.

The general activities described here could occur pre- or post-leasing and/or on- or off-lease. Pre-lease surveys are more likely to involve larger-scale activity designed to explore or evaluate geologic formations. Post-lease activities may also include deep penetration surveys, but would be expected to be smaller in spatial and temporal scale as they are associated with specific leased blocks. Shallow penetration and HRG surveys are more likely to be associated with specific leased blocks and/or facilities, with HRG surveys used along pipeline routes and to search for archaeological resources and/or benthic communities. Specific types of surveys, including 2D and 3D surveys and various survey geometries typically associated with 3D surveys (*e.g.,* narrow- and wide-azimuth (NAZ and WAZ) and coil surveys), were described in summary in the notice of proposed rulemaking (83 FR 29212; June 22, 2018). We also described surveys involving the placement of seismic sensors in a drilled well or borehole, including various types of vertical seismic profiling and other types of borehole seismic surveys. For full detail, please refer to that notice or sections 1.2 and 1.3 of BOEM's petition.

Surveys may be designed as either multi-source (*i.e.,* multiple arrays towed by one or more source vessel(s)) or single source. Surveys may also be differentiated by the way in which they record the return signals using hydrophones and/or geophones. Hydrophones may be towed in streamers behind a vessel (either the source vessel(s) or a separate vessel) or in some cases may be placed in boreholes (called vertical seismic profiling) or spaced at various depths on vertical cables in the water column. Sensors may also be incorporated into ocean-bottom cables (OBC) or autonomous ocean-bottom nodes (OBN) and placed on the seafloor—these surveys are referred to generally as ocean-bottom seismic (OBS). Autonomous nodes can be tethered to coated lines and deployed from ships or remotely-operated vehicles, with current technology allowing use in water depths to approximately 3,000 m. OBS surveys are most useful to acquire data in shallow water and obstructed areas, as well as for acquisition of four-component survey data (*i.e.,* including pressure and 3D linear acceleration collected via geophone). For OBS surveys, one or two vessels usually are needed to lay out and pick up cables, one ship is needed to record data, one ship tows an airgun array, and two smaller utility boats support survey operations.

In summary, 3D survey design involves a vessel with one or more acoustic sources covering an area of interest with relatively tight spatial configuration (compared with 2D surveys). In order to provide richer, more useful data, particularly in areas with more difficult geology, survey designs become more complicated with additional source and/or receiver vessels operating in potentially increasingly complicated choreographies.

As compared with 2D and 3D deep penetration surveys, shallow penetration and HRG surveys are conducted to provide data informing initial site evaluation, drilling rig emplacement, and platform or pipeline design and emplacement. Identification of geohazards (*e.g.,* gas hydrates, buried channels) is necessary to avoid drilling and facilities emplacement problems, and operators are required to identify and avoid archaeological resources and certain benthic communities. These surveys may use single airguns or small airgun arrays, but generally use various types of electromechanical acoustic sources. Please see our notice of proposed rulemaking or BOEM's petition for additional detail regarding these survey types and electromechanical acoustic sources.

Summary of Representative Sound Sources

Because the specifics of acoustic sources to be used cannot be known in advance of receiving LOA requests from industry operators, it was necessary to define representative acoustic source parameters, as well as representative survey patterns. BOEM determined realistic representative proxy sound sources and survey patterns, which were used in acoustic exposure modeling and more broadly to support the analysis, after discussions with individual geophysical companies. Acoustic exposure modeling is described in detail in ''*Acoustic Propagation and Marine Mammal Exposure Modeling of Geological and Geophysical Sources in the Gulf of Mexico*'' and ''*Addendum to Acoustic Propagation and Marine Mammal Exposure Modeling of Geological and Geophysical Sources in the Gulf of Mexico*'' (Zeddies *et al.,* 2015, 2017a), hereafter referred to collectively as ''the modeling report,'' as well as in ''*Gulf of Mexico Acoustic Exposure Model Variable Analysis*'' (Zeddies *et al.,* 2017b), which evaluated a smaller, alternative airgun array. The reports are available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.*

Representative sources for the modeling include a single airgun, an airgun array, and multiple electromechanical sources. Two major survey types were considered: Large-area seismic (including 2D, 3D NAZ, 3D WAZ, and coil surveys) and small-area, high-resolution geotechnical (including single airgun surveys and surveys using a CHIRP sub-bottom profiler in combination with multibeam echosounder and side-scan sonar; the single airgun was used as a reasonable proxy for surveys using a boomer). The nominal airgun sources used for analysis of the proposed action include a small single airgun (90 in^3 airgun) and a large airgun array (8,000 in^3). In addition, the supplemental Model Variable Analysis (Zeddies *et al.,* 2017b) provides analysis of an alternative 4,130 in^3 array (see Letters of Authorization section). We note that while high-resolution geophysical sources were conservatively included for consideration in this rule to allow for take authorization if necessary, some of these types of sources would not necessarily be expected to cause the incidental take of marine mammals, depending on the source type and/or the manner in which it is operated (*e.g.,* operational settings, mitigation measures), and Letters of Authorization would not be necessary in those cases.

Additional characteristics of the representative acoustic sources and representative operational parameters of the different survey types that were used in the modeling simulations to predict the exposure of marine mammals to different received levels of sound are described in the modeling report and in our notice of proposed rulemaking. Please see those documents for additional detail.

We note that while it was necessary to identify representative sources for the purposes of modeling the number of takes to be included in the analysis under the rule, the analysis is intended to be, and is appropriately, applicable to takes resulting from the use of other sizes or configurations of airguns (*e.g.,* the alternative, smaller airgun array modeled in the ''*Gulf of Mexico Acoustic Exposure Model Variable Analysis*'' report (Zeddies *et al.,* 2017b) referenced in the proposed rule and available for public review as supplementary material to the proposed rule).

While these descriptions reflect existing technologies and current practice, new technologies and/or uses of existing technologies may come into practice during the period of validity of these regulations. NMFS will evaluate any such developments on a case-specific basis to determine whether expected impacts on marine mammals are consistent with those described or referenced in this document and, therefore, whether any anticipated take incidental to use of those new technologies or practices may appropriately be authorized under the existing regulatory framework. We also note here that activities that may result in incidental take of marine mammals, and which would therefore appropriately require authorization under the MMPA, are not limited to those activities requiring permits from BOEM. There may be some activities that do not require permits from BOEM, such as certain ancillary activities, for which an LOA under this rule may be appropriate. Operators should consult NMFS regarding the appropriateness of applying for an LOA under this rule prior to conducting such activities.

Estimated Levels of Effort

As noted previously, actual total amounts of effort by survey type and location cannot be known in advance of receiving LOA requests from industry operators. Therefore, BOEM's PEIS provided projections of survey level of effort for the different survey types for a 10-year period (and BOEM's updated scope refined those projections to a five-year period). In order to construct a realistic scenario for future geophysical survey effort, BOEM evaluated trends in permit applications as well as industry estimates of future survey activity. In addition, GOMESA precludes leasing, pre-leasing, or any related activity (though not geophysical surveys) in the GOM east of 86°41′ W, in BOEM's Eastern Planning Area (EPA) and within 125 mi (201 km) of Florida, or in BOEM's Central Planning Area (CPA) and within 100 mi of Florida (and according to certain other detailed stipulations). These leasing restrictions are in place until June 30, 2022. On September 8, 2020, the President effectively extended this moratorium through withdrawal under OCSLA of the same area covered by the GOMESA moratorium from disposition by leasing for 10 years, beginning on July 1, 2022, and ending on June 30, 2032. This withdrawal prevents consideration of these areas for any leasing for purposes of exploration, development, or production during the 10-year period beginning on July 1, 2022, and ending on June 30, 2032. Although the withdrawal does not preclude geophysical survey activity, similar to the moratorium under GOMESA, the lack of leasing opportunities may be expected to curtail interest in exploratory surveys to some degree.

In order to provide some spatial resolution to the projections of survey effort and to provide reasonably similar areas within which acoustic modeling might be conducted, the geographic region was divided into seven zones, largely on the basis of water depth, seabed slope, and defined BOEM planning area boundaries. Shelf regions typically extend from shore to approximately 100–200 m water depths where bathymetric relief is gradual (off Florida's west coast, the shelf extends approximately 150 km). The slope starts where the seabed relief is steeper and extends into deeper water. In the GOM water deepens from 100–200 m to 1,500–2,500 m over as little as a 50 km horizontal distance. As the slope ends, water depths become more consistent, though depths can vary from 2,000–3,300 m. Three primary bathymetric areas were defined as shelf (0–200 m water depth), slope (200–2,000 m), and deep (>2,000 m).

Available information regarding cetacean density in the GOM (*e.g.,* Roberts *et al.,* 2016) shows that, in addition to water depth, animal distribution tends to vary from east to west in the GOM and appears correlated with the width of shelf and slope areas from east to west. The western region is characterized by a relatively narrow shelf and moderate-width slope. The central region has a moderate-width shelf and moderate-width slope, and the eastern region has a wide shelf and a very narrow slope. Therefore, BOEM's western, central, and eastern planning area divisions provide appropriate longitudinal separations for the shelf and slope areas. Due to relative consistency in both physical properties and predicted animal distribution, the deep area was not subdivided. As shown in Figure 3, Zones 1–3 represent the shelf area (from east to west), Zones 4–6 represent the slope area (from east to west), and Zone 7 is the deep area.

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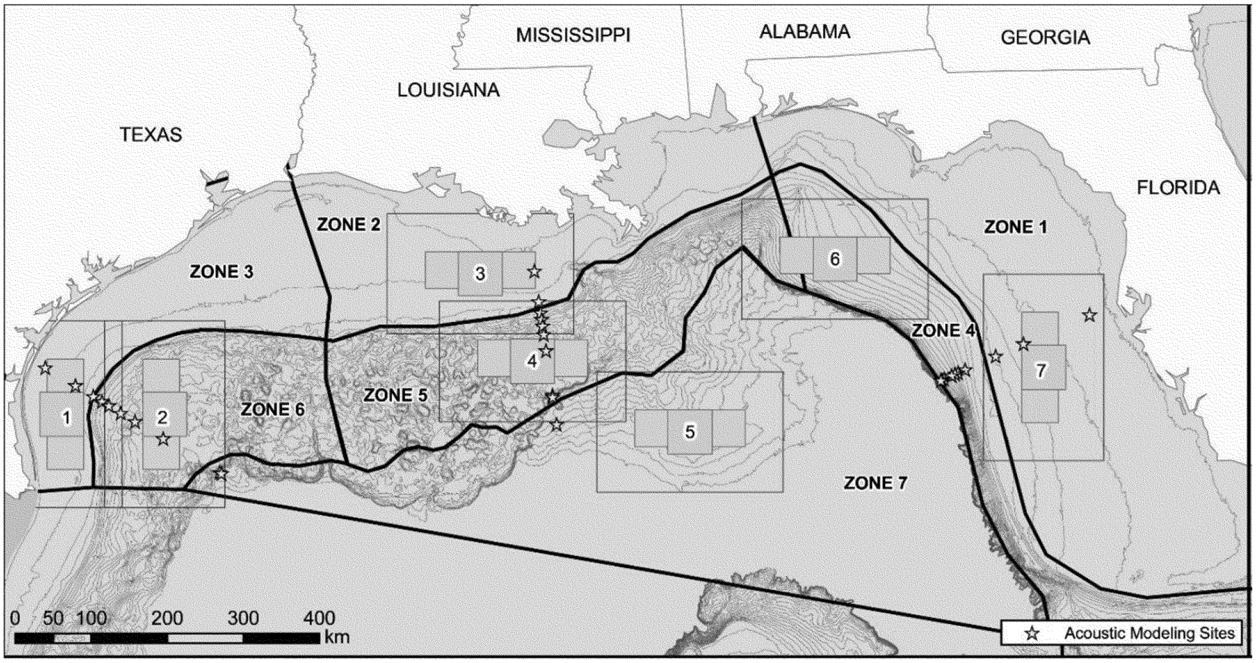

Figure 110 in Zeddies *et al.* (2015). Zones 1-3 represent the shelf region; Zones 4-6 the slope region, and Zone 7 the deep region. Within each of the seven zones, a set of representative survey-simulation rectangles (smaller numbered boxes) for each of the survey types was defined. For additional detail regarding Figure 3, please see discussion under "Modeling Overview," later in this document.

Figure 3. Gulf of Mexico Modeling Zones.

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Table 1 in the notice of proposed rulemaking provided the 10-year estimated levels of effort from BOEM's PEIS, estimated as 24-hr survey days, including annual totals by survey type and by zone for deep penetration and shallow penetration surveys, respectively. As the basis for the analysis supporting the proposed rulemaking, NMFS selected one high survey effort scenario and two each of moderate and low survey effort scenarios from the ten survey effort scenarios provided by BOEM. Of the ten "years" or effort scenarios, Year 1 (high), Years 4 and 5 (moderate), and Years 8 and 9 (low) were selected as representative effort scenarios and carried forward for further evaluation.

However, as noted previously, BOEM subsequently revised its proposed action by removing the area subject to leasing moratorium under GOMESA from consideration in the rule. In support of this revision, BOEM provided revised 5-year level of effort predictions and associated acoustic exposure estimates. BOEM's process for developing this information, described in detail in "Revised Modeled Exposure Estimates," available online, was straightforward. Rather than using the PEIS's 10-year period, BOEM provided revised levels of effort for a 5-year period, using Years 1–5 of the original level of effort projections. BOEM stated that the first five years were selected to be carried forward "because they were contiguous, they included the three years with the most activity, and they were the best understood in relation to the historical data upon which they are based." NMFS concurs with this choice. Levels of effort were revised based on the basic assumption that if portions of areas are removed from consideration, then the corresponding effort previously presumed to occur in those areas also is removed from consideration. Revised estimates of future effort and associated acoustic exposures draw upon the prior projections and modeling approach, which were subject to notice and comment. Table 1 shows the percentage reduction in survey area for each modeling zone that results from BOEM's scope revisions, and Table 2 provides the subsequent revised level of effort projections for the 5-year period.

TABLE 1—PERCENTAGE REDUCTION IN SURVEY AREA FOR EACH MODELED ZONE

Modeling zone	Percentage reduction in area
1	100.0
2	2.7
3	0.0
4	98.2
5	4.0
6	0.0
7	33.0

TABLE 2—PROJECTED LEVELS OF EFFORT IN 24-HR SURVEY DAYS FOR FIVE YEARS, BY ZONE AND SURVEY TYPE [1]

Year	Zone [2]	2D [3]	3D NAZ [3]	3D WAZ [3]	Coil [3]	VSP [3]	Total (deep) [3]	Shallow hazards [4]	Boomer [4]	HRG [4]	Total (shallow) [4]
1	1	0	0	0	0	0	0	0	0	1	1
	2	0	7	0	0	0	7	0	0	1	1
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	2	16	8	3	0	29	0	0	1	1
	6	0	0	0	0	0	0	0	0	0	0
	7	23	170	82	35	1	311	0	0	11	11
Total		25	193	90	38	1	347	0	0	14	14
2	1	0	0	0	0	0	0	0	0	1	1
	2	0	10	1	0	0	11	0	0	1	1
	3	0	0	0	0	0	0	0	0	0	0
	4	27	0	0	0	0	27	0	0	0	0
	5	0	16	8	3	0	27	0	0	1	1
	6	0	0	0	0	0	0	0	0	0	0
	7	10	166	79	34	1	290	0	0	11	11
Total		37	192	88	37	1	355	0	0	14	14
3	1	0	0	0	0	0	0	0	0	1	1
	2	0	10	1	0	0	11	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0
	4	54	50	21	9	0	134	0	0	1	1
	5	1	10	4	2	0	17	0	0	1	1
	6	0	0	0	0	0	0	0	0	0	0
	7	31	125	46	20	1	223	0	0	12	12
Total		86	195	72	31	1	385	0	0	12	12
4	1	0	0	0	0	0	0	0	0	0	0
	2	0	10	1	0	0	11	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0
	4	54	50	21	9	0	134	0	0	1	1
	5	1	10	4	2	0	17	0	0	1	1
	6	0	0	0	0	0	0	0	0	0	0
	7	31	125	46	20	1	223	0	0	12	12
Total		86	195	72	31	1	385	0	0	14	14
5	1	0	0	0	0	0	0	0	0	0	0
	2	0	7	0	0	0	7	0	0	1	1
	3	0	0	0	0	0	0	0	0	0	0
	4	0	75	0	0	0	75	0	0	0	0
	5	0	12	8	3	0	23	0	0	1	1
	6	0	0	0	0	0	0	0	0	0	0
	7	0	154	79	34	1	268	1	1	11	13
Total		0	248	87	37	1	373	1	1	13	15

[1] Projected levels of effort in 24-hr survey days.
[2] Zones follow the zones depicted in Figure 3.
[3] Deep penetration survey types include 2D, which uses one source vessel with one large array (8,000 in^3); 3D NAZ, which uses two source vessels using one large array each; 3D WAZ and coil, each of which uses four source vessels using one large array each (but with differing survey design); and VSP, which uses one source vessel with a large array. "Deep" refers to survey type, not to water depth.
[4] Shallow penetration/HRG survey types include shallow hazards surveys, assumed to use a single 90 in^3 airgun or boomer, and high-resolution surveys using the multibeam echosounder, side-scan sonar, and chirp sub-bottom profiler systems concurrently. "Shallow" refers to survey type, not to water depth.

This description of the specified activity is a summary of critical information. The interested reader should refer to the notice of proposed rulemaking (83 FR 29212; June 22, 2018), as well as BOEM's petition (with recent addenda) and PEIS, for additional detail regarding these prospective activities and the region. Required mitigation, monitoring, and reporting measures are described in detail later in this document (please see Mitigation and Monitoring and Reporting).

Changes From the Proposed Rule

This section provides a summary of changes from the proposed rule. Each section in which changes were made (*e.g.,* Mitigation) includes a more detailed list of changes made and a fuller description of the rationale. The following Comments and Responses section also provides additional detail relating to changes, in cases where the change resulted from a public comment.

Most notably, as described in greater detail above, BOEM updated the scope of the specified activity/specified geographical region that is the subject of this rule by removing from consideration the area that is subject to the GOMESA leasing moratorium. In accordance with this updated spatial scope, BOEM provided revised activity level projections and revised estimated acoustic exposure numbers based on the same modeling that informed the numbers evaluated in the proposed rule. BOEM's revised activity level projections correspond with Years 1–5 of the original 10-year projections (see Table 1 of the notice of proposed rulemaking), which is a conservative choice as these years contained higher levels of effort than Years 6–10. In the proposed rule, NMFS selected years that were representative of different levels of effort as the basis for the total taking over five years, including one year of relatively high effort (Year 1), two years of relatively moderate effort (Years 4 and 5), and two years of relatively low effort (Years 8 and 9). This selection is now in part supplanted (with the two representative ''low effort'' years replaced by one relatively high effort year and one relatively moderate effort year) by BOEM's selection of Years 1–5 and the associated updated levels of effort.

The revised acoustic exposure numbers form the basis for our analyses in this final rule. Of note, the maximum total taking, as well as the annual maximum, that would be allowable under the regulations has decreased for most species and stocks, with the exception of the annual maximums for Atlantic spotted dolphin and bottlenose dolphins, and the total taking over five years for the Atlantic spotted dolphin, which have increased slightly (please see Estimated Take for additional information). These changes (largely decreases) in the take numbers do not have a meaningful effect on the analysis (except where impacts are significantly reduced, *e.g.,* for Bryde's whales) and do not change any of the findings.

In the proposed rule, NMFS included several time-area restrictions, including a seasonal restriction on airgun survey activity in the ''Bryde's whale core habitat'' area (as well as alternatives to this proposal that were offered for public comment, including a year-round restriction in the same area). Following BOEM's update to the scope of the rule, two of these areas (the Bryde's whale area and the ''Dry Tortugas'' area that was, in part, designed to provide protection for sperm whales and beaked whales) were removed from consideration, as the specified activity/specified geographical region no longer includes surveys in the areas where these proposed restrictions are located.

A third time-area restriction—the ''Coastal Restriction,'' designed to protect bottlenose dolphins in coastal waters most heavily impacted by the Deepwater Horizon oil spill—has been modified in consideration of public comments. The restriction was proposed to be GOM-wide within coastal waters inside the 20-m isobath, and to be in effect from February through May. The area encompassed by the restriction has been reduced to match the assumed range of the northern coastal stock of bottlenose dolphins (*i.e.,* between 90–84° W, but in effect only to the eastern extent of the coastal waters portion of BOEM's updated specified geographic region) while the temporal window has been expanded to include January. In addition, a proposed 13-km buffer to this area has been removed.

In the proposed rule, NMFS defined ''deep penetration'' surveys as those using arrays greater than 400 in^3 total volume. That delineation has been revised to include surveys using arrays greater than 1,500 in^3 total volume, with arrays of 1,500 in^3 total volume and less considered ''shallow penetration'' surveys.

In the notice of proposed rulemaking, NMFS proposed an exception to the general shutdown requirements for certain species of dolphins in relation to airgun surveys, in which the acoustic source would be powered down to the smallest single element of the array. Power-down conditions would be maintained until the animal(s) is observed exiting the exclusion zone or for 15 minutes beyond the last observation of the animal, following which full-power operations may be resumed without ramp-up. NMFS also provided an alternative proposal for consideration by the public, in which no shutdown or power-down would be required upon observation of the same species of dolphins. Following review of public comments, NMFS removes the power-down measure for small delphinids, in favor of the no-shutdown and no power-down alternative. No shutdown or power-down is required for these species.

NMFS proposed a number of extended distance 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 extended distance shutdown requirement (*e.g.,* whales with calves). These extended distance shutdowns were all conditioned upon observation or detection of these species or circumstances ''at any distance'' from the vessel. However, NMFS also included as an alternative proposal for public consideration a distance limit of 1,000 m for these shutdown requirements. Following review of public comments, NMFS determined that a distance limit on extended shutdown zones for relevant species or circumstances was appropriate, but determined 1,500 m was the appropriate distance (rather than 1,000 m).

The proposed rule included an extended distance shutdown for sperm whales that was applicable upon acoustic detection, but was not applicable to visual detection. Following review of public comments, the shutdown requirement has been expanded to include any detection of sperm whales within the extended distance shutdown zone, including visual detection.

For shallow penetration surveys, NMFS reduces the standard exclusion zone from 200 m to 100 m, while including an extended distance shutdown requirement mirroring the requirements for deep penetration surveys, but within a distance of 500 m. NMFS eliminates shutdown requirements for HRG surveys (defined here as surveys using electromechanical sources such as multi-beam echosounders, side-scan sonars, and chirp sub-bottom profilers). The proposed regulations required shutdown for marine mammals within the proposed exclusion zone for surveys operating in water depths greater than 200 m.

NMFS eliminates proposed requirements for visual observation during nighttime ramp-up and pre-clearance, and for the use of third-party PSOs aboard node retrieval vessels.

In the proposed rule, NMFS discussed the use of an extrapolation method recommended by the Marine Mammal Commission for use in estimating potential unobserved takes. NMFS agrees with public commenters that the appropriateness of the method for application to observations conducted from working source vessels (versus research vessels) is unknown and, as suggested through public comment, NMFS will not require use of this method but will continue to evaluate approaches for assessment of effects to marine mammal stocks, including those based on extrapolation of marine mammal detections, through the adaptive management process and subsequently apply them through LOAs as appropriate.

NMFS has revised requirements relating to reporting of injured or dead marine mammals and has added newly crafted requirements relating to actions that should be taken in response to notification of live stranding events in certain circumstances, in order to reflect current best practice.

The proposed rule indicated that LOA applications with take estimates based on modeling other than that specifically included in the modeling report used to support the EIS and the proposed rule (the modeling report; Zeddies *et al.,* 2015, 2017a) would necessarily be published for public comment prior to the issuance of an LOA. Upon consideration of public comment and related supplemental materials, the final rule more flexibly allows that if applicants do not use the modeling provided by the rule, NMFS will publish a notice in the **Federal Register** soliciting public comment, when the model or inputs differ substantively from those that have been reviewed by NMFS and the public previously. Please see the Letters of Authorization section for more detail.

Comments and Responses

NMFS published a notice of proposed rulemaking in the **Federal Register** on June 22, 2018 (83 FR 29212), beginning a 60-day comment period. In that notice, we requested public input on the proposed rule and regulations, including the variations of the proposed rule, two economic baselines, and other information provided in the Regulatory Impact Analysis and associated appendices, and requested that interested persons submit relevant information, suggestions, and comments. In response to BOEM's change in scope and in consideration of public comments, we modified our action, as discussed in the following responses to comments. Please also see the Changes from the Proposed Rule section, above. We note that one area of significant concern for some members of the public was potential impacts to Bryde's whales and related mitigation measures. The reduced geographic scope eliminates the need to consider activity in the Bryde's whale ''core habitat area'' and eliminates the majority of the incidental take of Bryde's whale that was evaluated in the proposed rule.

During the 60-day comment period, we received 17 comment letters. A letter was submitted jointly by the International Association of Geophysical Contractors, the American Petroleum Institute, the National Ocean Industries Association, and the Offshore Operators Committee (hereafter, the ''Associations''). A separate letter was submitted jointly by the Natural Resources Defense Council (NRDC), Center for Biological Diversity, Earthjustice, Gulf Restoration Network, Humane Society Legislative Fund, The Humane Society of the United States, and Sierra Club (hereafter, ''NRDC''). Additional letters were submitted by the following: BP Exploration & Production Inc. (BP), Consumer Energy Alliance, CGG, Chevron USA Inc. (Chevron), the Center for Regulatory Effectiveness (CRE), the Florida Department of Environmental Protection, the Marine Mammal Commission (MMC), and eight private citizens. NMFS has reviewed all public comments received on the proposed rulemaking. All relevant comments and our responses are described below, with comment responses outlined by major categories. All comments received are available online at: *www.regulations.gov.* A direct link to these comments is provided at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.*

General Comments

As an initial matter, we note that under the MMPA, NMFS generally does not have discretion regarding issuance of requested incidental take authorizations for small numbers of marine mammals, provided that (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); and (3) 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 and their habitat.

In addition, NMFS' proposed action—the issuance of the ITR and any subsequent LOAs authorizing incidental take of marine mammals—addresses only marine mammals (and their habitat). As such, effects of the surveys on other aspects of the marine environment are not relevant to NMFS' analyses under the MMPA.

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 BOEM's PEIS (available online at: *www.boem.gov/Gulf-of-Mexico-Geological-and-Geophysical-Activities-Programmatic-EIS/*), 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 NMFS' proposed action (issuance of the ITR and any subsequent LOAs) as well as all BOEM and Bureau of Safety and Environmental Enforcement (BSEE) approvals of activities associated with the OCS oil and gas program in the GOM, is available online at: *www.fisheries.noaa.gov/national/endangered-species-conservation/biological-opinions-issued-noaa-fisheries-office-protected.* We do not further address taxa other than marine mammals and marine mammal prey.

Comment: The Associations comment that the proposed ITR is a well-structured and thorough document that appropriately concludes that geophysical activities in the GOM would have no more than a negligible impact on marine mammal populations, and that they appreciate NMFS' effort in preparing the proposed ITR and consideration of some of the Associations' previous comments.

Response: NMFS appreciates the comment.

Comment: The Associations comment that geophysical surveys play a critical role in the safe and orderly development of the oil and gas resources of the GOM.

Response: We acknowledge the background operational information provided by the Associations.

Comment: BP comments that the ITR is a much-needed process to govern the authorization of incidental takes of marine mammals associated with geophysical survey activity in the GOM. Chevron also indicates support for promulgation of the ITRs.

Response: NMFS appreciates the comments.

Comment: BP comments that projected survey efforts are underestimated but did not provide specific justification or recommendations.

Response: Projected levels of survey effort were formulated by BOEM and included in their PEIS. BOEM's PEIS stated, ''the scenarios contain projections based on the analysis of recent historic activity levels and trends made by BOEM's subject-matter experts who also considered industry-projected activity levels in their estimates.'' These projected levels of survey effort were made available for public review on multiple occasions during the development of the PEIS, as well as during the notice of receipt comment period, in which the public was given the opportunity to review and comment on the petition itself (81 FR 88664; December 8, 2016). Neither BP nor other industry stakeholders submitted comments on the BOEM-developed effort levels, and no evidence was provided that projected survey efforts are underestimated. The projected levels of effort were subsequently updated by BOEM based on the removal of the GOMESA area from consideration.

Comment: The Florida Department of Environmental Protection (FLDEP) expressed its concern regarding the potential impacts of OCS oil and gas activities on marine and coastal environments and the biological resources and critical habitats associated with them. The FLDEP also indicated that former Secretary of the Interior Zinke had made a commitment to former Governor Scott to remove the State of Florida from future consideration for offshore drilling.

Response: NMFS acknowledges the comments. Assuming that the requirements of the MMPA are met, *e.g.,* findings of negligible impact and small numbers are made, NMFS does not have discretion as to whether it may issue ITRs and LOAs under those ITRs, and NMFS has no authority to limit oil and gas activities outside of prescribing appropriate mitigation requirements.

Marine Mammal Impacts

Comment: The Associations (as well as other industry commenters and the CRE) 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. The Associations stated that surveys have been ongoing in the GOM 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. The Associations go further in claiming that ''NMFS misconstrues its legal obligations'' and ''NMFS violates the MMPA's best available science requirement.''

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 in the notice of proposed rulemaking. In addition, 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; Pirotta *et al.,* 2018). 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 may be compromised), which in turn can adversely affect populations depending on their health, abundance, and growth trends.

With specific regard to sound, as a 2017 report from the National Academy of Sciences noted, while it is true that ''[n]o scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal population,'' this is largely because such impacts are very difficult to demonstrate (NRC, 2005; NAS, 2017), not because they do not exist. Population-level effects are inherently difficult to assess because of high variability, migrations, and multiple factors affecting the populations. Appropriate studies are exceedingly difficult to carry out, and no appropriate study and reference populations have yet been established. Nonetheless there is a growing body of literature and science illustrating the connections between prolonged behavioral disturbance and impacts to reproductive success and survivorship. Accordingly, it is not defensible to conclude that sub-lethal acoustic stressors cannot have population level consequences. Based on the available evidence, a sufficient analysis of the potential impacts of airgun noise requires consideration of impacts on individuals *and* the potential for population level effects. NMFS has carefully considered the available evidence in making the necessary determinations (see Negligible Impact Analysis and Determinations) and determining the most appropriate suite of mitigation measures.

Because some commenters repeatedly cite (and misunderstand) public statements by BOEM in support of a contention that there is ''no harm from seismic,'' we clarify the record by citing BOEM's own responses to similar comments on their PEIS (BOEM, 2017). BOEM stated: ''It is critically important to understand that BOEM's . . . Science Note . . . refers to impacts on marine mammal . . . population sustainability rather than effects on individual animals. Studies have shown that marine mammals may and do react to sound through physical displacement from or avoidance of the area of ensonification and/or by altering their vocalizations. This [PEIS] acknowledges that significant acute physical injury to or death of marine mammals is not likely to be a direct result of seismic noise. It does, however, acknowledge that sublethal injurious effects are possible and may, over time, result in the eventual death of the individual(s) from these physical injuries and/or loss of hearing with (as in the case of marine mammals) the resultant inability to forage and communicate with conspecifics. Another prominent concern is whether anthropogenic sounds such as those generated during seismic survey activities may ''mask'' communications between some marine mammals. Depressed survival rates related to energetic effects or other impacts of noise are difficult to determine. BOEM, however, does not assume that lack of demonstrated adverse population-level effects from seismic surveys means that those effects may not occur.''

In support of assertions that there are ''no effects'' to marine mammals from seismic surveys and that there is a ''lack of any harm'' to marine mammals, CRE cites statements made by NMFS, in which we conclude that there is no evidence that serious injury, death, or stranding is reasonably likely to occur as a result of such surveys, and that Level A harassment is not reasonably likely to occur for mid-frequency cetaceans. CRE's assertion that there are ''no effects'' and ''no harm'' to marine mammals as a result of seismic surveys is based on the fact that marine mammals still exist in the GOM despite survey activity. CRE overlooks the evidence put forward for Level B harassment, and the potential effects of behavioral disruption, as well as the additional effects of noise that do not rise to the level of a take, but which nevertheless must be considered when evaluating the effects of a specified activity on a species or stock.

The Associations assert that we premise our decisions on the idea that we must act conservatively because effects that have not been conclusively proven—which the Associations claim, without evidence, do not and cannot occur—could occur in the future. The Associations state that we misconstrue our legal obligations via the application of ''an additional layer of precautionary bias'' beyond that established in the MMPA standards themselves, though they do not demonstrate that the bias exists. The Associations acknowledge that the MMPA requires mitigation sufficient to meet the standard of least practicable adverse impact. Therefore, some portion of the mitigation requirements contained in the proposed ITR would be necessary to meet that standard. However, they provide no analysis to support the contention that specific mitigation requirements exceed that standard. In fact, we have declined to adopt the recommendations of other commenters that are based on vague and unexplained standards of ''conservatism'' that are not required in the MMPA. Here, we conducted the requisite analyses of mitigation and found that the requirements contained in this final ITR, as modified on the basis of new information and review of public comments, meet the least practicable adverse impact (LPAI) standard.

We base our conclusions, relating to the potential effects of the specified activity on the affected species and stocks, on reasonable interpretation of the available science, which we summarize in this preamble and described in detail in our notice of proposed rulemaking. While we acknowledge the lack of conclusive evidence for population-level consequences, this is an artifact of the extreme difficulty of empirically demonstrating such effects (as concluded by the National Academies of Science, stated above). The best available scientific information provides considerable evidence that the activities evaluated in this ITR have the potential to adversely affect the fitness of individual animals. The best available science clearly demonstrates that, given adverse impacts to an animal's fitness, population-level effects are plausible. The Associations' comments on this topic treat the lack of empirical evidence as evidence that such effects do not occur. However, NMFS does not agree that absence of evidence is evidence of absence of effects. The comments further incorrectly frame our decision-making as being premised on the idea that such effects could occur in the future, when they are actually based on a reasonable interpretation of the best available scientific information regarding what the effects of the specified activity are likely to be in the absence of prescribed mitigation. Despite the paucity of empirical research on population effects, the best available information demonstrates impacts at the individual level that, at a high enough level of take, have reasonably foreseeable population-level impacts.

Similarly, the Associations imply that our interpretation of the existing scientific information reflects speculation about what future research might demonstrate. The Associations' statements that NMFS dismissed current scientific findings and premised decisions on hypothesized future impacts are inaccurate, and their assertion that NMFS ''has effectively required conclusive scientific proof that seismic surveys do not impact marine mammal populations'' misunderstands NMFS' use of the scientific literature. The best available information demonstrates that the effects of seismic surveys on marine mammals may include adverse impacts on behavior in ways that can also have energetic consequences. To draw different conclusions regarding the need for the strong suite of mitigation requirements included in this final ITR, NMFS would require scientific evidence that demonstrates that seismic surveys do not have energetic consequences or, alternatively, do not reach a point where there are population-level consequences. NMFS is not aware of such evidence. NMFS' final rule is based on the best available scientific information and the requirements of the MMPA.

Chevron states that we do not account for ''real-world'' protected species observer (PSO) observations, calling this ''arbitrary and capricious,'' and seems to imply that these ''ignored'' PSO observations of marine mammals are evidence that seismic activities produce no more than ''negligible effects on species.'' Chevron does not provide evidence to support its comment or otherwise develop the suggestion to enable a specific response. However, we incorporated the best available scientific information for our analysis, as evidenced (for example) by our references in the notice of proposed rulemaking to BOEM's synthesis study of PSO data from 2002–08 (Barkaszi *et al.,* 2012) (as well as other similar syntheses from other locations). In this final rulemaking, we have incorporated analysis of a newly available study of PSO data from 2009–15 (Barkaszi and Kelly, 2018). These data are also key to the evaluation of direct costs found in our RIA. We disagree with Chevron's apparent contention that we ''ignore[d]'' BOEM's earlier ''admissions that no scientific evidence exists contradicting the real-world observations of negligible impact'' (citing to BOEM's ''Science Notes''). NMFS addressed BOEM's ''Science Notes'' in some detail in our notice of proposed rulemaking (83 FR 29264–65). Chevron misinterprets a statement from BOEM regarding the absence of evidence (''no documented evidence of noise from air guns . . . adversely affecting animal populations) as evidence itself of no adverse effects. According to Chevron, our ''failure to account for'' this is ''arbitrary and capricious.'' These issues have been addressed both above and in the notice of proposed rulemaking.

Comment: NRDC referenced studies showing that noise from airgun surveys can travel great distances underwater, suggesting that due to the scale of this propagation, marine mammals in the GOM are consistently compromised in their ability to perform important life functions.

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, we acknowledge that contraction of effective communication space for Bryde's whales, which vocalize and hear at frequencies overlapping those emitted by airgun arrays, can occur at distances on the order of tens to hundreds of kilometers (*e.g.,* Hatch *et al.,* 2012). However, attenuation to levels below which more acute effects are likely to occur is expected over much shorter distances (Zeddies *et al.,* 2015, 2017a) and, therefore, we do not agree with the contention that the GOM would be ensonified to a degree that marine mammals would find it an unsuitable habitat or would be consistently compromised in their ability to perform important life functions. Rather, it is likely that displacement would occur within a much smaller region in the vicinity of the acoustic source (*e.g.,* within 10–20 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 some displacement may occur (*i.e.,* Level B harassment as a result of acoustic exposure beyond the exclusion zone), the GOM 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 GOM, 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 surveys are expected to occur over large portions of the GOM, they will only be transitory in any given area. Therefore, NMFS does not expect displacement to occur frequently or for long durations. Please see Negligible Impact Analysis and Determinations for additional analysis.

Comment: NRDC states that airgun surveys have been linked to significant reductions in the probability of calf survival in western Pacific gray whales (an endangered baleen whale population), implying that these findings indicate that such surveys would similarly have significant negative effects on whales in the GOM.

Response: Commenters cite a preliminary report (Cooke *et al.,* 2015) that documented a reduction in calf survival that the authors 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: NRDC asserts that we have not adequately accounted for vessel collision risk, stating that the surveys will drive marine mammals into shipping lanes, thereby increasing their risk of ship strike. Relatedly, NRDC noted that NMFS' 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 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. While 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 (see Mitigation). 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 and, furthermore, vessels towing survey gear travel at very slow speeds (*i.e.,* roughly 4–5 kn).

Comment: The MMC criticizes one aspect of the methodology for the analysis of chronic effects to Bryde's and sperm whales conducted by NMFS with the support of JASCO Applied Sciences (JASCO), *i.e.,* removing the top ten percent of the greatest pulse exposures. (JASCO is a consulting company contracted by NMFS and BOEM to model acoustic exposures of marine mammals to noise produced by industry survey activity.) The MMC recommends re-estimation of the various lost listening and communication space parameters without removing the greatest ten percent of pulse exposures.

Response: The goal of this modeling exercise was to create a tool that could help evaluate loss of ability to detect signals of biological importance over spatial scales relevant to the sources and hearing capabilities of a wide variety of regional animals. In order to do so, we attempt to examine the portion of low-frequency acoustic energy lost from seismic surveys that has been empirically measured in many contexts around the world to generate higher chronic, longer-term average noise levels. Masking experienced by individual calling and receiving animals due to noise at relatively close proximity to a single intermittent source is an important but limited aspect of the real-world contexts within which populations of marine mammals are exposed to noise from multiple seismic surveys in a region like the GOM. This modeling sought to account for the known attributes of airgun noise, by which low-frequency energy lost laterally attenuates over large spatial scales with loss of impulsive features, leading to elevated background noise conditions, particularly when multiple surveys are concurrent within an acoustic region. Close range pulse energy would entirely drown out such evaluation, and would not account for the different acoustic characteristics of the signal and potential masking at such scales. Thus, while masking of specific signals relative to the near-field of operating airgun arrays is an impact that may occur, for the purposes of the analysis conducted for this rule, near-field impacts have been addressed through the modeling of acoustic exposures. The chronic and cumulative impacts analysis that is the subject of this comment addresses far-field chronic impacts. Additionally, there are technical concerns with modifying the analysis specifically as recommended and, accordingly, we disagree with the recommendation for purposes of this analysis of potential chronic effects.

The purpose of this modeling exercise was not to evaluate exposure implications for animals close to the modeling locations (*i.e.,* ''acute'' effects). Evaluation of acute effects, such as injury and behavioral disruption, was achieved through the primary acoustic exposure modeling effort (Zeddies *et al.,* 2015, 2017a). These evaluated effects (evaluated through the primary acoustic modeling effort) are separate and separable from loss of hearing opportunities experienced by animals farther from source locations, which are evaluated through the chronic and cumulative effects modeling discussed here.

Marine Mammal Impacts—Habitat

Comment: NRDC expressed concern regarding potential impacts to marine mammal prey and/or food webs from the planned surveys. NRDC 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, NRDC cited a publication by McCauley *et al.* (2017) as evidence that the surveys could potentially impact zooplankton and consequently marine mammal food webs.

Response: NMFS strongly disagrees with the suggestion 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 pre-survey distribution and behavior, and minimal impacts to recruitment or survival 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' 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. We agree that seismic surveys could affect certain marine mammal prey species, and addressed these potential effects, as well as the potential for those effects to impact marine mammal populations, in our notice of proposed rulemaking (83 FR 29241–29242). As stated in that notice, our review of the available information and the specific nature of the activities considered herein suggest that the activities evaluated in this ITR are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species. Further, any impacts to prey species are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations. In support of this conclusion, we refer the commenter to discussion provided in our notice of proposed rulemaking. Additional information is summarized below.

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), our review shows that the weight of evidence indicates either no or only a 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 may be impacts to fish as a result of noise from nearby airguns, any 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 (*e.g.,* 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).

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 temporary threshold shift (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 for surveys that are necessarily 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.

NMFS considered the research provided by NRDC and disagrees with its interpretation of the literature. A recent comprehensive review (Carroll *et al.,* 2017) found that results are mixed as to the effects of airgun noise on the prey of marine mammals. While some studies suggest a change in prey distribution and/or a reduction in prey abundance following the use of seismic airguns, others suggest no effects or even positive effects in prey abundance. As one specific example—regarding Paxton *et al.* (2017), which describes findings related to the effects of a 2014 seismic survey on a reef off of North Carolina—NRDC asserts that the study supports a conclusion that seismic surveys ''cause significant shifts in distribution that may compromise life history behaviors.'' However, our own review of this work shows that a reasonable interpretation leads to a more moderate conclusion. While the study did show a 78 percent decrease in observed nighttime abundance for certain species—which NRDC interprets as a significant shift in distribution that could compromise life history behaviors—it is important to note that the evening hours during which the decline in fish habitat use was recorded (via video recording) occurred on the same day that the seismic 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 because fish may remain present yet not be recorded on video. In summary, this particular study corroborates prior studies demonstrating a startle response or short-term displacement.

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.

We discussed impacts to benthic communities from impulsive sound generated by active acoustic sound sources in our notice of proposed rulemaking, including one study showing that 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 (although the authors state that the observed levels of mortality were not beyond naturally occurring rates) (Day *et al.,* 2017). In addition, 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.'' A majority of the studies reviewed by NMFS have observed no increased mortality in invertebrates exposed to airgun noise (*e.g.,* Wardle *et al.,* 2001; Parry *et al.,* 2002; Christian *et al.,* 2003; Andriguetto-Filho *et al.,* 2005; Parry and Gason, 2006; Payne *et al.,* 2007; Harrington *et al.,* 2010; Przeslawski *et al.,* 2018).

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 (*i.e.,* those with high growth rates and that produce many offspring) 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). Most prior research on this topic, which has focused on relatively small spatial scales, has showed minimal effects (*e.g.,* Kostyuchenko, 1973; Booman *et al.,* 1996; Sætre and Ona, 1996; Pearson *et al.,* 1994; Bolle *et al.,* 2012).

A modeling exercise was conducted as a follow-up to the McCauley *et al.* (2017) study (as recommended by McCauley *et al.*), 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 a full-scale airgun survey would impact copepod abundance within the survey area, but that effects at a regional scale were minimal (2 percent decline in abundance within 150 km of the survey area and effects not discernible over the full region). The authors also found that recovery within the survey area would be relatively quick (3 days following survey completion), and suggest that the quick recovery was due to the fast growth rates of zooplankton, and the dispersal and mixing of zooplankton from both inside and outside of the impacted region. The authors also suggest that surveys in areas with more dynamic ocean circulation in comparison with the study region and/or with deeper waters (*i.e.,* typical GOM survey locations) would have less net impact on zooplankton.

Notably, a recently described study produced results inconsistent with those of McCauley *et al.* (2017). Researchers conducted a field and laboratory study to assess if exposure to airgun noise affects mortality, predator escape response, or gene expression of the copepod *Calanus finmarchicus* (Fields *et al.,* 2019). Immediate mortality of copepods was significantly higher, relative to controls, at distances of 5 m or less from the airguns. Mortality one week after the airgun blast was significantly higher in the copepods placed 10 m from the airgun but was not significantly different from the controls at a distance of 20 m from the airgun. The increase in mortality, relative to controls, did not exceed 30 percent at any distance from the airgun. Moreover, the authors caution that even this higher mortality in the immediate vicinity of the airguns may be more pronounced than what would be observed in free-swimming animals due to increased flow speed of fluid inside bags containing the experimental animals. There were no sublethal effects on the escape performance or the sensory threshold needed to initiate an escape response at any of the distances from the airgun that were tested. Whereas McCauley *et al.* (2017) reported an SEL of 156 dB at a range of 509–658 m, with zooplankton mortality observed at that range, Fields *et al.* (2019) reported an SEL of 186 dB at a range of 25 m, with no reported mortality at that distance.

Regardless, if we assume a worst-case likelihood of severe impacts to zooplankton within approximately 1 km of the acoustic source, the typically wide dispersal of survey vessels and brief time to regeneration of the potentially affected zooplankton populations does not lead us to expect any meaningful follow-on effects to the prey base for odontocete predators (the region considered in this rule is not an important feeding area for taxa that feed directly on zooplankton, *i.e.,* mysticetes).

Given the inconsistency of the McCauley *et al.* (2017) results with prior research on impacts to zooplankton as a result of exposure to airgun noise and with the research of Fields *et al.* (2019), further validation of those findings would be necessary for NMFS to reach a determination that these impacts are likely to occur. Moreover, a single study is not sufficient to evaluate the potential impacts, and further study in additional locations must be conducted. Therefore, BOEM proposed to fund such a study as part of their 2019–21 Studies Development Plan (*www.boem.gov/FY-2019-2021-SDP/*).

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).

NRDC's assertions regarding the likely effects of airgun survey noise on marine mammal prey include, for example, the assertion that the specified activity 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 this response and in our review of the available literature. We also reviewed available information regarding populations of representative prey stocks in the northern GOM, *i.e.,* 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 also believe this information has some value in informing the likelihood of population-level effects to prey species and, therefore, the likelihood that the specified activity 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. Numerous other managed stocks are similarly healthy.

- 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, the scientific literature demonstrates that impacts of seismic surveys on marine mammal prey species will likely be limited to behavioral responses, the majority of prey species will be capable of moving out of the area during surveys, a rapid return to normal recruitment, distribution, and behavior for prey species is anticipated, and, overall, impacts to prey species, if any, 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.

Finally, and relevant to NMFS' findings under the MMPA, NRDC does not demonstrate that even the asserted worst-case effects on prey species would have any meaningful impact on marine mammals or their respective populations. Referencing a single study on zooplankton effects (*i.e.,* McCauley *et al.,* 2017), NRDC implies that airgun surveys will definitively reduce ''the abundance and diversity of zooplankton over vast areas and induc[e] changes in community composition due to the aggregation of individual- and population-level impacts across multiple fish and invertebrate species,'' thereby leading to ecosystem-level effects that would harm marine mammal populations. NMFS disagrees with this interpretation of the scientific literature and notes the presence of healthy stocks of marine mammal prey species currently found in the GOM, despite decades of routine geophysical survey operations, but also a devastating oil spill (discussed in detail in the notice of proposed rulemaking). NMFS believes that no evidence is presented to contradict our conclusions regarding likely impacts to marine mammals due to effects on prey species, *i.e.,* that impacts of the specified activity are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species, and that any effects that do occur are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Comment: The Associations object to NMFS' use of an analysis of chronic and cumulative impacts of noise on marine mammals in the GOM (*i.e.,* the CCE report), which was described in detail in our notice of proposed rulemaking. The Associations state that ''[c]oncepts such as ''soundscape,'' ''communication space,'' or ''acoustic footprint'' have no basis in any existing statutory or regulatory authorities, and are therefore inapplicable to this rulemaking.''

Response: The purpose of the analysis was to evaluate the more cumulative nature of low-frequency, long-distance propagation of relatively low-intensity energy from multiple seismic surveys operating concurrently in a region, and to evaluate potential loss of ability to detect signals of biological importance over spatial scales relevant to the sources and hearing capabilities of representative species. NMFS is required to evaluate the effects of the specified activity on the potentially impacted marine mammal stocks and their habitat. Noise can disrupt marine mammals' behavioral patterns through the contraction of their communication space, among other impacts. Moreover, NMFS is required to mitigate impacts on marine mammal species or stocks and their habitat. Concepts such as listening area and communication space are not novel, having been published in peer-reviewed literature and previously applied in impact assessment contexts. NMFS is required to consider these effects.

Comment: NRDC argues that NMFS fails to consider chronic harm, including masking effects and impacts on acoustic habitat. For example, NRDC asserts that the consideration of masking in NMFS' negligible impact analysis was cursory in that it only came through the vulnerability ratings and ''seems to misapprehend the spatial and temporal scope of the effects'' of masking. Similarly, in addition to citing general concerns about chronic effects to Bryde's whales and other species, NRDC asserts that acoustic habitat is discussed, but not factored into the negligible impact analysis.

Response: The potential impacts of masking were properly considered. NRDC significantly understates the consideration given to masking effects in the Expert Working Group (EWG) risk assessment framework (see Negligible Impact Analysis and Determinations). Broadly, the results of the EWG analysis for any given species are based on the integration of two components: The severity of the impacts (which reflects the extent of the activities overlaid with the presence and distribution of the given species) and the vulnerability of that species based on multiple biological and environmental risk factors, including explicit consideration of masking. The maximum possible vulnerability score any species can attain under the assessment across all of these factors is 30. The masking component of the vulnerability score considers communication masking, foraging masking, and navigation/orientation masking—for a total of seven points. The minimum score that any species assessed in the context of these survey activities could (and did) attain is 1, while the Bryde's whale was given the maximum scores across all types of masking for a score of 7. The differential across the highest and lowest possible masking scores is 6, out of a maximum possible total of 30 for the overall vulnerability score, which means that masking accounts for twenty percent of a species' vulnerability rating. Twenty percent is an appropriate and not insubstantial proportion of the vulnerability score, given that the total score (with its 30-point maximum) also accounts for behavioral impacts, whether there are biologically important areas or times overlaying the activities, whether there are additional chronic anthropogenic (*e.g.,* other anthropogenic noise) or chronic biological factors (*e.g.,* disease), and the status and trends of the population.

NMFS recognizes that masking is not necessarily co-extensive with harassment and explicitly recognizes this in our discussion of effects, although we also note that the distances at which behavioral harassment is quantified for this rule are farther than those contemplated in the past, due to the behavioral harassment thresholds used (see the Estimated Take section and comment responses later in this section for further discussion of acoustic thresholds). As discussed elsewhere, NMFS designed and supported the implementation of a chronic and cumulative effects analysis (the CCE report, discussed later in this preamble) for the specific purpose of addressing the effects of these activities on the listening space of all species and the communication space of Bryde's whales specifically. This modeling effort explicitly considered the effects of masking over realistic spatial scales. In their 2017 public comments on incidental harassment authorizations NMFS had proposed for seismic survey activities in the Atlantic Ocean, NRDC specifically recommended that NMFS conduct a modeling exercise like the effort conducted here for the GOM rule to better support those findings (see 83 FR 63268; December 7, 2018), yet they now suggest that this analysis is inadequate, even paired with the quantitative analysis included in the EWG analysis as it is here. See Potential Effects of the Specified Activities on Marine Mammals and Their Habitat in the notice of proposed rulemaking for additional discussion.

Comment: A private citizen offers commentary and clarifications regarding the discussions of acoustic masking and acoustic habitat provided in our notice of proposed rulemaking.

Response: We appreciate the discussion provided by the commenter, but note that no specific recommendations are provided towards an improved assessment of the effects of chronic aggregate noise from survey activity, as the commenter suggests is needed.

Cumulative Impacts and Related Issues

Comment: NRDC expressed concern regarding cumulative impacts, claiming that NMFS' 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. NRDC also stated that NMFS must include geophysical surveys occurring within state waters within the scope of the ITR.

Response: Neither the MMPA nor NMFS' codified implementing regulations address consideration of other unrelated activities and their impacts on populations. However, the preamble for NMFS' 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 baseline. Consistent with that direction, NMFS has factored into its negligible impact analysis 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, the chronic and cumulative effects analysis (the ''CCE report'' discussed later in this preamble), and other relevant stressors. Some of these are addressed explicitly through the environmental risk factor scoring in the population vulnerability analysis of the Expert Working Group Assessment (including consideration of Deepwater Horizon (DWH) oil spill effects and risk from other anthropogenic activities). In addition, we consider these factors as relevant contextual elements of the analysis. See the Negligible Impact Analysis and Determinations section of this notice for full detail.

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 (1) that NMFS would consider cumulative effects that are reasonably foreseeable when preparing a NEPA analysis, and (2) that reasonably foreseeable cumulative effects would also be considered under section 7 of the ESA for ESA-listed species.

Here, we recognize the potential for cumulative impacts, as analyzed through BOEM's PEIS, which addressed the impacts of an extended time period of survey activity that may be permitted by BOEM (ten years versus the five years that the ITR is limited to), and which NMFS adopted as the basis for its Record of Decision. In that analysis, the assessment was focused on whether the predicted level of take from the forecasted level of survey effort, 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 ITR and subsequent LOAs 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 background levels once the acoustic source moves a certain distance from the area, or the surveys cease. The proposed rule also identified several time-area restrictions to minimize risk or severity of impacts to the extent practicable, consistent with the MMPA's least practicable adverse impact standard. In the final rule, two of those areas were removed from consideration based on the reduction in the scope of the rule per BOEM's request. The other proposed mitigation area remains (as modified; see Mitigation). Although those two areas have been removed from consideration as mitigation due to the reduction in scope of the rule, the practical effect on GOM stocks is similar, in that no survey activity within those areas may be considered for take authorization pursuant to the rule. The similar result is a reduction in the overall numbers of take but also, importantly, elimination or minimization of impacts to marine mammal species or stocks in the areas most important to them for feeding, breeding, and other important functions. Therefore, the severity of takes that may occur pursuant to the rule is expected to be meaningfully lower due to the reduction in impacts that could reduce reproductive success or survivorship.

In summary, NMFS does not expect aggregate impacts from the forecast level of survey effort to affect rates of recruitment or survival for marine mammals, 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. These documents, as well as the relevant Stock Assessment Reports, are part of NMFS' 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' required intra-agency consultation under section 7 of the ESA, which concluded that NMFS' action of issuing the ITR and subsequent LOAs was not likely to jeopardize the continued existence of listed marine mammals.

We disagree with NRDC's suggestion that we include geophysical surveys in state waters within the scope of this rulemaking. Section 101(a)(5)(A) 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. NMFS' implementing regulations require applicants to include in their request a detailed description of the specified activity or class of activities that can be expected to result in incidental taking of marine mammals. 50 CFR 216.104(a)(1). Thus, the ''specified activity'' for which incidental take coverage is being sought under section 101(a)(5)(A) is generally defined and described by the applicant. Here, BOEM is the applicant for the ITR in support of industry operators, and we are responding to the specified activity as described in that petition (and making the necessary findings on that basis). As BOEM's PEIS makes clear, BOEM does not have a regulatory role regarding surveys occurring in state waters. (See, *e.g.,* BOEM's PEIS, Chapter 1.1.3)

NRDC's representation of our action—''The agency's decision to evaluate the impacts of state water surveys separately as if they would occur in isolation''—also ignores the fact that we have no information about the possible extent of potential future geophysical survey activity in state waters, including type, amount, duration, timing, location, etc., even if such activity were to occur. Although it may be reasonable to assume that such activity occurs, we have no specific knowledge of any past, present, or reasonably foreseeable future survey activity in state waters. No prospective applicant has contacted NMFS to request incidental take authorization for any such survey activity planned or expected within state waters, on either a programmatic or specific basis. NRDC did not provide any information about the expected future extent of survey activity in state waters.

Acoustic Thresholds

Comment: NRDC expressed concerns regarding NMFS' proposed use of the probabilistic response function described by Wood *et al.* (2012), in which 10 percent, 50 percent, and 90 percent of individuals exposed are assumed to produce a behavioral response (of a sufficient degree of severity to constitute Level B harassment) at exposures of 140, 160, and 180 dB root mean square (rms), respectively. (The function is shifted for the more behaviorally sensitive beaked whales such that 50 percent and 90 percent response probabilities are assumed to occur at 120 and 140 dB rms, respectively.) NRDC stated that the function is inconsistent with the best available science, asserting that behavioral disruptions occur at higher percentages at lower noise exposure levels than those suggested by Wood *et al.* (2012). NRDC's criticism of the function also focused on the use of horizontal displacement studies as the supposed basis of analysis for Wood *et al.* (2012), as well as on the function's nature as a series of step functions. In addition, NRDC expressed concerns that the use of frequency weighting in the Wood *et al.* (2012) approach is inappropriate. NRDC requested that NMFS revise the threshold as suggested in Nowacek *et al.* (2015), which recommended a similar function (but centered on 140 dB rms rather than 160 dB rms), while simultaneously stating that the use of such step-based risk functions is ''biologically irrational.'' Overall, NRDC claims that reliance on this function results in underestimation of impacts. A private citizen echoed some of NRDC's comments on this topic while CRE supports use of the Wood *et al.* approach.

Response: NMFS has been criticized in the past for the use of the single-step 160-dB rms approach. Those criticisms are based on the idea that an approach reflecting a more complex multi-step probabilistic function would 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, as well as the science indicating that animals may react in ways constituting Level B harassment when exposed to lower received levels. In developing the acoustic exposure analysis for the proposed rulemaking, we reviewed relevant past public comments as well as the best available science, determining that a more complex probabilistic function is indeed better reflective of available scientific information, and that it was appropriate to take the fundamental step of recognizing the potential for Level B harassment occurring at exposures to received levels below 160 dB rms (as well as the potential for *no* Level B harassment occurring at exposures above 160 dB rms). This approach necessarily also accounts for differential hearing sensitivity by incorporating frequency-weighting functions, as behavioral responses in cetaceans are best explained by the interaction between sound source type and functional hearing group (Gomez *et al.,* 2016). NMFS has determined that the general approach used for this rule—a probabilistic risk function that allows for the likelihood of differential response probability at given received levels on the basis of multiple factors, including behavioral context and distance from the source, and that addresses particularly sensitive species—is appropriate in light of the best available scientific information.

However, because behavioral responses to sound depend on the context in which an animal receives the sound, including the animal's behavioral mode when it hears sounds, prior experience, additional biological factors, and other contextual factors, defining sound levels that disrupt behavioral patterns is extremely difficult. Even experts have not previously been able to suggest specific new criteria due to these difficulties (*e.g.,* Southall *et al.* 2007; Gomez *et al.,* 2016). Agency expertise is appropriate in defining the particular steps at which specific response probabilities are assumed to occur, and while we acknowledge our approach reduces a complex suite of interactions to make reasonable inferences, it is consistent with the best available science.

NRDC expressed concerns regarding our approach by noting the size discrepancy between the area ensonified to 140 dB versus that ensonified to 160 dB, implying that we ignore potential responses at the lower received level. To clarify, the difference between our approach and NRDC's recommendation is solely in the proportion of a population assumed to be taken upon exposure to the specified received level which, as stated above, is determined on the basis of expert judgement based on the best available science. We believe that the Wood *et al.* (2012) function is consistent with the best available science, and is therefore an appropriate approach. Below, we address NRDC's concerns in greater detail.

NRDC referenced ''recent'' research they claim is not consistent with the recommendations of Wood *et al.* (2012). We note that, of the nine studies cited by NRDC, five were published prior to the Wood *et al.* (2012) study, and were therefore available for those authors' consideration (and some were specifically referenced by those authors in discussion of their recommendations). Further, we disagree that the referenced findings are inconsistent with Wood *et al.* (2012). First, a mere reaction to noise exposure does not 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. NRDC also suggests that some of these studies were not incorporated into Wood *et al.'*s recommendations, or our consideration of those and other potential approaches in context of the available science, and criticize what they view as an over-reliance on horizontal displacement studies as the supposed basis of analysis. While it is true that the majority of available behavioral data focus on avoidance responses, Wood *et al.* (2012) does not mention excluding behavioral studies involving vocal changes, and the precedent Southall *et al.* (2007) specifically incorporates numerous studies that do mention changes in vocalization associated with sound exposure. Thus, these datasets were not excluded and, as discussed in our notice of proposed rulemaking, we adequately considered all studies addressed by NRDC.

Regarding baleen whales, we acknowledge that changes in vocalization have been observed in association with exposure to airgun surveys within migratory and non-migratory contexts (*e.g.,* Castellote *et al.,* 2012; Blackwell *et al.,* 2013; Cerchio *et al.,* 2014). The potential for such effects to occur over relatively large spatial scales is not surprising for species with large communication spaces (*e.g.,* Clark *et al.,* 2009), but we reiterate our disagreement with NRDC's apparent contention that every detected change to vocalizations rises to the level of a take. NRDC cites reports of changes in vocalization, typically for baleen whales, as evidence in support of lower thresholds, claiming these reactions result in biological consequences indicating that the reaction was indeed a take. However, NMFS is not aware of research that provides a well-supported link between the reported reactions at lower received levels and the putative consequences. In conflict with NRDC's interpretation of the literature are documented instances of marine mammal exposure to greater received levels that did not elicit any response (*e.g.,* Malme *et al.,* 1983, 1984, 1985, 1988; McCauley *et al.,* 1998, 2000a, 2000b; Barkaszi *et al.,* 2012; Stone, 2015a; Gailey *et al.,* 2016; Barkaszi and Kelly, 2018).

The received level associated with stoppage of calling for bowhead whales (*Balaena mysticetus*) observed by Blackwell *et al.* (2013, 2015)—a response that may arguably rise to the level of harassment—is consistent with the Wood *et al.* (2012) scheme, in which the potential for take upon exposure to received levels as low as 140 dB is accounted for. Similarly, the findings of Pirotta *et al.* (2014) for harbor porpoise (*Phocoena phocoena*) are consistent with the treatment of behaviorally sensitive species by Wood *et al.,* in which the potential for take at even lower received levels is accounted for (though irrelevant here, as harbor porpoise are not found in the GOM). The response levels reported by McDonald *et al.* (1995) and Di Iorio and Clark (2009) for blue whales (*Balaenoptera musculus*) also comport with the Wood *et al.* function, if we assume that the observed responses equate to harassment (though it is not clear that they do). With regard to NRDC's citation of Clark and Gagnon (2006), a non-peer reviewed white paper, NRDC incorrectly overestimated the area over which the effect was observed by an order of magnitude (the paper discusses an area of 100 x 100 nmi, which equates to 10,000 nmi^2—not 100,000 nmi^2).

In regard to Cerchio *et al.* (2014), it is important to note that received levels provided in this study are those recorded at locations of their underwater recording devices. The authors indicated ''we did not have the ability to locate the singers or the seismic survey vessel, estimate the source level of the pulses, the distance between the source and potentially impacted singers, or the received level of the pulses at the singers.'' The same situation, *i.e.,* actual received levels at the location of the animals are unknown, is true for Castellote *et al.* (2012) and Clark and Gagnon (2006), which provide average background sound levels with and without the presence of airgun surveys. Thus, not having the location of the animals at the time of exposure makes it difficult to draw conclusions based strictly on received level. NMFS has evaluated the papers and determined they are not informative about appropriate Level B harassment thresholds.

Regarding sperm whales, NMFS disagrees that assuming a 100 percent probability of take of sperm whales upon exposure to survey noise at 135 dB—as suggested by NRDC—is an accurate reflection of the results of the Miller *et al.* (2009) study. While we agree that the work of Miller *et al.* (2009) suggests that sperm whales in the GOM may be susceptible to disruption of foraging behavior upon exposure to relatively moderate sound levels, NRDC incorrectly interprets results of the study in claiming that sperm whale ''foraging success'' was found to ''decline significantly.'' Instead, 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). Of the eight whales tagged in that study, only one was observed to actually cease foraging.

Moreover, while we do believe that these results support a conclusion 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.,* 2002a; Winsor *et al.,* 2017). Importantly, the observed effect was not statistically significant and, as reported by the authors, constituted ''subtle effects on their foraging behavior.'' Furthermore, the authors of the Wood *et al.* (2012) study explicitly described their consideration of Miller *et al.* (2009) in the development of their recommended criteria. Therefore, the Wood *et al.* (2012) recommendation is indeed consistent with the Miller *et al.* (2009) study.

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. NRDC recommends that NMFS base a sperm whale threshold on the findings of a separate study of exposure of sperm whales and other species to sonar signals (Miller *et al.,* 2012). NMFS disagrees that behavioral response data for sperm whales exposed to mid-frequency active sonar (Miller *et al.,* 2012) is more appropriate than using data from the airgun exposures described by Miller *et al.* (2009) and already considered within the Wood *et al.* function. Furthermore, the alternative recommendation of Nowacek *et al.* (2015), which is repeatedly mentioned by NRDC as a more appropriate alternative to Wood *et al.* (2012), does not make a distinction between sperm whales and other odontocetes and instead advocates for a criteria that treats all marine mammal species the same (we address this in greater detail below).

Regarding other odontocetes, NRDC's representation of the available scientific information is also inaccurate. Miller *et al.* (2005) specifically state that ''[s]ighting rates at distances of 10–20 km from the airgun array were significantly lower than those in areas 20–30 km from the airgun array, where sighting rates were unexpectedly high'' (*i.e.,* the study indicates sighting rates of beluga whales (*Delphinapterus leucas*) were lower, not ''100% avoidance'' as claimed by NRDC). Miller *et al.* (2005) reported seven aerial beluga whale sightings from 8 to 18 km from the survey vessel and two vessel-based beluga whale sightings at 1.5 and 2.5 km from the survey vessel. Furthermore, Southall *et al.* (2007) described the findings of the Miller *et al.* (2005) study as temporary avoidance behaviors at these lower received levels, while Gomez *et al.* (2016) (which NRDC agrees reflects the best available science) evaluated Miller *et al.* (2005) based on a received level of 150 dB. Thus, the Wood *et al.* (2012) approach does capture responses associated with this study.

Additionally, Wood *et al.* (2012) has the advantage of accounting for sensitive species such as beaked whales, meaning that a response of a beaked whale at 140 dB (as cited by NRDC) is covered within the Wood *et al.* (2012) recommended criteria (*e.g.,* Wood *et al.* assumes 90 percent of an exposed beaked whale population will respond at 140 dB). If Nowacek *et al.* (2015) was instead used, as advocated by NRDC, the probability of response would only be 50 percent at 140 dB.

It should be noted that the systematic review by Gomez *et al.* (2016), cited by NRDC in support of their position, found that received level was not appropriate as the sole indicator of behavioral response. For example, this review shows that ''low'' effects were actually found to reach peak probability at a higher received level than ''moderate'' effects for baleen whales. As we discussed in our notice of proposed rulemaking, the results of the Gomez *et al.* (2016) review are not inconsistent with Wood *et al.* (2012). With regard to NRDC's comment that the authors consider their results ''non-conservative,'' Gomez *et al.* (2016) only indicates that they may have scored the severity of vocal responses higher if they had more information on the ecological significance of these types of responses. There is no indication elsewhere in Gomez *et al.* (2016) that their overall results and analysis are ''non-conservative.''

NRDC repeatedly cites Nowacek *et al.* (2015) in public comments. We note first that while NRDC repeatedly 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 (which is co-authored by the author of NRDC's comment letter) 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. We addressed the Nowacek *et al.* (2015) approach relative to the Wood *et al.* (2012) approach, in context of the best available scientific information, in detail in our notice of proposed rulemaking. Then, as now, we found that those recommendations are not justified by the available scientific evidence.

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 Level B harassment function that NRDC indicates as important, Nowacek *et al.* (2015) does not make distinctions between any species or species groups and provides 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. Few studies are offered in support of the recommended midpoint and the proposal is offered only in a one-page supplementary document. The Nowacek *et al.* (2015) approach is not well-supported scientific consensus, as NRDC's comment suggests.

Additionally, the application of the Nowacek *et al.* (2015) approach disregards the important role that distance from a source plays in the likelihood that an animal will respond to a given received level from that source type in a particular manner. By assuming, for example, a 50 percent midpoint at 140 dB rms, the approach implies an unrealistically high probability of marine mammal response to signals received at very far distances from a source (*e.g.,* greater than 50 km). DeRuiter *et al.* (2013) found that beaked whales exposed to similar received levels responded when the sound was coming from a closer source and did not respond to the same level received from a distant source. Although the Wood *et al.* (2012) approach does not specifically include a distance cut-off, the distances at which marine mammals are predicted to respond better comport with the distances at which behavioral responses have been detected and reported in the literature.

NRDC also criticizes the use of weighting functions in evaluating potential Level B harassment, and specifically criticizes use of the M-weighting scheme of Southall *et al.* (2007). Gomez *et al.* (2016) suggest that incorporation of frequency-weighting is necessary to account for differential hearing sensitivity, as behavioral responses in cetaceans are best explained by the interaction between sound source type and functional hearing group. That is, implementing weighting functions allows for consideration that different marine mammal groups do not hear varying frequencies of sound equally well. Thus, it is appropriate to account for sounds below a group's best hearing range having a lower likelihood of resulting in a behavioral response (let alone that animals are likely unable to effectively detect sounds at frequencies completely outside their hearing range).

The M-weighting functions are described in Southall *et al.* (2007) as ''intentionally precautionary (wide)'' (as opposed to the weighting functions used in NMFS' 2018 Revised Technical Guidance [2] to account for noise-induced hearing loss) and are used to account for the functional hearing ranges of different marine mammal hearing groups. This frequency weighting scheme was intentionally selected because it is more conservative in accounting for hearing sensitivity (as is appropriate in evaluating potential Level B harassment) than are more recently developed filters designed to better assess potential noise-induced hearing loss.

NRDC asserts that because M-weighting assumes that mid- and high-frequency (MF and HF) cetaceans are relatively insensitive to noise below 1 kHz, it is likely that the incorporation of M-weighting has a significant downwards effect on take estimates. This is incorrect. The table below illustrates the impact of M-weighting functions on frequencies ranging from 100 Hz to 1 kHz.

TABLE 3—IMPACT OF M-WEIGHTING FUNCTIONS ON FREQUENCIES RANGING FROM 100 Hz TO 1 kHz

Hearing group	Weighting (−dB) 1 kHz	500 Hz	250 Hz	100 Hz
Mid-frequency Cetaceans	−0.186 dB	−0.76 dB	−2.77 dB	−10 dB.
High-frequency Cetaceans	−0.034 dB	−1.33 dB	−4.45 dB	−13.6 dB.

We see that, at 250 Hz and above, the M-weighting functions do not result in a significant reduction (less than 3 dB for MF cetaceans and less than 5 dB for HF cetaceans). Furthermore, the lower bound of the functional hearing range of these groups is 150 Hz for MF cetaceans and 275 Hz for HF cetaceans (*i.e.,* sounds below 100 Hz, where most energy in airgun noise is found and where M-weighting results in the greatest reductions, are outside functional hearing range). At 1 kHz, where these species are most likely to be able to detect and respond to airgun noise, there is very little assumed reduction in sensitivity.

Finally, NRDC advocates for the use of a linear risk function as opposed to the multiple step function of Wood *et al.* (2012), stating that linear risk functions are scientifically accepted methodology that better acknowledge individuals may vary in responsiveness. Although NRDC does not specifically define what they mean by ''linear risk function,'' NMFS assumes a linear risk function is a smooth, continuous function, as opposed to a function defined by multiple steps, as is the case of Wood *et al.* (2012) (and Nowacek *et al.* (2015), which NRDC recommends as an alternative to Wood *et al.*). NRDC states that Wood *et al.* (2012) ''has a significant negative bias on take estimates'' where ''all exposures from 140 dB to 159.9 dB are considered to produce the same risk.'' While it is true that relying upon Wood *et al.* (2012) results in all exposures within a particular step (*e.g.,* 140 dB and 159.9 dB) having the same risk, and future risk functions may be further refined by incorporating more steps, Wood *et al.* (2012) better represents known variation in behavioral responses at different received levels than Nowacek *et al.* (2015), which provides only a suggested midpoint for a risk function without any guidance on what should be done above or below this midpoint, much less the linear risk function NRDC states should be used. Wood *et al.* (2012) does acknowledge that responsiveness varies with received levels, while relying on broad steps, rather than a continuous function. These broad steps allow for easier implementation of a risk function and are more practical for most users, which is an important consideration, especially in the context of users that may not have the ability or access to more sophisticated modeling (*i.e.,* non-Navy users). Therefore, if new linear risk functions become available, NMFS may still provide a more simplistic function broken down in broad steps, so that it can be applied by all users.

In referencing NMFS' proposal to use the recommendations of Wood *et al.,* and prior to even attempting to characterize the scientific evidence, NRDC states, ''Incredibly [NMFS'] approach produces take estimates that are substantially lower than the much-criticized, non-conservative, 160 dB threshold [. . .].'' NRDC (1) mischaracterizes criticism of the historic 160-dB threshold as being about the results of its use, rather than being about whether it adequately represents the best available science; (2) introduces an MMPA standard that does not exist in the statute (implying that NMFS is being unlawfully or improperly ''non-conservative''); and (3) suggests that NRDC favors whichever method of evaluating potential Level B harassment returns the highest estimate. This is repeated later in their comment when they assert that use of the Wood *et al.* recommendations are ''arbitrary and capricious'' because use of the recommendations ''appears, in its results, even less conservative than the outdated 160 dB threshold.'' However,

[2] NMFS. 2018. 2018 revision to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0). NOAA Technical Memorandum NMFS–OPR–59, National Marine Fisheries Service: 178.

selection of an evaluation scheme on the basis of the results it returns, rather than on how well the scheme reflects the available scientific literature, would be truly arbitrary and capricious and run counter to our mandates.

Overall, we reiterate the lack of scientific consensus regarding what criteria might be most appropriate for evaluating Level B harassment. Defining sound levels that disrupt behavioral patterns is difficult because responses depend on complex, difficult to predict contextual factors much more so than received level. Therefore, levels at which responses occur are not necessarily consistent and can be difficult to predict. However, although better methods of assessing likely behavioral response to acoustic stimuli than the relatively simple multi-step function used here may be forthcoming from the scientific community, NMFS is compelled to move forward with the best available information. We believe the recommendations of Wood *et al.* (2012) reflect the best available science.

Comment: NRDC notes NMFS' reference to a ''preliminary analysis'' in the discussion of acoustic thresholds for Level B harassment and asserts that NMFS must make the analysis publicly available and allow opportunity for public comment before finalizing the rule.

Response: Our use of the phrase ''preliminary analysis'' in the notice of proposed rulemaking merits some clarification. The particular analysis we referred to is not in and of itself pre-decisional or preliminary. Rather, it is a discrete analytical product with a result that will not change—it is one way (non-parametric regression method) of looking at one subset (Malme *et al.,* 1984, 1988; Houser *et al.,* 2013; Antunes *et al.,* 2014; Moretti *et al.,* 2014) of the data related to marine mammal behavioral responses to intermittent sound. NMFS conducted an analysis of relevant data starting with the premise of deriving a generic exposure-response curve using previously published exposure-response curves. This exercise was conducted as part of an ongoing separate and broader agency effort to evaluate behavioral response data. We also clarify that the Level B harassment criteria for this rule did not substantively rely upon that analysis.

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. NRDC states that NMFS instead 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 further states 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 criteria for Level B harassment.

Response: The 2018 Revised Technical Guidance's (NMFS, 2018) onset thresholds for 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 2018 Revised 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 2016 Technical Guidance (81 FR 51694; August 4, 2016; NMFS, 2016), indicated that onset of auditory injury (*i.e.,* permanent threshold shift (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 ITR 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 criteria in a previous comment response.

Comment: NRDC raised concerns regarding use of NMFS' 2018 Revised Technical Guidance (NMFS, 2018), claiming that the guidance is not based on the best available science and underestimates potential auditory injury. We also note that NRDC's comment references an attachment that was not provided.

Response: The 2018 Revised Technical Guidance (NMFS, 2018) 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 2016 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 NMFS 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. The concerns raised by NRDC have been addressed by NMFS in responses associated with the guidance (see *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*). In light of these considerations, NRDC's argument that use of the guidance is ''arbitrary and capricious'' is unpersuasive. As was stated in our notice of proposed rulemaking, NMFS considers the 2018 Revised Technical Guidance to represent the best scientific information currently available and, given the incorporation of multiple peer reviews and public comment opportunities during its development, we did not solicit and are not responding in detail to comments concerning the contents of the Technical Guidance (NMFS, 2016, 2018), as such comments are outside the scope of this rulemaking.

NRDC also referenced information related to occupational noise standards established by the National Institute of Occupational Safety and Health (NIOSH). Human noise risk assessments (NIOSH, 1998) are not equivalent (or applicable) to thresholds provided in the guidance, because they are used to predict hearing loss based on a daily 8-h exposure over 40 years (*i.e.,* current marine mammal TTS data are only available to predict exposure periods of 24-h or less and cannot be used to assess or predict risk associated with a lifetime of exposure) and are based on larger sample sizes of human listeners (*e.g.,* NIOSH 1972 and 1997 risk assessments were based on a sample size of 1,172 people). As pointed out in Wright (2015), NIOSH criteria provide a 95 percent confidence interval for their human noise standards but also allow for an excess risk of material hearing impairment, defined as an average threshold elevation for both ears that exceeds 25 dB, of eight percent (*i.e.,* human noise standards limits do allow for some risk; risk is not zero percent and specifically that eight percent of the population is still capable of developing noise-induced hearing loss exceeding 25 dB when exposed to the 85 dB NIOSH level).

Finally, we note that a group of scientists recently published an update to their original, seminal publication concerning noise exposure criteria to predict the onset of auditory effects in marine mammals (Southall *et al.,* 2007, 2019a), the topic of this comment. The newer publication evaluates the recommendations of the original publication in light of subsequent scientific findings, including those findings that form the basis for the recommendations of NMFS (2018). While Southall *et al.* (2019a) provide recommendations for future research that could lead to revisions, the fundamental aspects of an evaluation of the onset of auditory effects for the marine mammals considered in this ITR (*i.e.,* auditory weighting functions and noise exposure criteria) are identical to those presented by NMFS (2018) and incorporated into the modeling process developed for this ITR.

Sound Field Modeling

Comment: NRDC asserts that NMFS has not appropriately accounted for hard-bottom habitat in our propagation analysis, stating that there are areas of hard bottom in the GOM and that we cannot assume that proposed surveys will take place entirely in areas with soft or sandy bottoms.

Response: Sound propagation modeling performed in support of BOEM's PEIS and this ITR was developed to adequately represent a wide range of conditions for a variety of parameters, including bottom composition. NMFS does not assume that hard bottom does not exist in the GOM, but rather that it is not sufficiently predominant to warrant specific representation in a propagation modeling exercise covering the whole GOM. As shown in Figure 50 of the modeling report—depicting a compilation of surficial sediment composition available through a hydrographic survey database from NOAA's National Ocean Service and its predecessor, the U.S. Coast and Geodetic Survey—muds and sands are the dominant substrate types throughout the GOM (as stated in our notice of proposed rulemaking), with only small, scattered areas of hard bottom. The Minerals Management Service (MMS) report cited by NRDC, which concerns conversion of seafloor maps existing at the time to MMS-approved GIS format for use in geohazards evaluations, does not contradict this.

Substrate types for propagation modeling are based on grain size, porosity, and shear velocity, etc., and do not include ''hard'' or ''coral'' bottom. It is also important to note that, while some hard bottom habitats would increase propagation due to increased reflectivity, NRDC's statement that coral bottom can ''significantly increase propagation of airgun noise'' is erroneous. In fact, the roughness of the coral habitat would cause severe bottom loss due to scattering. As noted above, bottom composition in the region is mostly mud and sand and, therefore, selection of parameter values associated with these bottom types for propagation modeling is appropriate. We also note that, for the shelf region of the eastern GOM, where sand is predominant, a larger grain size value was selected to account for this. The acoustic modeling provided by Zeddies *et al.* (2015, 2017a) appropriately and reasonably accounts for variability in bottom composition throughout the region.

The modeling process requires the use of simplifying assumptions about oceanographic and seabed parameters, and these assumptions carry some uncertainty, which may lead to uncertainty in the form of variance or error in individual model outputs and in the final estimates of marine mammal acoustic exposures. It is for this reason that parametric uncertainty analysis was performed to evaluate the effects of this uncertainty ''envelope.'' (This analysis was summarized in our notice of proposed rulemaking and described in detail in the modeling report. NRDC does not reference this assessment.) Uncertainties in the results of acoustic propagation modeling were estimated by examining the variation in model outputs when model inputs were offset by realistic errors. The environmental properties were selected so that the median, or expected, value could be compared to a worst-case outcome (*e.g.,* assuming an extreme case of a more reflective bottom), which was generated by selecting extreme values for several input parameters. These comparisons represent the maximum errors in the predicted sound fields that result from incorrect specification of the parameters tested. As described in the modeling report, the greatest uncertainty due to geoacoustic parameters of the sea bottom is 4 dB (in the deep zone). The effect of the geoacoustic uncertainty increased when the sound speed profile was downwardly refracting. In the case of a surface channel (slope zone, winter season), the average difference between the median and worst-case was only 0.5 dB, *i.e.,* in this case the geoacoustic parameters had virtually no effect on the sound levels at the top of the water column (where marine mammals are likely to be present).

Marine Mammal Densities

Comment: NRDC criticized NMFS' use of the Roberts *et al.* (2016) model outputs for purposes of deriving abundance estimates, as used for comparison to exposure estimates herein. 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 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 rulemaking, 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.

The two potential sources of abundance data—the output of cetacean density models (Roberts *et al.,* 2016) and the available SARs data—provide different results, with the SARs estimates typically much lower. Differences between the two separate sets of abundance estimates result from key methodological differences. In order to produce sufficiently reliable and detailed density surfaces (maps), Roberts *et al.* (2016) combined multiple NMFS cetacean surveys and modeled density using a habitat-based approach (Miller *et al.,* 2013), while the SARs estimates utilized only the most recent NMFS survey and estimated density using traditional distance sampling (Buckland *et al.,* 2001). The two approaches, while compatible and based on a common statistical framework (distance sampling), can yield different results, depending on complex factors such as whether population sizes have changed, or species habitat preferences have shifted over time. Neither approach will necessarily yield a higher abundance estimate than the other, but use of multiple years of data in developing an abundance estimate minimizes the influence of interannual variation in over- or underestimating actual abundance. By linking sightings with environmental conditions, habitat-based density layers represent smoothed surfaces that are not biased by anomalous conditions. This makes them particularly appropriate for the five-year timeframe of this ITR, which will span varying environmental conditions.

To illustrate why this smoothing of interannual variation helps to create a meaningful comparison to take estimates, we provide the extreme example of the GOM Clymene dolphin. NMFS' 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' 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 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 against an abundance estimate of 129 dolphins. Our goal in assessing predicted takes is to generate a meaningful comparison, which is accomplished through use of the model-predicted abundance.

A second key methodological difference explains the tendency for the model-predicted abundance estimates to be higher than the SARs estimates. SAR abundance estimates are typically underestimates of actual abundance because they do not account for bias on the ability of observers to detect animals—in contrast, Roberts *et al.* (2016) do account for availability bias and perception bias on the probability of sighting an animal. Availability bias occurs when a model assumes that animals are always available to be observed by the survey team when, in fact, they are not. Cetaceans are diving animals; while submerged, they are unavailable. Assuming diving animals are always available results in an underestimation of abundance, because while they are diving they are present but not counted by the survey team. Perception bias occurs when a model assumes that animals will always be detected when they are on the survey trackline, when, in fact, detection is not certain.

With regard to bias correction, NRDC suggests that such corrections are incorporated into NMFS' GOM SARs. However, some correction has been performed only for the more-recently surveyed shelf and coastal stocks of bottlenose dolphin, *i.e.,* four out of the 25 stocks of GOM marine mammals considered herein. NRDC also strangely suggests that ''NMFS doesn't show that applying trackline correction factors consistent with Barlow (2015), who reported trackline detection probabilities for marine mammals in the Pacific, would result in population estimates consistent with the ones the agency has derived from Roberts *et al.* (2016).'' We can safely assume that these would be consistent, given that the models developed by Roberts *et al.* (2016) considered, and in some cases directly incorporated, the correction factors of Barlow (1999) and Barlow and Forney (2007) (the original work upon which Barlow (2015) builds).

These issues, which are typical for NMFS' SAR abundance estimates, are particularly exacerbated for GOM stocks. For the majority of stocks, the most recent abundance estimates are derived from the results of vessel-based surveys in 2009, *i.e.,* even if one believes that such ''snapshot'' estimates are most appropriate, the GOM estimates are out of date and NMFS' guidelines state that data greater than eight years old should not be used for abundance estimates. (We note that more recent survey effort has been conducted, but corresponding abundance estimates have only recently been made available via unpublished draft SARs for most stocks that have yet to be available for public comment or finalized at the time the analyses were completed for these regulations.) More important for cryptic species, *i.e.,* those species that spend little time at the surface and/or are difficult to detect when at the surface, is the lack of any bias correction. For example, the Cuvier's beaked whale—a cosmopolitan species and perhaps the most widespread and most commonly observed species of beaked whale—is officially estimated by NMFS to number 74 individuals in the GOM, a clear underestimate. For purposes of reference, current abundance estimates for the U.S. Pacific and Atlantic stocks—for which some bias corrections have been made—are 3,274 and 5,744 individuals, respectively. Marine mammal scientists working in the GOM have acknowledged that the likely abundance of beaked whales (and other cryptic species, such as *Kogia* spp.) should be expected to be closer to the values predicted by Roberts *et al.* (2016) than those given in the SARs. For example, Dias and Garrison (2016) state that current abundance estimates for *Kogia* spp. may be considerably underestimated due to the cryptic behavior of these species and difficulty of detection in Beaufort sea state greater than one, while density estimates for certain species derived from long-term passive acoustic monitoring are much higher than are estimates derived from visual observations (*e.g.,* Hildebrand *et al.,* 2015). Separately, NMFS' announcement of a negative 90-day finding on a petition to list the GOM Cuvier's beaked whale as endangered (84 FR 11058) included adoption of the abundance estimate of Roberts *et al.* (2016) as being most appropriate. Roberts *et al.* (2015b) summarize this situation: ''Because [NMFS' SAR] estimates are very low relative to the abundance we estimated, it is likely that if our [density] results are used to estimate population-level impacts from potentially harmful human activities (*i.e.* ''takes'', as defined by the Marine Mammal Protection Act), the estimated impacts will be very high [. . .].''

NRDC suggests 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' 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 minimize the effect of interannual variability, and, importantly, should provide a meaningful comparison. In this light, our use of the Roberts *et al.* (2016) abundance estimates are not a ''radical departure from past practice,'' as claimed by NRDC. Our practice, as mandated by our implementing regulations, is to use the best scientific evidence available. NRDC states that ''NMFS cannot simply discard this Congressionally mandated estimate in favor of the larger population estimates derived from its misapplication of the [. . .] model.'' The statute does not mandate use of the SARs for comparison with take estimates.

Aside from their failure to explain the claim of ''misapplication,'' and the unwarranted implication that we must make use of the model-generated abundance estimates simply because they are larger (and not because they are the best available scientific information), NRDC errs in asserting that the MMPA requires that we use SAR abundance estimates. Section 117 of the MMPA requires the development of SARs, and dictates certain information that SARs must provide. However, there is no part of the MMPA that requires the population abundance estimates given in a SAR to be used in any specific application and, importantly, the MMPA does not even require that the SAR include a best population estimate. The MMPA requires only that SARs provide a minimum population estimate, which is used in the formulation of a potential biological removal (PBR) level, which is then required by section 118 of the MMPA for certain uses in the management of marine mammal take incidental to commercial fisheries. In summary, NRDC's comment reflects an inaccurate interpretation of the available information, and NMFS disagrees with the approach recommended by the comment.

Take Estimates

Comment: The Associations state that ''NMFS substantially overestimates the number of incidental takes predicted to result'' from the specified activity. The comment goes on to discuss the modeling that is ''intentionally designed to overestimate takes,'' and discusses the findings of the *Acoustic Exposure Model Variable Analysis* (Zeddies *et al.,* 2017b) (which was provided for public review in association with the proposed rule). Other industry commenters and the CRE echo these points.

Response: The commenters' statements that NMFS has substantially overestimated takes are incorrect. We used current scientific information and state-of-the-art acoustic propagation and animal movement modeling to reasonably estimate potential exposures to noise. Chevron stated that the modeling used ''admittedly erroneous models'' but provides no supporting information or citation. Chevron further describes ''errors in methodology'' and ''admissions'' that the modeling methodology and the data used are not ''rigorous science,'' while asserting that NMFS ''repeatedly rejects and omits science that is available.'' Chevron's comments do not provide any illumination as to what specifically these errors may be, what data it believes is flawed, or what ''science'' NMFS has rejected or omitted. NMFS has considered all relevant available scientific information.

To summarize in a basic way, it is foreseeable that a large amount of noise-producing activity, such as BOEM's application and PEIS describe, results in a substantial number of predicted acoustic exposures. Despite recommending that ''a better approach would be to use the best and most likely values for all of the input variables to the model,'' the Associations' comments do not include substantive recommendations for improvement. They do not specify which of the many data inputs are ''conservative'' or to what degree, nor do they recommend alternatives to the choices that were painstakingly documented in developing the modeling.

As was noted in the notice of proposed rulemaking, NMFS disagrees with the Associations' characterization of the modeling and with certain statements in BOEM's draft PEIS regarding the modeling that are frequently cited by the Associations. As we stated in the notice, BOEM's draft PEIS included unsupported and erroneous statements that characterized the modeling results—which BOEM and NMFS developed collaboratively—as ''unrealistically high,'' ''overly conservative,'' and representative of a ''worst-case scenario,'' among other things. These statements were included in that document without NMFS' prior knowledge. Importantly, as a result of NOAA's public comments on that draft PEIS in its role as a cooperating agency, the statements referenced by the commenters were properly removed from the final PEIS, which more accurately characterizes the modeling process and results.

The Associations take out of context a number of statements from the discussion in NMFS' notice of proposed rulemaking of the modeling process, data inputs, and user selections. We address these in turn:

- The Associations quote NMFS as stating that our modeling likely ''leads to substantial overestimates of the numbers of individuals potentially disturbed [and] . . . to an overestimation of the population-level consequences of the estimated exposures'' and that, even with the application of a correction factor, the modeling still represents an ''overestimate.'' (83 FR 29261, 29291). But the full statement in our notice is as follows: ''While the modeling provides reasonable estimates of the total number of instances of exposure exceeding Level B harassment criteria, it is likely that it leads to substantial overestimates of the numbers of individuals potentially disturbed, given that all animals within the areas modeled are unlikely to be completely replaced on a daily basis. Therefore, in assuming an increased number of individuals impacted, these results would lead to an overestimation of the potential population-level consequences of the estimated exposures.'' Our point was that, although the modeling provides reasonable estimates of the total amount of acoustic exposures, it would be an overestimate to interpret this total as representative of the number of individuals impacted. We then discussed our development of a correction factor to address this issue (see Table 12 of the notice of proposed rulemaking).

- The Associations highlight our ''admission'' that the modeling is purposely conservative. We address this below by explaining why, in some cases, it is appropriate to make reasonably conservative choices.
- The Associations mischaracterize the Wood *et al.* (2012) Level B harassment criteria as ''expressly rejecting the best available science.'' In discussing different versions of frequency weighting functions, we stated that ''Type III filters'' are better designed to predict the onset of auditory injury, while explaining why use of ''Type I filters'' (or M-weighting) was appropriate for use in evaluation of Level B harassment (83 FR 29248). The Type III filters, as adopted by NMFS (2018), were appropriately used for evaluation of Level A harassment (which includes auditory injury).
- Although characterized as ''conservative'' NMFS has made reasonable choices through the application of professional judgment by subject matter experts. For example, using single airgun modeling results in lieu of boomer results was a choice made for computational efficiency precisely because it was not significantly influential on the results. (83 FR 29251). And selecting an estimate for standard deviation in an investigation of model sensitivity to source level variance was in response to a concern of the commenters—overall sensitivity of the model to uncertainty in input parameters and the resulting uncertainty in model results—and had no bearing on the model results (83 FR 29257).
- The Associations also highlight our statement that ''the lack of aversion within the animal movement modeling process results in overestimates of potential injurious exposure,'' without noting that we corrected this issue through a post-hoc correction to reasonably account for aversion.

The modeling required that a number of assumptions and choices be made by subject matter experts and, in most cases, the most representative data or methods were used. As we acknowledged, in some cases, some assumptions or choices are purposely conservative (where the conservative choice is reasonable) to minimize the likelihood of underestimating the potential impacts on marine mammals represented by a specified level of survey effort. These are reasonable, scientifically acceptable choices that do not create, as the Associations state, ''multiplicatively accumulating bias as the conservative assumptions interact with each other to multiply uncertainty''). To the extent that the results of the modeling may be conservative, they are the most credible, science-based information available at this time (assuming the notional 8,000 in^3 array and activity level projections specified by BOEM in the petition).

These comments provide no reasonable justification as to why the modeling results in overestimates of take. The Associations instead seem to rely on the incorrect premise that real-time mitigation would somehow reduce actual levels of acoustic exposure (versus reducing the duration and/or intensity of exposure). NMFS disagrees that ''each of the inputs is purposely developed to be conservative''—again, the Associations do not provide any support for this assertion, and none is to be found in the administrative record for this action. Although it may be correct that some conservativeness accumulates throughout the analysis, the Associations do not adequately describe the nature of conservativeness associated with model inputs or the degree to which such conservativeness ''accumulates'' (either quantitatively or qualitatively), nor do they offer more appropriate alternatives.

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 the GOM 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. The notice of proposed rulemaking described all aspects of the modeling effort in significant detail, including numerous investigations (test scenarios) designed by the agencies to understand various model sensitivities and the effects of certain choices on model results. The modeling report itself was provided for public review, in association with both BOEM's PEIS and NMFS' notice of proposed rulemaking.

We quote the Marine Mammal Commission's public comment on this topic: ''Complex sound propagation and animat modeling was used to estimate the numbers of potential takes from various types of geophysical surveys in the Gulf. NMFS received comments from industry operators suggesting that the modeling results were overly conservative and that the take estimates were 'higher than BOEM expects would actually occur in a real world environment.' However, the Commission has reviewed the modeling approach and parameters used to estimate takes and believes they represent the best available information regarding survey scenarios, sound sources, physical and oceanographic conditions in the Gulf, and marine mammal densities and behavior. As such, the Commission agrees with NMFS and BOEM that the resulting take estimates were conservative but reasonable, thereby minimizing the likelihood that actual takes would be underestimated.''

The CRE says, absent citation or reference, that ''everyone agrees'' that takes are overestimated. Their assertion that we ''greatly overestimate both exposures and takes'' is based on their view that we relied on ''flawed models and on Risk Assessment Frameworks that are unfinished and have not been peer reviewed.'' While the Associations focus on supposed conservatism built into the modeling process, the CRE appears to believe that there is some unknown process by which modeled exposures are ''converted'' to takes. (''These take overestimates stem primarily from [NMFS'] use of various models to convert exposures to takes [. . .]. They have no credible framework for converting exposure to takes.'') We believe the CRE is likely referring to the EWG risk assessment framework, which is a systematic analysis used as an aid to understanding the significance of the modeled takes to the affected stocks. However, this framework plays no role in the estimation of takes (takes are an input to the EWG framework) and is not itself a ''model.'' CRE also makes the claim, addressed elsewhere in this response, that the take estimates ''do not include the impact of mitigation measures.''

Regarding the modeling variable analysis submitted by the Associations (Zeddies *et al.,* 2017b), we have fully considered the results in developing this final ITR,[3] but do not find that the

[3] The Associations misunderstand the timeline relating to the availability of the report for NMFS' consideration for developing the proposed rule. (''NMFS inexplicably dismisses [the report] as being provided too late despite the fact that it was provided to NMFS 11 months ago''). We must correct the record on this point. The analysis was submitted by IAGC for NMFS' consideration on September 6, 2017, well after the total 45-day comment period on the petition had closed (81 FR 88664 (December 8, 2016, notice of receipt of petition providing for 30-day comment period); 81 FR 92788 (extending comment period an additional 15 days to January 23, 2017)). The final PEIS was then issued in August 2017. Subsequent materials could no longer be considered as NMFS prepared

analysis supports any changes to the modeling. IAGC and API contracted with JASCO Applied Sciences, which performed the original modeling effort, to conduct additional analysis regarding the effect that various acoustic model parameters or inputs have on the outputs used to estimate numbers of animals exposed to threshold levels of sound from geophysical sources used in the GOM. The analysis investigated five factors:

- Airgun array size (including total volume, number of array elements, element air pressure, array geometry and spacing) used in source and propagation models;
- Acoustic threshold criteria and associated weighting used to calculate exposures;
- Animal densities used for adjusting simulated computer model exposures to potential real-world animal exposures;
- Natural aversive behaviors of marine mammals; and
- The addition of mitigative measures that lessen the potential for animals' exposure to threshold levels of seismic sound.

The primary finding of the Acoustic Exposure Model Variable Analysis is that use of appropriate acoustic injury criteria (*i.e.,* NMFS, 2016, 2018) decreased predictions of injurious exposure. At the time the Associations submitted this report, they were apparently unaware that, as described herein, *NMFS had already made the change that the Associations' analysis indicates is most significant:* The appropriate acoustic injury criteria (*i.e.,* NMFS, 2016, 2018), representing the best available science, were used in NMFS' analysis in the proposed rule. Other significant investigations in the Associations' modeling variable analysis included an alternative array size and quantitative consideration of animal aversion and mitigation effectiveness. We address these below.

The Associations state that the selected array (8,000 in^3) is unrealistically large, resulting in an overestimation of likely source levels and, therefore, size of the sound field with which marine mammals would interact. Zeddies *et al.* (2017b) evaluated the use of a substitute 4,130 in^3 array, finding that reduction in array volume reduces the number of predicted exposures. Use of a smaller airgun array volume with lower source level unsurprisingly creates a smaller ensonified area resulting in fewer numbers of animals expected to exceed exposure thresholds. However, selection of the representative array to be used in the modeling was directed by the ITR applicant (*i.e.,* BOEM). Given that the array used was selected by the applicant and included in the petition for the ITR (which was available for public comment in our **Federal Register** notice of receipt of BOEM's application), any complaint regarding this or other aspects of the specified activity, including activity level projections and representative source characteristics or survey geometry, should be addressed to BOEM. According to BOEM, the particular array was selected as a realistic representative proxy after BOEM's discussions with individual geophysical companies. An 8,000-in^3 array was considered reasonable, as it falls within the range of typical airgun arrays currently used in the GOM, which are roughly 4,000–8,475 in^3 (BOEM, 2017). According to BOEM's permitting records, approximately one-third of arrays used in a recent year were 8,000 in^3 or greater. Also, as noted previously, regardless of the representative airgun array size used to model the number of takes of marine mammals for the purposes of the analysis conducted in this rule, the analysis of the take and the associated findings are applicable to take incurred from the use of other sizes of airgun arrays, including smaller ones such as those modeled in the Acoustic Exposure Model Variable Analysis report.

The Associations' comments also focus significantly on the need to incorporate quantitative adjustments to account for aversion and mitigation. As discussed in the notice of proposed rulemaking, the effects of mitigation and aversion on exposure estimates were investigated via test scenarios, and NMFS acknowledges that both of these factors would lead to a reduction in likely injurious exposure to some degree. (As noted above, the issue of aversion was addressed via post-hoc quantitative adjustment). Ultimately these factors were not quantified in the modeling because, in summary, there is too much inherent uncertainty regarding the effectiveness of detection-based mitigation for these activities to support any reasonable quantification of its effect in reducing injurious exposure, and there is too little information regarding the likely level of onset and degree of aversion to justify its use in the modeling via precise quantitative control of animat movements (as compared to post-hoc adjustment of the modeling results, as is done here). Zeddies *et al.* (2017b) found that incorporation of aversion into the modeling process appears to reduce the number of predicted injurious exposures, though the magnitude of the effect was variable. The authors state that this variability is likely because there are few samples of injurious exposure exceedance, meaning that the statistical variability of re-running simulations is evident.

While aversion and mitigation implementation are expected to reduce somewhat the modeled levels of injurious exposure, it is important to note that they would not be expected to result in any meaningful reduction in assumed exposures resulting in Level B harassment, nor in total takes by harassment, as any averted injurious (Level A harassment) takes would not be alleviated, but rather would be appropriately changed to behavioral disturbance (Level B harassment) takes. The Associations, acknowledging the analysis we have done to produce more realistic estimates of potential Level A harassment, are focused on the supposed overestimation of Level B harassment. Yet their focal areas of complaint are limited to array size, which is a decision made by BOEM, and mitigation effectiveness, a factor that would have no effect on the amount of predicted Level B harassment. With regard to the large number of other data inputs and/or choices made in the modeling, the Associations conclude that ''NMFS has admittedly chosen conservative numerical values to assess allegedly uncertain variables to overestimate adverse effects,'' without specifically identifying a single issue where they feel a meaningful data or process error was made.

Comment: The CRE recommends a different method of estimating potential take of marine mammals, stating that NMFS ''should continue to use Line Transect to estimate exposures and takes.''

Response: Although CRE does not actually describe the method they recommend, we infer that they are referencing a relatively simplistic method historically used in estimating acoustic exposures, typically on a survey-specific basis. Essentially, this methodology consists of: (1) Determination of estimated isopleth ranges from the source for a specified acoustic threshold (nominally this threshold was historically the 160 dB

the draft proposed rule for interagency review. The rule was submitted to OMB on October 3, 2017. Upon submission, no further changes could be made to the rule other than those arising pursuant to the interagency review. The Office of Information and Regulatory Affairs cleared the proposed rule on June 11, 2018, whereupon it was submitted to the **Federal Register** on June 12 and published on June 22. Therefore, the analysis was not able to be considered by NMFS in the notice of proposed rulemaking despite the length of time between submission of the report to NMFS and publication of the proposed rule.

rms received level for Level B harassment); (2) assumption that a cylinder whose radius matched the range to these isopleths and encompassed the entire water column was ensonified to that threshold; (3) calculating the surface area ensonified by this water column as the source moved along its track; and (4) multiplying that resultant ensonified surface area by the density of each marine mammal species present to estimate potential harassment takes. (Note that this process is somewhat more complicated for evaluation of 3D surveys.) In this case, following a modeling workshop held in 2014 as a collaborative effort between the American Petroleum Institute (API) and the International Association of Geophysical Contractors (IAGC), NMFS, and BOEM, the agencies determined that it would be most appropriate to collaborate on a more sophisticated approach, in which more detailed modeling of the source and its properties, the acoustic propagation field in three dimensions, and three dimensional animal placement and movement is used to better calculate the potential impacts to marine mammals. To summarize aspects of the process:

- *Operational Scenario Development:* According to BOEM, the source and operations scenarios presented in the petition and which underlie the modeling effort were based on historical permit information. BOEM sought industry input and used historical data to develop the specification of the nominal airgun array. The array specifications and level of survey effort were intended to be representative of future activity, not a conservative over-estimate.
- *Acoustic Modeling:* The propagation model output has been compared with measured data and been shown to be reliable. The physical inputs to the model are the best available data. The full sound field was used to predict exposures, not a 'maximum over depth' simplification.
- *Animal Modeling:* The animal movement model used is one of the few models available that incorporates full four-dimensional movement. Properly applied, such models provide the most accurate predictions of acoustic exposure.
- *Animal Density:* The density and distribution data used were the best available and represent the latest synthesis and analysis.
- *Effects Criteria:* The historical Level B harassment threshold of 160 dB has been criticized for multiple reasons, and the use of the Wood *et al.* (2012) criteria in this analysis allows for the application of current scientific information to address some of the issues raised. The best available science relating to potential auditory injury, as synthesized in NMFS (2018) and more recently described by Southall *et al.* (2019a), was used in the modeling effort.

Taking advantage of these more sophisticated tools allows for a more accurate and detailed model of the exposures of a population of marine animals in the three dimensions and time, and also provides: (1) Statistical data on each individually modeled animal and the population as a whole; (2) rate of exposure (threshold exceedance per unit time) over the duration of a survey; and (3) the data necessary to determine effects based on more sophisticated thresholds, such as cumulative sound exposure level. A comparison of these methods—animat method involving three-dimensional animal movement modeling and static distribution, in which a static two-dimensional density is overlaid on a simplified representation of the sound field—found that differences consistently arise between the two methods. The static distribution method was found to consistently underestimate the number of takes by Level B harassment compared with the animat method. In addition, repeating many simulations with the animat method provides a more robust risk assessment and provides a better measure of variability (Schecklman *et al.,* 2011).

We agree with CRE (and our own statements, as cited by CRE) that sophisticated modeling is not a requirement of the MMPA process. However, all take estimation requires the use of modeling; the difference between various approaches to estimating take is the degree of sophistication of the modeling approach employed. We note that the National Science Foundation (NSF) typically utilizes the method espoused by CRE in take authorization requests for specific surveys. In order to derive the necessary estimated isopleth distance, NSF applications typically use Nucleus (a source model) in conjunction with ray trace modeling to approximate propagation of the acoustic signatures. The modeling developed by BOEM and NMFS supports both BOEM's 2017 PEIS and the analyses conducted for this rulemaking, and additionally is available for use in supporting LOA applications to maximize efficiency of the LOA process for disparate applicants. However, we have made clear that LOA applicants are free to pursue a different method of estimating takes than the modeling effort developed collaboratively by NMFS and BOEM. Use of a different analytical method in support of an LOA application will necessarily require additional review.

CRE compares ''Line Transect'' modeling performed in support of a 2004 Minerals Management Service Environmental Assessment to that developed in support of this effort, stating that the take estimates generated in that effort are ''orders of magnitude smaller than the take estimates'' evaluated here. CRE's erroneous implication is that the only difference between the two efforts is the modeling approach. (''The great difference between GOM takes as estimated by Line Transect, and as estimated by [NMFS]'s current models, demonstrates just how inaccurate and exaggerated the model take estimates are.'') However, the inputs to the two efforts are significantly different. Most notably, the assumptions relating to projected effort, animal occurrence, and sound source output are not comparable. Effort projections for the 2004 modeling were roughly 53 percent of those given by BOEM for the high effort scenario in the PEIS, and included only relatively archaic 3D survey geometries, versus the more complex azimuth designs and coil surveys considered herein. Advances in cetacean density modeling provide estimates for use here that are, in some cases, multiple orders of magnitude greater than the poor estimates used in the 2004 effort. The 15-year old modeling held up by CRE as a good example assumed a 4,550 in^3 acoustic source with a uniform 3 km isopleth distance to the 160-dB rms threshold. BOEM specified use of an 8,000 in^3 acoustic source for the modeling effort here, with a mean distance to the 160 dB isopleths of 12.7 km, but even more recent modeling of a more comparable source (4,130 in^3) shows that the isopleth distance may be as large as 8.4 km, depending on the season (Zeddies *et al.,* 2017b). Moreover, the 2004 modeling reduced even that ensonified area by an arbitrary 50 percent to account for an ''elliptical zone of ensonification.'' It is clear that the two modeling efforts are in no way comparable.

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, 2019a) and in NMFS' 2018 Revised Technical Guidance to define PTS onset (*i.e.,* 40 dB). It is unknown whether smaller levels of 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' 2018 Revised 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 active (MFA) navy sonar. Military 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. Yet NRDC infers that because strandings of beaked whales have been correlated with navy MFA sonar use, strandings are also likely to occur due to seismic surveys. As explained below, navy MFA sonar is very different from airguns, and it is not reasonable to assume that airguns will cause the same effects as navy MFA sonar (including strandings).

To understand why navy MFA sonar affects beaked whales differently than airguns do, it is important to note the distinction between behavioral sensitivity and susceptibility to auditory injury. To understand the potential for auditory injury in a particular marine mammal species in relation to a given acoustic signal, the frequency range the species is able to hear is critical, as well as the species' auditory sensitivity to frequencies within that range. Current data indicate that not all marine mammal species have equal hearing capabilities across all frequencies and, therefore, species are grouped into hearing groups with generalized hearing ranges assigned on the basis of available data (Southall *et al.,* 2007, 2019a). Hearing ranges as well as auditory sensitivity/susceptibility to frequencies within those ranges vary across the different groups. For example, in terms of hearing range, the high-frequency cetaceans (*e.g., Kogia* spp.) have a generalized hearing range of frequencies between 275 Hz and 160 kHz, while mid-frequency cetaceans—such as dolphins and beaked whales—have a generalized hearing range between 150 Hz to 160 kHz. Regarding auditory susceptibility within the hearing range, while mid-frequency cetaceans and high-frequency cetaceans have roughly similar hearing ranges, the high-frequency group is much more susceptible to noise-induced hearing loss during sound exposure, *i.e.,* these species have lower thresholds for these effects than other hearing groups (NMFS, 2018). Referring to a species as behaviorally sensitive to noise simply means that an animal of that species is more likely to respond to lower received levels of sound than an animal of another species that is considered less behaviorally sensitive. So, while dolphin species and beaked whale species—both in the mid-frequency cetacean hearing group—are assumed to (generally) hear the same sounds equally well and be equally susceptible to noise-induced hearing loss (auditory injury), the best available information indicates that a beaked whale is more likely to behaviorally respond to that sound at a lower received level compared to an animal from other mid-frequency cetacean species that is less behaviorally sensitive. This distinction is important because, while beaked whales are more likely to respond behaviorally to sounds than are many other species (even at lower levels), they cannot hear the predominant, lower frequency sounds from seismic airguns as well as sounds that have more energy at frequencies that beaked whales can hear better (such as navy MFA sonar).

Navy MFA sonar affects beaked whales differently than airguns do because it produces energy at different frequencies than airguns. Mid-frequency cetacean hearing is generically thought to be best between 8.8 to 110 kHz, *i.e.,* these cutoff values define the range above and below which a species in the group is assumed to have declining auditory sensitivity, until reaching frequencies that cannot be heard (NMFS, 2018). However, beaked whale hearing is likely best within a higher, narrower range (20–80 kHz, with best sensitivity around 40 kHz), based on a few measurements of hearing in stranded beaked whales (Cook *et al.,* 2006; Finneran *et al.,* 2009; Pacini *et al.,* 2011) and several studies of acoustic signals produced by beaked whales (*e.g.,* Frantzis *et al.,* 2002; Johnson *et al.,* 2004, 2006; Zimmer *et al.,* 2005). While precaution requires that the full range of audibility be considered when assessing risks associated with noise exposure (Southall *et al.,* 2007, 2019a), animals typically produce sound at frequencies where they hear best. More recently, Southall *et al.* (2019a) suggested that certain species amongst the historical mid-frequency hearing group (beaked whales, sperm whales, and killer whales) are likely more sensitive to lower frequencies within the group's generalized hearing range than are other species within the group and state that the data for beaked whales suggest sensitivity to approximately 5 kHz. However, this information is consistent with the general conclusion that beaked whales (and other mid-frequency cetaceans) are relatively insensitive to the frequencies where most energy of an airgun signal is found. Navy MFA sonar is typically considered to operate in the frequency range of approximately 3–14 kHz (D'Amico *et al.,* 2009), *i.e.,* outside the range of likely best hearing for beaked whales but within or close to the lower bounds, whereas most energy in an airgun signal is radiated at much lower frequencies, below 500 Hz (Dragoset, 1990).

It is important to distinguish between energy (loudness, measured in dB) and frequency (pitch, measured in Hz). In considering the potential impacts of mid-frequency components of airgun noise (1–10 kHz, where beaked whales can be expected to hear) on marine mammal hearing, one needs to account for the energy associated with these higher frequencies and determine what energy is truly ''significant.'' Although there is mid-frequency energy associated with airgun noise (as expected from a broadband source and as we acknowledged in the notice of proposed rulemaking), airgun sound is predominantly below 1 kHz (Breitzke *et al.,* 2008; Tashmukhambetov *et al.,* 2008; Tolstoy *et al.,* 2009). As stated by Richardson *et al.* (1995), ''[. . .] most emitted [seismic airgun] energy is at 10–120 Hz, but the pulses contain some energy up to 500–1,000 Hz.'' Tolstoy *et al.* (2009) conducted empirical measurements, demonstrating that sound energy levels associated with airguns were at least 20 decibels (dB) lower at 1 kHz (considered ''mid-frequency'') compared to higher energy levels associated with lower frequencies (below 300 Hz) (''all but a small fraction of the total energy being concentrated in the 10–300 Hz range'' [Tolstoy *et al.,* 2009]), and at higher frequencies (*e.g.,* 2.6–4 kHz), power might be less than 10 percent of the peak power at 10 Hz (Yoder, 2002). Energy levels measured by Tolstoy *et al.* (2009) were even lower at frequencies above 1 kHz. In addition, as sound propagates away from the source, it tends to lose higher-frequency components faster than low-frequency components (*i.e.,* low-frequency sounds typically propagate longer distances than high-frequency sounds) (Diebold *et al.,* 2010). Although higher-frequency components of airgun signals have been recorded, it is typically in surface-ducting conditions (*e.g.,* DeRuiter *et al.,* 2006; Madsen *et al.,* 2006) or in shallow water, where there are advantageous propagation conditions for the higher frequency (but low-energy) components of the airgun signal (Hermannsen *et al.,* 2015). This should not be of concern because the likely behavioral reactions of beaked whales that can result in acute physical injury would result from noise exposure at depth (because of the potentially greater consequences of severe behavioral reactions) and because, even if near-surface exposure to such higher-frequency components were of concern, oceanographic conditions in the GOM do not consistently support such ducting conditions. In summary, the frequency content of airgun signals is such that beaked whales will not be able to hear the signals well (compared to MFA sonar), especially at depth where we expect the consequences of noise exposure could be more severe.

Aside from frequency content, there are other significant differences between MFA sonar signals and the sounds produced by airguns that minimize the risk of severe behavioral reactions that could lead to strandings or deaths at sea, *e.g.,* significantly longer signal duration, horizontal sound direction, typical fast and unpredictable source movement. All of these characteristics of MFA sonar tend towards greater potential to cause severe behavioral or physiological reactions in exposed beaked whales that may contribute to stranding. Although both sources are powerful, MFA sonar contains significantly greater energy in the mid-frequency range, where beaked whales hear better. Short-duration, high energy pulses—such as those produced by airguns—have greater potential to cause damage to auditory structures (though this is unlikely for mid-frequency cetaceans, as explained later in this document), but it is longer duration signals that have been implicated in the vast majority of beaked whale strandings. Faster, less predictable movements in combination with multiple source vessels are more likely to elicit a severe, potentially anti-predator response. Of additional interest in assessing the divergent characteristics of MFA sonar and airgun signals and their relative potential to cause stranding events or deaths at sea is the similarity between the MFA sonar signals and stereotyped calls of beaked whales' primary predator: The killer whale (Zimmer and Tyack, 2007). Although generic disturbance stimuli—as airgun noise may be considered in this case for beaked whales—may also trigger antipredator responses, stronger responses should generally be expected when perceived risk is greater, as when the stimulus is confused for a known predator (Frid and Dill, 2002). In addition, because the source of the perceived predator (*i.e.,* MFA sonar) will likely be closer to the whales (because attenuation limits the range of detection of mid-frequencies) and moving faster (because it will be on faster-moving vessels), any antipredator response would be more likely to be severe (with greater perceived predation risk, an animal is more likely to disregard the cost of the response; Frid and Dill, 2002). Indeed, when analyzing movements of a beaked whale exposed to playback of killer whale predation calls, Allen *et al.* (2014) found that the whale engaged in a prolonged, directed avoidance response, suggesting a behavioral reaction that could pose a risk factor for stranding. Overall, these significant differences between sound from MFA sonar and the mid-frequency sound component from airguns and the likelihood that MFA sonar signals will be interpreted in error as a predator are critical to understanding the likely risk of behaviorally-mediated injury due to seismic surveys.

The available scientific literature also provides a useful contrast between airgun noise and MFA sonar regarding the likely risk of behaviorally-mediated injury. There is strong evidence for the association of beaked whale stranding events with MFA sonar use, and particularly detailed accounting of several events is available (*e.g.,* a 2000 Bahamas stranding event for which investigators concluded that MFA sonar use was responsible; Evans and England, 2001). D'Amico *et al.* (2009) reviewed 126 beaked whale mass stranding events over the period from 1950 (*i.e.,* from the development of modern MFA sonar systems) through 2004. Of these, there were two events where detailed information was available on both the timing and location of the stranding and the concurrent nearby naval activity, including verification of active MFA sonar usage, with no evidence for an alternative cause of stranding. An additional ten events were at minimum spatially and temporally coincident with naval activity likely to have included MFA sonar use and, despite incomplete knowledge of timing and location of the stranding or the naval activity in some cases, there was no evidence for an alternative cause of stranding.[4] Separately, the International Council for the Exploration of the Sea reported in 2005 that, worldwide, there have been about 50 known strandings, consisting mostly of beaked whales, with a potential causal link to MFA sonar (ICES, 2005). In contrast, very few such associations have been made to seismic surveys, despite widespread use of airguns as a geophysical sound source in numerous locations around the world.

A more recent review of possible stranding associations with seismic surveys (Castellote and Llorens, 2016) states plainly that, ''[s]peculation concerning possible links between seismic survey noise and cetacean strandings is available for a dozen events but without convincing causal evidence.'' The authors' ''exhaustive'' search of available information found ten events worth further investigation via a ranking system representing a rough metric of the relative level of confidence offered by the data for inferences about the possible role of the seismic survey in a given stranding event. Only three of these events involved beaked whales. Whereas D'Amico *et al.* (2009) used a 1–5 ranking system, in which ''1'' represented the most robust evidence connecting the event to MFA sonar use, Castellote and Llorens (2016) used a 1–6 ranking system, in which ''6'' represented the most robust evidence

[4] The U.S. Navy has publicly stated its agreement that five such events since 1996 were associated in time and space with MFA sonar use, either by the U.S. Navy alone or in joint training exercises with the North Atlantic Treaty Organization. The U.S. Navy additionally noted that, as of 2017, a 2014 beaked whale stranding event in Crete coincident with naval exercises was under review and had not yet been determined to be linked to sonar activities (DoN, 2017).

connecting the event to the seismic survey. As described above, D'Amico *et al.* (2009) found that two events were ranked ''1'' and ten events were ranked ''2'' (*i.e.,* 12 beaked whale stranding events were found to be associated with MFA sonar use). In contrast, Castellote and Llorens (2016) found that none of the three beaked whale stranding events achieved their highest ranks of 5 or 6.[5] However, we acknowledged in the notice of proposed rulemaking that one of these stranding events, involving two Cuvier's beaked whales, was contemporaneous with and reasonably associated spatially with a 2002 seismic survey in the Gulf of California, and here acknowledge the same for the 2007 Gulf of Cadiz seismic survey discussed by Castellote and Llorens (also involving two Cuvier's beaked whales). However, neither event was considered a ''true atypical mass stranding'' (according to Frantzis [1998]) as used in the analysis of Castellote and Llorens (2016). While we agree with the authors that this lack of evidence should not be considered conclusive, it is clear that there is very little evidence that seismic surveys should be considered as posing a significant risk of acute harm to marine mammals.

Comment: NRDC asserts that NMFS has failed to account adequately 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 analysis. 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' existing enumeration of takes via exposure to noise, which includes an accounting for exposures above received levels as low as 140 dB rms (and as low as 120 dB rms for beaked whales). NRDC provides nothing informative regarding how such an analysis might be carried out. With regard to NMFS' negligible impact analysis, we believe that the potential effects of stress are addressed and subsumed within NMFS' considerations of severity of effect and vulnerability of affected populations. Similarly, NRDC provides no justification as to why stress would appropriately be considered separately in this analysis, 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: 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 such as the Bryde's whale, and particularly when considered in the context of the full suite of regulated and unregulated anthropogenic sound contributions overlaying an animal's acoustic habitat. We acknowledge that masking can constitute a take, depending on the particular circumstances, but do not agree that masking effects from the incremental noise contributions of individual activities or sound sources always rise to the level of take. Further, not all takes are readily quantifiable. In this case, while masking is considered in the analysis, we do not believe it will result in take of marine mammals beyond those that have already been quantified as taken by behavioral harassment. Specifically, in the case of these proposed activities, in the event that some masking incidents rise to the level of a take, we would expect them to be accounted for in the quantified exposures above the harassment thresholds. 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 accounts for takes that may occur upon exposure at relatively low levels of received sound (*e.g.,* 140 dB).

Comment: MMC commented that the aversion adjustment applied to estimates of Level A harassment proposed by NMFS for low- and high-frequency cetaceans is not supported. NRDC provided similar comments.

Response: NMFS disagrees with these comments, and clarifies our position given the misunderstanding evident in the comments. The MMC cites NMFS' statements that ''too little is known about the factors that lead to avoidance of sounds to quantify aversive behavior for survey activities when modeling marine mammal exposure to sound'' and that ''aversion is a context-dependent behavioral response affected by biological factors, including energetic and reproductive state, sociality, and health status of individual animals'' in characterizing our subsequent use of a post-hoc correction factor to account for aversion as an ''apparent contradiction.'' Similarly, NRDC cites NMFS' statement that aversion was not quantified in the modeling process due to lack of information regarding species-specific degree of aversion and level of onset in criticizing the adjustment that was later made.

Aversion is a known real-world phenomenon. It is well-known that animals will avoid unpleasant stimuli, such as very high received levels of sound. A large and growing literature has demonstrated behavioral aversion in a number of contexts for many marine mammal species in increasingly controlled and well-documented contexts. While considerable species, individual, and context-dependencies exist in terms of received noise levels associated with behavioral aversion, clear patterns of behavioral aversion have been demonstrated empirically within odontocetes and mysticetes (*e.g.,* Miller *et al.,* 2012, 2014; DeRuiter *et al.,* 2013; Southall *et al.,* 2019b). This is particularly true for exposure scenarios in which animals occur relatively close to sources and at the high levels that would be required for even TTS (much less PTS) to occur. In some instances, in these and other studies, behavioral avoidance has been measured at received levels many orders of magnitude below those required for predicted PTS onset and even below the nominal, 50 percent behavioral response probability at 160 dB rms that NMFS has applied historically.

However, accounting for aversion quantitatively in an acoustic exposure modeling process is a significantly data-

[5] Of the ten total events, none achieved the highest rank of 6. Two events were ranked as 5: One stranding in Peru involving dolphins and porpoises and a 2008 stranding in Madagascar. This latter ranking can only broadly be associated with the survey itself, as opposed to use of seismic airguns. An exhaustive investigation of this stranding event, which did not involve beaked whales, concluded that use of a high-frequency mapping system (12-kHz multibeam echosounder) was the most plausible and likely initial behavioral trigger of the event, which was likely exacerbated by several site- and situation-specific secondary factors. The review panel found that seismic airguns were used after the initial strandings and animals entering a lagoon system, that airgun use clearly had no role as an initial trigger, and that there was no evidence that airgun use dissuaded animals from leaving (Southall *et al.,* 2013).

heavy endeavor and, as we noted, despite the growing body of evidence there is at this time still not sufficient data regarding the specific degree of aversion and level of onset on a species-specific basis. That is, in order to account for aversion within the modeling process, one must program individual animats representing different species to respond at a specific received level by changing their direction of travel by a specific degree and assuming a specific rate of speed. Through a test scenario evaluation (discussed in the notice of proposed rulemaking), we determined that while this is possible to do, the specific values that must be used in programming the animat response could not be adequately derived. Instead, a nominal offset factor was applied to the modeled injurious exposures based on published model result evaluation to account for aversion.

Ellison *et al.* (2016) modeled scenarios using animal movement models to evaluate predicted PTS in which no aversion was assumed relative to scenarios where reasonable assumptions were made about aversion, in line with historical response probability assumptions and that existing scientific literature suggest are appropriate. Scenarios where no aversion probability was used overestimated the potential for high levels of exposure required for PTS by about five times. Accordingly, total modeled injurious exposures calculated without accounting for behavioral aversion (for low- and high-frequency species) were multiplied by 0.2 as part of the EWG risk analysis. NMFS consulted the EWG in selecting the specific offset factor, and discussed that selection again in context of the public comments received. The EWG—which is composed of some of the foremost scientists in the field of marine mammal behavioral response study, and includes the lead author of the Ellison *et al.* (2016) study—agreed that the approach and specific offset factor was a reasonable and likely conservative approach to addressing the issue of aversion.

The commenters do not dispute that aversion is a meaningful real-world phenomenon that is significantly influential on actual occurrence of Level A harassment. As NRDC acknowledges, ''it is certainly true that some marine mammals will flee the sound.'' Yet the commenters would have us ignore this phenomenon and assume unrealistically high amounts of auditory injury for marine mammals in the GOM. NMFS does not agree that this would be appropriate. As described above, there is extensive information supporting the aversion concept in marine mammals, but limited quantitative data with which to develop precise, species-specific offset factors. Accordingly, utilizing the available data and expert input, NMFS applied its professional judgement in order to account for this meaningful phenomenon.

Comment: NRDC disagrees with NMFS' conclusion that Level A harassment is not likely to occur for mid-frequency (MF) cetaceans and states that this ''problem [. . .] must be addressed.''

Response: As was explained in the notice of proposed rulemaking, the number of modeled incidents of Level A harassment for MF cetacean species is not realistic. The modeled isopleth distance to the relevant Level A harassment threshold, *i.e.,* the predominant MF peak pressure threshold, is only 18 m. As we explained in the notice of proposed rulemaking, it is understandable that even such a small assumed area could lead to the results given when a real-world density value is sufficiently high to lead to non-zero scaled 24-hr modeled exposure results, which are then multiplied by large numbers of notional survey days. We explain in greater detail below why relatively small zones, *i.e.,* zones contained within the near-field of an airgun array, should not be expected to result in actual injurious exposure. NRDC also appears to be under the impression that the conclusion was based on what they refer to as ''shorter injurious take distances assumed in the Gulf of Mexico modeling than in modeling for seismic in other regions, such as the Atlantic,'' an apparent misunderstanding on the part of the commenter that they refer to as a ''discrepancy'' that is ''never explained'' and ''appears arbitrary.'' Given the lack of detail provided, NMFS cannot be sure what NRDC is referring to. However, we do know that state-of-science propagation modeling performed for a notional array here provided the 18 m result described above. For five different, real-world arrays evaluated for use in the Atlantic Ocean (83 FR 63268; December 7, 2018), the calculated isopleth distance to the 230 dB peak sound pressure level (SPL) MF Level A harassment threshold was an average 27 m (range 14–63 m), in keeping with the value calculated here.

For MF cetaceans, the only potential injury zones will be based on the peak pressure metric, as such zones will be larger than those calculated on the basis of the cumulative sound exposure level (SEL) metric (which are essentially non-existent for MF and HF cetaceans). As noted, the estimated zone size for the 230 dB peak threshold for MF cetaceans is only 18 m. In a theoretical modeling scenario, it is possible for animats to engage with such a small assumed zone 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 MF cetaceans in the modeling report. However, 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 be expected to be within the near-field of the arrays where the definition of source level breaks down. Therefore, actual locations within this distance (*i.e.,* within 18 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 for five specific, real-world arrays proposed for use in the Atlantic Ocean (83 FR 63268). The average distance to the near-field calculated for the five arrays, following the process described below, was 203 m (range 80–417 m).

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 $D >> \lambda$, 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 array at which the modeled source level prediction is 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 specified source level is 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 as the distances at which we expect to be in the near-field is a conservative approach because 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 the modeled notional source level, 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 MF 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 MF cetacean.

Comment: The MMC comments that the estimated numbers of Level B harassment must be increased to account for the incidents of acoustic exposure that were modeled as injurious but subsequently discounted due to aversion. NRDC commented similarly.

Response: NMFS agrees that animals that avoid Level A harassment through aversive behavior should be considered as having been subject to Level B harassment and increased the Level B harassment estimates accordingly. However, these estimates have been superseded by the revised estimates submitted by BOEM in support of their revised scope of activity.

Marine Mammal Protection Act—General

Comment: The MMC recommended that any ''formal interpretation'' by NMFS of MMPA standards, such as the least practicable adverse impact standard and small numbers standard, be issued in stand-alone, generally applicable rulemakings (*e.g.,* in amendments to 50 CFR 216.103 or 216.105) or in a separate policy directive, rather than in the preambles to individual proposed rules.

Response: We appreciate the recommendation and may consider the recommended approaches in the future. However, providing directly relevant explanations of programmatic approaches or interpretations related to the incidental take provisions of the MMPA in a proposed incidental take authorization is an effective and efficient way to provide information to and solicit focused input from the public. Further, this approach ultimately affords the same opportunities for public comment as a stand-alone rulemaking would.

Regarding the least practicable adverse impact standard, NMFS has provided similar explanations in other recent section 101(a)(5)(A) rules. See, *e.g.,* 83 FR 66846 (December 27, 2018) (U.S. Navy Training and Testing Activities for Hawaii-Southern California Study Area).

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,* 828 F.3d 1125 (9th Cir. 2016); and (2) inappropriately ''balances'' or weighs effectiveness against practicability without sufficient analysis, counter to *Pritzker.*

Response: NMFS carefully evaluated the Ninth Circuit's opinion in *Pritzker* and believe we have fully addressed the court's concerns. NMFS' discussion of the least practicable adverse impact standard in the Mitigation section explains why we believe a population focus is a reasonable interpretation of the standard.

With regard to the second point, NMFS disagrees that the analysis is insufficient. NMFS' interpretation of the LPAI standard is a reasonable interpretation that gives effect to the language in the statute and the underlying legislative intent. Congress intended the agencies administering section 101(a)(5)(A) to consider practicability when determining appropriate mitigation, and we do not believe the analysis must be conducted in a rigid sequential fashion. There is a tension inherent in the phrase ''least practicable adverse impact'' in that ''least [. . .] adverse impact'' pulls in favor of one direction (*i.e.,* expanding mitigation) while ''practicable'' pulls in favor of the other direction (*i.e.,* limiting mitigation), and weighing the relative costs and benefits is, in NMFS' view, a meaningful way to address and resolve this tension. Further, as described in the proposed rule and augmented in this final rule in both the Mitigation section and the response to comments, NMFS considered all recommended mitigation in the context of both the reduction of impacts on marine mammal species and stocks and their habitat and the practicability of such mitigation in reaching the required set of measures that we believe satisfy the least practicable adverse impact standard.

Comment: The Associations assert that NMFS failed to provide sufficient practicability analyses for the proposed mitigation requirements.

Response: No guidance is provided by the MMPA or NMFS' implementing regulations as to what constitutes ''practicability'' for the non-military readiness activities considered here, or how to ascertain whether a proposed measure is practicable. Neither the term ''practicable'' nor the phrase ''least practicable adverse impact'' is defined by the MMPA or in NMFS' implementing regulations. (See Mitigation, later in this document, for extensive discussion on NMFS' interpretation of the meaning of ''least practicable adverse impact.'') Therefore, while the MMPA's requirement to prescribe mitigation achieving the ''least practicable adverse impact'' demands consideration of practicability, the need for additional ''analysis'' of unspecified scope, detail, or methodology, as demanded by the Associations, cannot be found in the statute, legislative history, regulations, or case law.

However, NMFS does not start from scratch. Our implementing regulations at 50 CFR 216.104(a)(11) require applications for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance. This often provides the foundation of NMFS' proposed mitigation, after consideration of the objectives of those and other possible measures and how they may achieve those objectives as well as, when possible, what we know about the practicability of the proposed measures.

As a general matter, where an applicant proposes measures that are likely to reduce impacts to marine mammals, the fact that they are included in the proposal and application indicates that the measures are practicable, and it is not necessary for NMFS to conduct a detailed analysis of the measures the applicant proposed (rather, they are simply included). However, it is incumbent on NMFS to consider whether there are other practicable measures that would contribute to the reduction of risk or severity of adverse effects on the species or stocks.

We then seek public comment on the proposal and, if contradictory information is presented by members of the public (including prospective applicants), the information is considered in making a decision regarding whether to retain, modify, or eliminate a proposed measure.

Our notice of proposed rulemaking presented specific discussion of practicability considerations, including both the monetized direct costs of proposed measures as well as what we understand about potential indirect costs, and provided detailed discussion relating to certain measures. While much of this analysis was conducted under a regulatory impact analysis (RIA) conducted pursuant to Executive Order 12866, as stated by the Associations, the utility of the analysis is not limited to use there. For example, while the Associations claim that NMFS fails to ''consider impacts beyond immediate operational impacts,'' the RIA provides a detailed analysis of the sort of speculative indirect costs of concern to industry, and the RIA's analysis is incorporated into NMFS' consideration of practicability. Overall, we note that the Associations' comments are peppered with reference to cost increases, both vague (''resulting in millions of dollars of added cost'') and specific (''increase costs an estimated 5% to 20%''), but without sufficient supporting data.

NMFS interprets ''practicable'' simply as capable of being put into practice or of being done or accomplished. Practicability of the standard operational protocols was reasonably assumed in consideration of the fact that they are included in many incidental take authorizations and that we did not receive any specific public comments to the contrary. Moreover, many of these measures were proposed by the applicant (BOEM) in their petition for regulations, including ramp-up and shutdown requirements and a requirement to observe a time-area restriction in coastal waters to protect bottlenose dolphins during the time of their reproductive activity peak. The Associations claim that our proposal applies these standard measures in such a way as to extend their ''geographic and temporal scope or to circumstances where they are unnecessary or impossible to implement,'' but provide no specific information as to what measures they specifically refer to, in what circumstances they believe specific measures are unnecessary, or in what circumstances specific measures are impossible to implement. The Associations assert that NMFS' considerations of practicability ''fail to adequately estimate levels of current and future geophysical work or consider costs and impacts beyond the immediate survey work,'' but their comments provide no specific information to enable NMFS to assess its consideration of practicability. NMFS' consideration of practicability was sufficient and in accordance with law, and the Associations provided no specific contradictory information for NMFS' evaluation.

Comment: The MMC recommended that NMFS rework its evaluation criteria for applying the least practicable adverse impact standard to separate the factors used to determine whether a potential impact on marine mammal species or stocks or their habitat is adverse and whether possible mitigation measures would be effective. In this regard, the MMC asserted that it seems as though the proposed ''effectiveness'' criterion more appropriately fits as an element of practicability and should be addressed under that prong of the analysis. In other words, a measure not expected to be effective should not be considered a practicable means of reducing impacts.

Response: In the Mitigation section, NMFS has explained in detail its interpretation of the least practicable adverse impact standard, the rationale for the interpretation, and our approach for implementing the interpretation. The ability of a measure to reduce effects on marine mammals is entirely related to its ''effectiveness'' as a measure, whereas the effectiveness of a measure is not connected to its practicability. The MMC did not support its argument with scientific information, and NMFS has not implemented the suggestion.

Comment: The MMC recommended that NMFS address the habitat component of the least practicable adverse impact provision in greater detail. It asserted that NMFS' discussion of critical habitat, marine sanctuaries, and biologically important areas (BIA) in the proposed rule is not integrated with the discussion of the least practicable adverse impact standard. As stated by the MMC, it would seem that, under the least practicable adverse impact provision, adverse impacts on important habitat should be avoided whenever practicable. Therefore, to the extent that activities would be allowed to proceed in these areas, NMFS should explain why it is not practicable to constrain them further. The MMC also suggests that NMFS intends to defer consideration of measures to protect habitat to individual LOAs, rather than addressing such measures in the regulations, as the MMC contends is required.

Response: Marine mammal habitat value is informed by marine mammal presence and use and, in some cases, there may be overlap in mitigation measures for the species or stock directly and for use of habitat. In this rule, NMFS has identified one time-area restriction (carried forward from the proposed rule) based on a combination of factors that include higher densities and observations of specific important behaviors of marine mammals themselves, but also that clearly reflect preferred habitat. In addition to being delineated based on physical features that drive habitat function (*e.g.,* bathymetric features, among others for some BIAs), the high densities and concentration of certain important behaviors (*e.g.,* feeding) in these particular areas indicate the presence of preferred habitat. The MMC seems to suggest that NMFS must always consider separate measures aimed at marine mammal habitat. However, the MMPA does not specify that effects to habitat must be mitigated in separate measures, and NMFS has identified measures that provide significant reduction of impacts to both ''marine mammal species and stocks and their habitat,'' as required by the statute. Finally, we clarify here that all measures to reduce impacts to both marine mammal species and stocks and their habitat are included in the regulations and then implemented through activity-specific LOAs.

Negligible Impact

Comment: The Associations and Chevron concur with NMFS' finding that the incidental taking that may be authorized under the ITR will have a negligible impact on the affected marine mammal stocks. The Associations additionally specify their agreement with NMFS' conclusions that Level A harassment will not play a meaningful role in the overall degree of impact experienced by marine mammal populations as a result of the projected survey activity and that mid-frequency cetaceans are unlikely to incur Level A harassment, as well as with NMFS' use of the Wood *et al.* (2012) probabilistic risk function.

Response: NMFS appreciates the comments.

Comment: NRDC claims that NMFS did not define the total amount of take it evaluated in making the negligible impact determination and asserts that the proposed rule is unclear about the data and calculations that informed the basis of the negligible impact finding.

Response: NMFS disagrees with these comments. NMFS explicitly defined the basis, as well as the process, for the negligible impact analysis. Although the negligible impact analysis was built upon relatively sophisticated acoustic exposure modeling, and incorporated advances in the science of risk assessment, the informational inputs to the analysis and the analytical framework were clearly elucidated and the supporting documentation identified and provided as companion documents to the public for review in association with our negligible impact analysis. The notice of proposed rulemaking identified a point of contact available to provide further information or answer questions if necessary.

NMFS stated that the ''specified activity'' for the proposed regulations is a broad program of geophysical survey activity that could occur at any time of year in U.S. waters of the GOM. This conceptual program, as defined by BOEM through projected levels of survey effort, was described and shown in Table 1 of the notice of proposed rulemaking. These annual survey projections aligned generally with ''low,'' ''moderate,'' and ''high'' effort years (83 FR 29224). These projected levels of survey effort informed the acoustic modeling report (Zeddies *et al.* 2015, 2017a), which was extensively and clearly summarized in the notice of proposed rulemaking, while the report itself was made available for public review concurrently with the notice of proposed rulemaking. In order to reasonably estimate the actual effort that might occur over the five-year timeframe of the proposed ITR, NMFS determined for the proposed rule analysis that it would be appropriate to assume that one high-effort year, two moderate-effort years, and two low-effort years (and, therefore, associated acoustic exposure estimates) would occur. NMFS then selected and identified the specific effort scenarios that formed the basis for the analysis in association with Table 9 of the notice of proposed rulemaking, titled ''Scenario-Specific Expected Take Numbers and Mean Annual Take Level.'' Table 9 of the notice identified the annual and total amounts of take that NMFS expected to occur under the ITR. The preliminary negligible impact analysis then referred back to Table 9 as the basis for the analytical process and discussion provided therein (See 83 FR 29290–29291).

NRDC complains that ''NMFS never defines the total amount of take it proposes to authorize.'' However, as is typical for a programmatic analysis, the ITR and its associated analysis (including negligible impact) do not propose to authorize take per se, but rather to provide a description of the upper bound within which take may be authorized via LOAs. The upper bounds of the instances of take that may be authorized under this rule are indicated in Table 9 in this final rule. The actual amount of take authorized through LOAs under the ITR will be determined by applicant interest (subject to the upper bound).

NMFS also identified the Expert Working Group (EWG) report (Southall *et al.,* 2017) as an essential companion to the notice of proposed rulemaking and, similar to the acoustic modeling report, provided the document for concurrent public review. The EWG report describes the systematic risk assessment framework that, in part, forms the basis for the negligible impact analysis. We concisely described the analytical framework in the notice and provided the results of that analysis. Ultimately, the EWG report provides overall evaluated relative risk for each of the three effort scenarios (low, moderate, high) for each species in each of seven different zones. As stated in the notice, the severity and vulnerability ratings (facets of the analytical framework that are also clearly explained both in the EWG report and the notice) are integrated to provide relative impact ratings of overall risk. These zone-specific relative impact ratings for each species were then integrated using basic calculations to produce species-specific, GOM-wide overall evaluated relative risk ratings for each of the three effort scenarios. Overall vulnerability scores for each species were produced by summing the zone-specific vulnerability scores, as scaled to the zone-specific population. For example, the Zone 1 vulnerability score is multiplied by the ratio of the Zone 1 population to the total population. These zone-specific products are then summed. Overall severity scoring is calculated as the proportion of the sum of scenario-specific takes to the total population. These two factors are then integrated as described in the EWG report.

NRDC also states that the ''actual percentages of populations affected by takes'' are not provided. NMFS disagrees, as this information can be replicated using information that was provided to the public via the acoustic modeling report. Additional underlying data are necessary to replicate zone-specific findings. Excel workbooks containing these data were made publicly available by BOEM during review of their PEIS. NMFS did not view these additional data as essential to understanding the modeling report or the proposed ITR and did not publish these data on its website. Members of the public interested in further exploration of the information provided in the modeling report, or in need of assistance regarding their independent analysis of the modeling report, could have contacted the NMFS point of contact identified in the notice of proposed rulemaking.

In sum, NMFS provided sufficient information in support of its negligible impact analysis affording the public meaningful opportunity to comment. Further, consistent with a potential alternative scope identified in the proposed rule that would remove the Eastern Planning Area (EPA), the scope of this final rule has been modified to remove the GOMESA area, which includes most of the EPA (and a small portion of the Central Planning Area), based on BOEM's update to its action. This has resulted in a reduction in the upper bounds of the instances of take that may be authorized for all species pursuant to this final rule (see Tables 8 and 9).

Comment: The MMC commented similarly to NRDC, expressing some concern regarding the risk assessment framework and asserting ''apparent inconsistencies,'' while recommending that NMFS (1) provide the final risk assessment framework, underlying results, and its interpretation of those results to the public and (2) allow for an additional 30-day comment period to review the findings sufficiently in advance of issuing the final rule.

Response: NMFS disagrees with the MMC comments. They state that the EWG report and analysis ''has some apparent inconsistencies'' as compared against the preamble to the proposed rule because the scenario-specific high, moderate, and low values presented in Table 3 of the EWG report do not align with the summary minimum, maximum, and mean values given in Table 2 of the notice of proposed rulemaking. We note that the MMC provided clarifying questions to NMFS during the public comment period in advance of submitting a formal comment letter and expressed some confusion regarding Table 2 of that notice at that time. As was explained to the MMC then, Table 2 of the preamble was provided for illustrative purposes only, as a way of providing a more concise look at the information given in Table 1 of the preamble. As was explained, the values given in Table 2 were not consequential with regard to anything that followed in the preamble. NMFS regrets any confusion caused by inclusion of Table 2 in the notice of proposed rulemaking but explained clearly to the MMC that the table was not related to the analysis. It has been removed from this final rule.

Separately, the MMC states that ''neither NMFS nor BOEM stipulated why only certain years were selected for analysis,'' claiming that NMFS indicated that years 1, 4, and 9 were used in the analysis ''upon further inquiry.'' This is incorrect. In the notice of proposed rulemaking, we stated that ''Year 1 provides an example of what might be a high-effort year in the GOM, while Year 9 is representative of a low-effort year. A moderate level of effort in the GOM, according to these projections, would be similar to the level of effort projected for Year 4.'' (83 FR 29224.) NMFS provided explanation of its choices in the notice of proposed rulemaking (see, *e.g.,* 83 FR 29261–29262, 29290).

This portion of the MMC's recommendation regarding representative years is no longer relevant to this final rule. As discussed previously, BOEM revised the scope of the activity and provided revised effort projections and resulting take estimates accordingly. The revised take estimates provided by BOEM reflect years 1–5 of their original level of effort projections and, therefore, the question of rationale behind the selection of years 1, 4, and 9 is no longer relevant.

Regarding the notice of proposed rulemaking, the MMC also states that supposed discrepancies between zone-specific risk ratings and risk derived per year across the GOM are ''inconsistencies.'' Zone-specific risk ratings for any given effort scenario are driven by the actual effort within that zone for that scenario, while the overall level of effort GOM-wide underlies the labeling of scenarios as ''high,'' ''moderate,'' and ''low.'' For example, although year 1 was designated as the ''high'' effort scenario and year 4 the ''moderate'' effort scenario on the basis of the total projected GOM-wide survey days (2,286 and 1,902, respectively), the ''high'' effort scenario actually includes significantly less projected effort in zones 2 and 4 than does the ''moderate'' effort scenario. Therefore, risk ratings for certain species were higher in those specific zones for the ''moderate'' effort scenario than they were for the ''high'' effort scenario. This was explained in our notice of proposed rulemaking: ''[P]er-zone ranges can provide a different outlook than does an assessment of total year projected effort across zones. For example, in the ''high'' effort annual scenario (Year 1; considering total projected survey days across zones), there are 263 projected survey days in Zone 2, while the ''moderate'' effort annual scenario (Year 4) projects 446 survey days in Zone 2.'' This was explained directly to the MMC upon its informal inquiry during the public comment period. The MMC also stated to NMFS at that time that ''the relative risk scores for certain species [. . .] do not make sense, presumably because they are based on the incorrect number of estimated survey days,'' giving as an example that ''rough-toothed dolphins in Zone 5 have an overall Moderate risk in the High and Low scenario years, but a Low risk in the Moderate scenario year.'' We reiterated to the MMC at that time that what the MMC viewed as illogical and erroneous did not in fact reflect errors, but rather the confluence of zone-specific activity levels and species presence for a given year. The effort scenarios used as the basis for the analysis were clearly identified, and there were no inconsistencies in terms of risk ratings in consideration of the zone-specific information underlying those ratings (which was explained in the notice of proposed rulemaking).

Separately, the MMC stated its view that ''the basis for determining the relative risk thresholds, relative rating thresholds, species-specific biological risk factors, and environmental risk factors was not provided'' and that ''many of the quantitative aspects have not been substantiated.'' While NMFS disagrees with this statement and refers the reader to the EWG report (Southall *et al.,* 2017), we also point out that, in the absence of precise quantitative information on these aspects of the risk assessment framework (on a species- and zone-specific basis), the application of the framework necessarily requires the application of professional judgment. As NMFS acknowledged, ''[e]lements of this approach are subjective and relative within the context of this program of projected actions and, overall, the analysis necessarily requires the application of professional judgment.'' (83 FR 29290.) The MMC comments do not find fault with any specific element or attribute of the framework or with any specific value chosen to represent a particular risk threshold or a particular species' vulnerability. NMFS does not agree that the MMC's recommendation to allow for an additional 30-day comment period for the public to review the risk assessment framework findings in advance of issuing the final rule is warranted and has not implemented the suggestion.

Comment: NRDC asserts that NMFS has erroneously used the relativistic assessment presented in the EWG report as the basis for the negligible impact determination, incorrectly applying it as though it evaluated absolute risk. A private citizen offers similar comments.

Response: NMFS disagrees with the comment. The EWG analysis is an important component of the negligible impact analysis, but is not the sole basis for our determination. While the EWG analysis comprehensively considered the spatial and temporal overlay of the activities and the marine mammals in the GOM, as well as the number of takes predicted by the described modeling, there are details about the nature of any ''take'' anticipated to result from these activities that were not considered directly in the EWG analysis and which warrant explicit consideration in the negligible impact analysis. Accordingly, NMFS' analysis considers the results of the EWG analysis, the effects of the required mitigation, and the nature and context of the takes that are predicted to occur. NMFS' analysis also explicitly considers the effects of predicted Level A harassment and impacts to marine mammal habitat, which were, respectively, not integrated into or included in the EWG risk ratings. These components of the full analysis, along with any germane species or stock-specific information, are integrated and summarized for each species or stock in the Species and Stock-specific Negligible Impact Analysis Summaries section of the negligible impact analysis.

In addition, while the EWG framework comprehensively considers the aggregate impacts to marine mammal populations from the activities addressed in this rule in the context of both the severity of the impacts and the vulnerability of the affected species, it does not fully consider the absence of survey activity in the eastern GOM (within the GOMESA moratorium area), following BOEM's update to the scope of activity. While this is to some degree reflected in the updated take estimates, and thereby incorporated into the EWG framework's risk ratings, the absence of survey activities within areas of increased biological importance for certain species benefits those species GOM-wide beyond what is simply reflected in the updated take numbers. The negligible impact analysis considers the reduction of both acute and chronic effects afforded through the revised scope of the rule.

Also, we note that while the EWG framework produces relativistic risk ratings, its components consist of absolute concepts, some of which are also absolutely quantified (*e.g.,* whether the specified activity area contains greater than 30 percent of total region-wide estimated population, between 30 and 15 percent, between 15 and 5 percent, or less than 5 percent). Further, NMFS provided substantive input into the scoring used in implementing the EWG framework for the GOM, to ensure that the categories associated with different scores, the scores themselves, and the weight of the scores within the overall risk rating all reflected meaningful biological, activity, or environmental distinctions that would appropriately inform the negligible impact analysis. Accordingly, and as intended, we used our understanding of the framework and best professional judgment to interpret the relativistic results of the EWG analysis appropriately into the larger negligible impact analysis, with the other factors discussed above, to make the necessary findings specific to the effects of the total taking on the affected species and stocks.

Comment: NRDC asserts that the vulnerability ratings used in the EWG framework fail to account for several factors appropriately, which undermine the framework's ability to contribute accurately to the overall evaluation of relative risk. NRDC cites the following as problematic factors: Application of vulnerability ratings on a zone-by-zone basis, which they state negatively biases the habitat use and temporal overlap factors; unaccountably low ratings for non-seismic stressors (specifically citing the DWH oil spill); relatedly, failure to account appropriately for all other stressors; and failure to fully account for stock structure and status.

Response: NMFS first notes that the application of the EWG framework, and specifically the development of appropriate vulnerability ratings, necessarily involves the use of professional judgment, here on the part of a group of experts in the fields of marine mammal biology, ocean acoustics, and the effects of noise on marine mammals, among other things (and in consultation with NMFS and BOEM). Reasonable people may disagree about the specific numerical values assigned to any one of the 11 different factors contributing to the overall species-specific vulnerability score generated for each of the seven zones (with seven factors that are static GOM-wide and four that vary spatially, scoring for 18 taxa and seven zones means that 630 individual numerical value selections underlie the vulnerability scores); but this does not imply that any of the specific values selected are unreasonable. All relevant factors were considered in generating the species- and zone-specific vulnerability scores.

NRDC misapprehends one of the fundamental values of the analytical framework, in that it is structured in a spatially explicit way that can be applied at multiple scales, based on the scope of the action and the information available to inform an assessment of the risk associated with the activity (or suite of activities). This allows one to generate overall risk ratings while also evaluating risk on finer scales. In this case, severity ratings were generated on the basis of seven different GOM zones, allowing an understanding not only of the relative scenario-specific risk across the entire GOM, as is demanded for this analysis, but also to better understand the particular zones where risk may be high (depending on actual future survey effort) and what part of the stock's range may be subject to relatively high risk. The framework recognizes, fundamentally, that the spatial, temporal, and spectral overlaps between noise-generating activities and animal distribution are the primary factors that drive the type, magnitude, and overall evaluated risk of potential noise effects on marine mammals. These considerations are inherent and fundamental in both the severity and vulnerability ratings and are deliberately integrated into both the vulnerability and severity assessments; in fact, key features of the analytical framework include explicit recognition of the importance of species distribution relative to activity spatial distribution and temporal and contextual differences in exposure scenarios. If the spatially explicit nature of the framework were removed, as it seems NRDC is suggesting, there would be no value in generating a ''habitat use'' factor (*i.e.,* the spatial scale would be the GOM, and it would necessarily contain 100 percent of the estimated population). Spatial overlap is a central consideration for the extent of physical overlap between species and other environmental stressors, with consideration of species distribution across all zones, as well as the extent of population concentration and habitat specialization (as expressed through zone-specific vulnerability assessment). Regarding the temporal overlap factor referenced by NRDC, overall activity duration is a limited consideration within the vulnerability assessment rating but is expressed as a central consideration within magnitude-duration functions used to evaluate severity.

Despite the explanations provided in the EWG report, NRDC characterizes certain aspects of the vulnerability scoring as ''unaccountably low.'' However, NRDC does not provide specific recommendations for revisions to the assigned numerical values, or justification for their contention that scoring is too low. All relevant stressors were accounted for in the vulnerability scoring and specific scores were reasonably made on the basis of expert professional judgment. Contrary to NRDC's assertion, the effects of the DWH oil spill were considered in the vulnerability scoring (as well as in our development of mitigation in consideration of the MMPA's least practicable adverse impact standard). Overall, NRDC seems to provide a blanket suggestion, without adequate justification or evidence, that for all species, impacts should be considered to be higher than we have determined. We believe that we have satisfied the statutory standards after careful consideration of the available science.

Regarding stock structure, NRDC criticizes the treatment of bottlenose dolphins in the vulnerability scoring. Overall, species-level take and abundance estimates are used to support findings for bottlenose dolphins out of necessity. The best available information (Roberts *et al.,* 2016) was used to inform combined species values and did not support further quantitative apportionment of estimated take or abundances to stocks. However, NRDC's specific criticism of the ''population'' vulnerability scoring for bottlenose dolphins is unwarranted. The population score comprises three components: Status, *i.e.,* is the stock listed under the ESA and/or designated as depleted under the MMPA; trend, *i.e.,* does information over the available time series of abundance estimates indicate a trend; and size, *i.e.,* is the population defined as small (less than 2,500). None of the five designated stocks of bottlenose dolphin in Federal waters of the GOM are listed under the ESA or designated as depleted under the MMPA, and none would be classed as small. Regarding trend, multiple SAR abundance estimates are available for three of the five stocks (oceanic stock and northern and western coastal stocks); and available information does show an increasing trend for these stocks. We recognize that the effects of the DWH oil spill included likely population reductions for all GOM marine mammal stocks (other than the eastern coastal stock of bottlenose dolphins, which was not impacted by the spill); however, the best available information indicates that these reductions were likely modest for all bottlenose dolphin stocks other than the northern coastal stock (Table 5), and no more recent population abundance estimates that might reflect any potential reduction are yet available. While the likely decline in population abundance for northern coastal bottlenose dolphins is subsumed within the population score assigned for bottlenose dolphins at the species level, vulnerability scoring is necessarily performed at the species level such that it may appropriately be integrated with the take-based severity scoring and used to generate an overall risk rating. As mentioned above, the best available scientific information does not allow for stock-specific parsing of take for bottlenose dolphins. Moreover, the trend component of the population score is a relatively small contribution to the overall vulnerability scoring, accounting for a maximum of two out of 30 potential points. The likely decline in population abundance for northern coastal bottlenose dolphins, although not reflected in the existing vulnerability scoring, is insignificant as a contribution to the overall vulnerability score for bottlenose dolphins as a species. As noted above, the effects of the DWH oil spill are separately accounted for in the vulnerability scoring. Importantly, and also not accounted for in the EWG framework, we include significant mitigation (time-area restriction) intended to alleviate impacts to northern coastal bottlenose dolphins during periods of greatest importance for their reproductive behavior.

Comment: NRDC states that NMFS' use of daily exposure durations ''to justify its negligible impact determination'' is arbitrary and capricious. They state that we incorrectly used exposure times above the 160-dB threshold (rather than the lower threshold associated with the multi-step probabilistic risk function); assumed low severity for certain exposure durations; and disregarded repeated exposures. A private citizen offers similar comments.

Response: As an initial matter, while it is true that NMFS evaluated exposure durations for the negligible impact analysis, it is not the only factor that we considered ''to justify'' the determination, as described fully in the Negligible Impact Analysis and Determinations section. Moreover, the consideration of exposure duration is entirely appropriate in assessing the severity of a likely exposure, which is critical to understanding how the authorized takes are likely to impact individual marine mammals. This was not addressed in the EWG assessment but was incorporated into the negligible impact analysis.

NMFS appreciates NRDC's comments regarding use of exposure times above the 160-dB threshold, and we have re-evaluated the exposure duration information and better integrated discussion of this information into the negligible impact analysis (see Negligible Impact Analysis and Determinations and Table 16 for more information). However, it is incorrect that ''NMFS' time-exposure analysis is predicated on its use of 160 dB as the operative threshold of harm'' and that our use of exposure information above the 160-dB threshold is a ''back-door return'' of the ''outdated 160 dB threshold.'' Inherent in the concept of a multi-step probabilistic risk function is the assumption that varying proportions of an exposed population will be harassed upon exposure at the different steps of the function. We presented the 160-dB exposure durations in the notice of proposed rulemaking because exposure above this step represents the 50 percent midpoint of the function (for all species other than beaked whales) and, therefore, was deemed an appropriate representation of durations where a significant proportion of exposed animals would be expected to experience harassment (versus 10 percent of the population exposed to received sound levels between 140 and 160 dB). In Table 16 of this final rule, we present these durations for both the 160-dB and 140-dB steps of the function. It is important to keep in mind that, of the animals exposed above the 160-dB threshold for the indicated species-specific durations, not all are considered harassed. The risk function assumes 50 percent of animals exposed between 160-dB and 180-dB will be harassed. For the longer exposure durations associated with the 140-dB threshold, only 10 percent are expected to be harassed.

As we indicate in the Negligible Impact Analysis and Determinations discussion of this final rule, to put the predicted amount of take into meaningful context, it is useful to understand the duration of exposure at or above a given level of received sound (as well as the likely number of repeated exposures across days). While a momentary exposure above the criteria for Level B harassment counts as an instance of take, that accounting does not make any distinction between fleeting exposures and more severe encounters in which an animal may be exposed to that received level of sound for a longer period of time. This information is meaningful to an understanding of the likely severity of the exposure, which is relevant to the negligible impact evaluation. For example, for bottlenose dolphin exposed to noise from 3D WAZ surveys in Zone 6, the modeling report shows that approximately 72 takes (Level B harassment) would be expected to occur in a 24-hr period. However, each animat modeled has a record or time history of received levels of sound over the course of the modeled 24-hr period. The 50th percentile of the cumulative distribution function indicates that the time spent exposed to levels of sound above 160 dB rms SPL (*i.e.,* the 50 percent midpoint for Level B harassment) would be only 1.8 minutes—a minimal amount of exposure carrying little potential for significant disruption of behavioral activity.

The Species and Stock-specific Negligible Impact Analysis Summaries discussion considers the relative impact ratings in conjunction with required mitigation and other relevant contextual information—including exposure durations at the various thresholds—to produce an assessment of impact to the stock or species, *i.e.,* the negligible impact determinations. For beaked whales, take is estimated on the basis of a risk function shifted down such that 90 percent of the animals exposed to received levels above 140 dB and 50 percent exposed to received levels above 120 dB are expected to be harassed. We used this approach based on the documented behavioral sensitivity of beaked whales. However, as NRDC acknowledges, context is important when assessing behavioral responses to sound. The exposures above 120 dB here occur at significant distance from the source (*i.e.,* greater than 50 km). It is generally accepted that an animal's distance from the sound source plays an important role in the animal's behavioral response to a received sound level (*e.g.,* Gomez *et al.,* 2016). NMFS believes that exposures to the relevant harassment thresholds at significant modeled distances from the actual sound source, although included in the take estimates based on the risk function, will not carry significant consequences for the potentially exposed animals. Rather, these exposures are likely to result in significantly less severe responses (if any). Examples provided by NRDC purporting to demonstrate greater severity of response than we have assumed include irrelevant examples—beaked whales are known to respond with greater severity to mid-frequency active military sonar than to other sources, as discussed in greater detail in a previous comment response—and examples of ''responses'' entailing changes to vocalization patterns over longer durations, but these responses do not necessarily rise to the level of a take, much less a take event of significant severity.

Regarding repeated exposures, despite the figures cited by NRDC concerning potential days of activity, it is unlikely that any given individual animal would in fact experience repeated take events of the magnitude suggested. Each of the seven GOM zones is an extremely large area (average zone size approximately 100,000 km^2), and the likely harassment ''footprint'' of any given survey would be relatively small. Modeled isopleth distances to the 160-dB threshold are approximately 12 km for low-frequency cetaceans (*i.e.,* the Bryde's whale), 7 km for mid-frequency cetaceans (*i.e.,* sperm whales, beaked whales, dolphins), and 6 km for high-frequency cetaceans (*i.e., Kogia* spp.). Distances to the 140-dB isopleths are substantially larger, but we again emphasize that only ten percent of the animals exposed at that level would be expected to incur harassment, while 50 percent of the animals exposed at the 160-dB level would be expected to incur harassment. It is clear that, in reality, there is a relatively low chance of any given individual marine mammal being repeatedly taken within relatively short timeframes, much less that such events would result in fitness consequences for those individuals. Additionally, NRDC suggests that NMFS fails to consider repeated takes at all, when in fact this likelihood is inherently addressed through the severity rating of the EWG assessment.

NRDC concludes their comment by claiming that NMFS failed to undertake sufficient analysis in support of the negligible impact determinations. We disagree with this assertion, and refer to the Negligible Impact Analysis and Determinations section in support of this final rule. NRDC focuses in particular on sperm whales, implying that they are likely to incur impacts to reproductive fitness and stating that NMFS cannot make a negligible impact finding for sperm whales without additional mitigation requirements. NMFS agrees that the bioenergetics simulations of Farmer *et al.* (2018a)—cited by NRDC in support of their argument—show that frequent disruptions in foraging can have potentially severe fitness consequences for individual sperm whales. However, a follow-up study (Farmer *et al.,* 2018b), which additionally accounted for the population-level effects of the DWH oil spill on GOM sperm whales, modeled the potential population level consequences of the specific disturbance events underlying this analysis (*i.e.,* the acoustic exposure modeling of Zeddies *et al.,* 2015, 2017a). This follow-up study found that, under realistic modeled scenarios, no sperm whales were projected to reach terminal starvation and no fetal abortions were predicted as a result of long-term disturbance effects (*i.e.,* over ten years of projected survey activity). Similarly, predicted declines in relative body condition (expressed as the percentage of available reserves for a disturbed individual whale relative to an undisturbed whale with identical characteristics) as a result of long-term disturbance effects were not significant under realistic modeled scenarios. When evaluating the additional effects of modeled disturbance on the DWH oil spill-impacted trajectory, the modeling did not predict any significant additional stock declines (Farmer *et al.,* 2018b). We believe the administrative record for this final rule 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)(A). Of note, and as indicated in Changes from the Proposed Rule, as a result of BOEM's updated scope of the activities and the associated revisions to the levels of effort, both the maximum allowable amount of take and the maximum annual take under the rule have decreased (significantly in some cases, including for Bryde's whales and sperm whales) for all except two species/stocks. For the two exceptions these figures increased only slightly, and the severity of many of the impacts has been lessened via the removal and/or reduction of take in areas of greater biological importance previously considered as mitigation areas.

Comment: Chevron comments that NMFS should make the final version of the EWG report available to the public for review and suggests expanding the description of the inputs of the analysis. Chevron states that the ''vulnerability'' assessment, in particular, would benefit from additional discussion to explain how professional judgments led to specific rankings for each species. Chevron also comments that NMFS should provide an additional plain language discussion of the risk analysis process, including background on the development of the risk analysis framework, including any relevant analogues in other ecosystems or regulatory contexts, the ways in which species may be considered ''vulnerable,'' and the meaning of the ''risk'' discussed.

Response: NMFS appreciates the comment. The final report is available to the public online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.* The content of the final report was determined by NMFS and BOEM in conjunction with the EWG. We believe that we have provided sufficient plain language discussion of the EWG framework.

Comment: NRDC claims that NMFS' negligible impact analysis is 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 the analysis, consideration of the implementation of prescribed mitigation is one factor in the analysis 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 the prescribed mitigation by stating (mistakenly) that it is ''unsupported by evidence,'' NRDC offers no support for their conclusions.

NRDC misunderstands the degree to which NMFS relies on shutdowns for sensitive or vulnerable species, including beaked whales, at extended distances. We agree that these measures in and of themselves will have limited benefit for cryptic species such as beaked whales that are unlikely to be observed. However, we believe that it makes sense to minimize the duration and intensity of disturbance for these species when they are observed, and because they are practicable we include them in the suite of prescribed measures and discuss them where appropriate. For more readily detected species, such as the sperm whale, which is easily detected when at the surface and which vocalizes frequently while underwater, the extended distance shutdowns (for both visual and acoustic detections) should appropriately be considered influential in our assessment of impacts to affected individuals and, therefore, ultimately on the stock. Despite NRDC's dismissal of these requirements, we presume they would agree that the duration and intensity of disturbance of sensitive species should be minimized where practicable.

In summary, we consider these measures appropriately as mitigating factors when considering context as part of our negligible impact analysis.

Comment: The Associations state that the Expert Working Group framework was applied without following all of the recommended steps, such as conducting expert elicitation to derive risk functions for species that do not have parameterized Population Consequences of Disturbance (PCOD) models. The Associations recommend that NMFS seek input and advice on the framework and its conclusions from independent experts.

Response: There is extensive scientific interest in forecasting how short-term behavioral responses by individual animals may aggregate and result in population-level consequences. The concept was introduced by the National Research Council (2005) as Population Consequences of Acoustic Disturbance. However, given the lack of data on acoustic responses, research studies have generalized the issue to look at environmental and anthropogenic stressors in general and renamed the concept Population Consequences of Disturbance. New *et al.* (2014) presented a modified conceptual framework to help forecast long-term impacts. Conceptually, a series of transfer functions connect increasingly broader impacts from the initial disturbance to effects on individual health, individual vital rates, and finally population dynamics. The concept has been demonstrated with a few species for which there are extensive data from tagged or photo-identified animals so that effects on individuals can be quantified. Northern elephant seals were the first study species for which the data from time-depth recorders were able to be linked to an individual animal's body fat condition (Aoki *et al.,* 2011; Adachi *et al.,* 2014), which provided insight into foraging success and ultimately individual health and vital rates (Robinson *et al.,* 2010). Rolland *et al.* (2016) used photographic data of North Atlantic right whales to evaluate individual health and link it to demographic groups and population status. Additional studies exploring population consequences are ongoing, but a common theme is that extensive data documenting individual health and population vital rates are necessary for such analyses. These are considered the gold standards for future studies, but, at present, studies within the GOM have not occurred in sufficient detail for such analyses.

For purposes of the analysis contained herein, the disturbance severity rating facet of the EWG framework involves a relativistic framework relating Level B harassment to the zone-specific population size and then evaluating this proportion to specified severity criteria common across species. In the idealized framework discussed by the EWG (Southall *et al.,* 2017), the severity rating involves consideration of the magnitude of population affected and the duration of disturbance, *i.e.,* by deriving magnitude-duration risk functions that describe the potential effects of exposure to noise on affected populations. The EWG considered that a better approach would apply values obtained using software developed to implement the Interim PCOD approach (Harwood *et al.,* 2014; King *et al.,* 2015).

While various models have been developed implementing the PCOD approach (*e.g.,* New *et al.,* 2013), the approach is problematic for general application because it is very data-heavy, and sufficient data specific to a taxon and/or disturbance context is not typically available. Few marine mammal populations have been as intensively studied as the PCOD case study populations, and the lack of appropriate datasets that link exposure to disturbance with behavioral change, and behavioral change with health, currently limits the general applicability of the full PCOD model. This difficulty led to development of the Interim PCOD approach, which uses results from an expert elicitation process, rather than empirical data, to predict the effects that a specific amount of disturbance will have on the vital rates of an individual marine mammal. In evaluating potential use of the Interim PCOD approach for developing magnitude-duration curves suitable for use in assessing risk associated with the projected survey activity considered here, the EWG used the results of an expert elicitation process that considered potential effects of pile driving noise associated with the construction of offshore wind farms on bottlenose dolphins, harbor porpoises, and minke whales in the North Sea. While this evaluation provided proof-of-concept and highlighted areas for future improvement of the process, such evaluations are not appropriately extrapolated to a risk assessment involving dissimilar species, stressors, and locations. For example, demographic rates and population growth rates specific to those species in U.K. waters of the North Sea were used and, further, even in that expert elicitation the authors warned that the results for the minke whale were likely not reliable due to a lack of available data. The EWG recommended that the available elicitation results not be used towards the current analysis, and NMFS and BOEM concurred. Currently, results of these expert elicitation processes are additionally viewed as potentially unreliable because experts may misinterpret the questions they are asked (Booth *et al.,* 2016).

Overall, while we agree with the Associations that it would be ideal to evaluate the effects of the specified activity on the affected populations by incorporating a PCOD or Interim PCOD approach to the EWG framework, sufficient data are not available to conduct a PCOD approach, and sufficient resources were not available to NMFS to develop and implement an expert elicitation process specific to seismic and the affected GOM populations on a timeline amenable to this ITR. With regard to the Associations' suggestion that outside experts review the EWG framework, we note that the EWG comprises experts outside NMFS and BOEM who were contracted for the express purpose of developing the framework. We do not believe it necessary to engage outside experts to review the work of other experts outside NMFS and BOEM, which is itself subject to review by experts within both NMFS and BOEM.

Comment: The Associations object to the terminology used for the relative severity ratings in the EWG framework approach, stating their disagreement with the implications of rating descriptors such as ''severe,'' and reiterating their belief that the modeled exposure levels are incompatible with the available data. Relatedly, the Associations assert that there is ''little scientific support'' for the relative risk ratings for sperm and beaked whales.

Response: Respectfully, NMFS believes this comment involves a semantic issue. The Associations do not suggest alternative terminology for the relative risk ratings. Regarding the risk ratings for sperm whales and beaked whales, these ratings are a product of a relatively straightforward analysis of severity (*i.e.,* amount of predicted disturbance relative to population size) and vulnerability (*i.e.,* consideration of factors inherent to the population that make it more or less vulnerable to the disturbance considered via the severity rating). The Associations provide no specific critique of any of these aspects of the analysis. We have addressed the Associations' criticism of the acoustic exposure modeling elsewhere in these comment responses.

Comment: The Associations object to use of the potential biological removal (PBR) metric as the basis for evaluating severity of Level A harassment within the EWG framework, stating that its use in evaluating non-serious injury is inappropriate because the metric was developed for evaluation of the significance of serious injury and mortality.

Response: We acknowledge that 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, and therefore that it is inappropriate to make comparisons between Level B harassment takes and the PBR value for any stock. However, as discussed in the EWG report and in the notice of proposed rulemaking, while NMFS does not expect PTS (Level A harassment) that might be accrued through noise exposure to result in mortality of marine mammals, PBR can serve as a good surrogate for population vulnerability/health. Accordingly, PBR or a related metric can be used appropriately as a value against which to evaluate the potential severity to the population of a permanent impact such as PTS on a given number of individuals, and it is only in this sense that we use the PBR value. The Associations do not provide an alternative recommendation.

Small Numbers

Comment: The Associations and other industry commenters express agreement with NMFS' interpretation of the small numbers requirement as allowing that the finding may be made at the individual LOA level.

Response: We thank the Associations for their comment in support of the small numbers approach. NMFS' analysis generally comports with many of the points they raise, as discussed in this preamble.

Comment: NRDC states that the interpretation of ''small numbers'' presented by NMFS in the notice of proposed rulemaking is contrary to the plain meaning and purpose of the MMPA, in part because NMFS allegedly did not provide a reasoned basis for the take limit proposed (*i.e.,* one-third of the best available species or stock abundance estimate). NRDC makes four specific claims. First, NRDC states that one-third 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 be infrequent or unavoidable. Third, NRDC contends that NMFS should define different small numbers thresholds on the basis of the 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. Industry commenters suggest that additional detail is necessary regarding the basis for NMFS' small numbers threshold.

Response: NMFS disagrees with NRDC's arguments on this topic. Although there is limited legislative history available to guide NMFS and an apparent lack of biological underpinning to the concept, we have worked to develop a reasoned approach to small numbers. As discussed in the section of the notice of proposed rulemaking entitled Small Numbers, NMFS explains the concept of ''small numbers'' in recognition that there could also be quantities of individuals taken that would correspond with ''medium'' and ''large'' numbers. As such, NMFS has 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 the statement from the legislative history that ''[small numbers] is not capable of being expressed in absolute numerical limits'' (H.R. Rep. No. 97–228, at 19 (September 16, 1981)), and relevant case law (*Center for Biological Diversity* v. *Salazar,* 695 F.3d 893, 907 (9th Cir. 2012) (holding that the U.S. Fish and Wildlife Service reasonably interpreted ''small numbers'' by analyzing take in relative or proportional terms)).

NRDC claims that a number may be considered small only if it is ''little or close to zero'' or ''limited in degree.'' We note that the comment selectively picks a definition in support of NRDC's favored position. For example, the definition of ''small'' in Webster's New Collegiate Dictionary (1981) included ''having little size, esp. as compared with other similar things.'' See also *www.merriam-webster.com/dictionary/small* (defining ''small'' as ''having comparatively little size''). These definitions comport with the small numbers interpretation developed by NMFS, which utilizes a proportionality approach. The comment also selectively quotes the relevant legislative history language, stating that Congress ''intended that the agency limit takes to 'infrequent, unavoidable' occurrences.'' The actual statement from the legislative history is that taking of marine mammals should be ''infrequent, unavoidable, *or* accidental.'' H.R. Rep. No. 97–228, at 19 (September 16, 1981) (emphasis added). This language suggests that taking that is unavoidable (or accidental) may qualify as small numbers, even if 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 NMFS' proposed approach fails to account for ''additive and adverse synergistic effects'' from multiple surveys is not required by section 101(a)(5)(A) of the MMPA, and it is unclear how NRDC defines this concept or how it may be related to the ''small numbers'' concept. These suggestions are not founded in any relevant requirement of statute or regulation, discussed in relevant legislative history, or supported by relevant case law.

A private citizen echoed certain of NRDC's comments on this topic, adding that NMFS' approach is ''embarrassing and scientifically indefensible.'' However, the commenter does not provide a more scientifically defensible interpretation of small numbers, suggesting only that ''[o]ne could approach this in many ways.''

Regarding the comment that additional explanation is needed for NMFS' interpretation of the small numbers standard, we believe the proposed and final rule provide sufficient explanation for setting one-third as the upper limit for small numbers where reasonably reliable quantified take estimates are available. See the Small Numbers section later in this preamble.

Comment: Several commenters suggest that the small numbers finding need not be based on a quantitative threshold.

Response: NMFS agrees that a more qualitative small numbers finding may be permissible. See, *e.g., Center for Biological Diversity* v. *Salazar,* 695 F.3d at 906–908. However, in this case, where take estimates can be predicted with relative confidence, we have elected to set a quantitative threshold. Moreover, the commenters do not provide any specific recommendations for an appropriate qualitative approach in this case.

Comment: The MMC recommended that any ''formal interpretation'' of the small numbers standard by NMFS be issued in a stand-alone, generally applicable rulemaking (*e.g.,* in amendments to 50 CFR 216.103 or 216.105) or in a separate policy directive, rather than in the preambles to individual proposed rules.

Response: We appreciate the MMC's recommendation and may consider the recommended approaches in the future. We note, however, that providing relevant explanations in a proposed ITR is an effective and efficient way to provide information to the reader and solicit focused input from the public, and ultimately affords the same opportunities for public comment as a stand-alone rulemaking would.

Comment: NRDC asserts that NMFS' interpretation of the MMPA's small numbers requirement is contrary to law, stating their belief that NMFS must make a small numbers determination in the rule, rather than for issuance of individual LOAs; that NMFS must evaluate the same amount of take in order to separately determine that the total take will both meet the small numbers standard and have a negligible impact; and that NMFS' approach impermissibly cuts the public out of the agency's findings.

Response: Based on NMFS' analysis of the language and structure of section 101(a)(5)(A) and the implementing regulations for that provision, NMFS disagrees that the small numbers finding must be based on the total of all take over the five-year (or less) period from all potential survey activity. The MMPA does not define small numbers or explain how to apply the term in either section 101(a)(5)(A) or the similar provision for incidental harassment authorizations (IHAs) in section 101(a)(5)(D),[6] including how to apply the term in a way that allows for consistency across those two provisions that are similar but allow for potentially different time and activity scales. (See Small Numbers below.) Especially when taken together with NMFS' implementing regulations, our approach is consistent with the structure of section 101(a)(5)(A), which provides:

(i) Upon request therefor by citizens of the United States who engage in a specified activity (other than commercial fishing) within a specified geographical region, *the Secretary shall allow,* during periods of not more than five consecutive years each, *the incidental, but not intentional, taking* by citizens while engaging in that activity within that region *of small numbers of marine mammals of a species or population stock* if the Secretary, after notice (in the **Federal Register** and in newspapers of general circulation, and through appropriate electronic media, in the coastal areas that may be affected by such activity) and opportunity for public comment—

(I) *finds that the total of such taking during each five-year (or less) period*

[6] Section 101(a)(5)(D) states in relevant part:

(i) Upon request therefor by citizens of the United States who engage in a specified activity (other than commercial fishing) within a specific geographic region, the Secretary shall authorize, for periods of not more than 1 year, subject to such conditions as the Secretary may specify, the incidental, but not intentional, taking by harassment of small numbers of marine mammals of a species or population stock by such citizens while engaging in that activity within that region if the Secretary finds that such harassment during each period concerned—

(I) will have a negligible impact on such species or stock, and

(II) will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses[.]

concerned will have a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses [. . .]. (emphasis added).

Section 101(a)(5)(A)(i)(I) is explicit that the ''negligible impact'' determination for a specified activity must take into account the ''total of such taking'' (*i.e.,* all of the taking that the Secretary may conceivably allow (or authorize) under individual LOAs during the five year (or less) period considered for the rule). In contrast, the ''small numbers'' language in 101(a)(5)(A) is not subject to the same time period requirement of five years (or less in cases where the period being considered for a rule is less than five years).

In our view, the statutory language for small numbers and the negligible impact finding indicates that the negligible impact finding is made based on consideration of an aggregation of potential authorizations (LOAs) for taking small numbers of marine mammals, and allows for different temporal periods in applying the two different standards. The statute contemplates that the Secretary shall allow taking during the five year (or less) period, which in our view also implies that there could be multiple allowances or authorizations (*i.e.,* LOAs), so long as the maximum allowable total taking from all of those authorizations combined is considered in the upfront assessment of whether the negligible impact standard is met.

As we have noted, the regulatory vehicle for authorizing (*i.e.,* allowing) the take of marine mammals is the LOA, a creature of NMFS' long-standing implementing regulations that is not in the statute. See 50 CFR 216.106. Those 1989 implementing regulations requiring an LOA to effectuate an authorization were in effect when Congress amended the MMPA in 1994 to add section 101(a)(5)(D) for issuance of one-year IHAs, and over the years when Congress amended section 101(a)(5)(A) for various reasons (including most recently in 2018, to extend the maximum authorization period to seven years for military readiness activities, Pub. L. 115–232 (John S. McCain National Defense Authorization Act for Fiscal Year 2019) (Aug. 13, 2018)). Presumably Congress was aware of these implementing regulations and the framework they created for authorizing take under section 101(a)(5)(A) and could have invalidated those regulations had it so desired.

Under NMFS' approach, the negligible impact analysis for the rulemaking is conducted for the time period covered by the rule (five years in this case, the maximum under the statute for a non-military readiness activity), but the small numbers analysis attaches to the instrument that actually ''allows'' or authorizes taking, *i.e.,* the LOA. The statute does not preclude NMFS from issuing an LOA that comports with the small numbers level set forth in the relevant rule for the specified activity. Consistent with the MMPA requirement, here the Secretary (through NMFS) has prescribed the necessary specified activity regulations after notice and comment. At that point, once the regulations are effective, NMFS thereafter may authorize incidental take through the issuance of LOAs, provided that they satisfy the requirements set forth in the rule and regulations, including the small numbers standard articulated in the rule.

NRDC cites *Conservation Council for Hawaii* v. *NMFS,* 97 F. Supp. 3d 1210 (D. Hawaii 2015), in stating that the MMPA ''plainly requires that the agency evaluate both whether there will be small numbers of take and whether there will be a negligible impact'' before issuing regulations, and that these determinations ''must be based on the same amount of take.'' We disagree. In NMFS' view, *Conservation Council for Hawaii* stands for the proposition that NMFS cannot authorize more take than it has analyzed under the negligible impact standard. 97 F. Supp. 3d at 1221. There the court found that there were substantial differences between the anticipated take numbers, which were the basis for the negligible impact finding, and the amount of take that NMFS was prepared to authorize incidental to U.S. Navy military readiness activities. That case did not even involve the small numbers provision, which does not apply in the case of military readiness activities. 16 U.S.C. 1371(a)(5)(F)(i). The court in *Conservation Council for Hawaii* did not consider or make any pronouncements about whether the small numbers provision must be applied to the total annual taking under the rule or whether it could be applied at the LOA stage.

NRDC repeatedly states that the negligible impact and small numbers provisions must have separate meaning. NMFS agrees that the two provisions do have separate meanings, and this rule satisfies that requirement. Each LOA must meet the small numbers requirement as NMFS has interpreted it in this rule. In other words, it is not sufficient for the survey activity described in an LOA application to fall within the scope of the activity analyzed for the rule and NMFS' negligible impact determination. The small numbers limitation also must be satisfied. For example, NMFS may receive an application for an LOA where the take estimates exceed the small numbers standard identified in the rule. In that case, the request would be denied, *even if* the amount of taking was considered in the negligible impact evaluation. Thus the negligible impact and small numbers inquiries are separate and have different meanings.

To summarize, the MMPA is silent on how to apply ''small numbers'' in either section 101(a)(5)(A) or (D), including in a way that allows for consistency across those two very similar provisions. Moreover, NMFS' implementing regulations for section 101(a)(5)(A) make it clear that LOAs are the instrument for authorizing take. Thus, the mere existence of regulations under 101(a)(5)(A) for a specified activity is not sufficient to authorize take under that provision. An LOA is required.

As we have previously stated, the small numbers standard has limited biological relevance (*i.e.,* there is a lack of a biological underpinning for the concept), but NMFS' application of the small numbers standard at the LOA stage does not rely on that view for the approach taken here (and moreover, NMFS did not receive any public comments offering an alternative definition that is rooted in biological concepts or is not conflated with negligible impact considerations). As the notice of proposed rulemaking explained, NMFS' interpretation and approach are based on analysis of the governing section 101(a)(5)(A) and limited legislative history, as well as consideration of section 101(a)(5)(D), and our long-standing approach to implementing section 101(a)(5)(A) through separate LOAs. NMFS has determined that the statute is ambiguous in terms of what small numbers means and how ''small numbers'' must be applied, which affords the agency reasonable discretion in how to do so. After weighing various policy considerations, NMFS exercised its discretion to define small numbers and apply small numbers determinations at the LOA level.

Importantly, the final rule, which was subject to notice and comment, sets the small numbers standard for future LOAs issued under the rule. Moreover, contrary to NRDC's assertions, NMFS has set the total taking allowable for all LOAs issued under the rule for this specified activity—*i.e.,* the taking that was analyzed for the negligible impact determination. If an LOA application for a survey provides take estimates that are within the small numbers threshold set in this rule, then the LOA for that survey will be deemed to satisfy the small numbers requirement.

As NRDC correctly points out, NMFS' implementing regulations require issuance of LOAs to be consistent with the ''total taking allowable'' under the activity-specific regulations. The regulations for the specified activity also reflect this. The rulemaking for these regulations evaluated the level of activity projected in BOEM's update for its petition, and NMFS' negligible impact determination is based on consideration of that level (as are the corresponding take estimates). Any LOA must be within the amount analyzed for the scope of the rule, and the total amount of take under all issued LOAs combined cannot exceed the amount analyzed and ''allowable'' under the rule for this activity.

Regarding the differences between the processes under sections 101(a)(5)(A) and (D), we did not mean to suggest that section 101(a)(5)(A) is necessarily or always more protective than and preferable to 101(a)(5)(D). Rather, section 101(a)(5)(A), which can span a longer period of time and cover multiple applicants through issuance of LOAs, allows for a more comprehensive/holistic analysis by the agency (one negligible impact analysis for all activities over the five-year (or less) period and consideration of mitigation appropriate for the full suite of activities). Such an approach has the potential to be more protective because it allows for a more comprehensive understanding of impacts, as well as a mechanism to include holistic mitigation that can more effectively address both acute and chronic effects resulting from multiple activities covered under a rule. Section 101(a)(5)(A) also focuses public attention on one rulemaking (rather than—as would be the case for these survey activities—potentially dozens of IHA actions per year, each with separate notice and comment), and allows for other administrative efficiencies. We note that BOEM applied for the regulations in support of the oil and gas industry, and prepared an EIS in support of its own program related to the permitting of the survey activities that are the subject of this MMPA application and rulemaking.

NRDC claims that the approach ''is a novel interpretation of the MMPA.'' However, the rule cited in support of their argument (81 FR 47240; July 20, 2016) is consistent with one aspect of our approach here, in that the small numbers determinations in both contexts are based on annual take estimates, not total take over the five-year period of the regulations.[7] We acknowledge that we have not previously determined that small numbers could be applied at the individual LOA stage where more than one LOA applicant may apply under the activity-specific regulations. However, that is simply because the issue had not previously presented itself. In nearly all cases to date,[8] there has been a single operator who is the sole applicant for both the LOA (or LOAs if they cover less than the five-year period) and the governing specified activity regulations. As a result, in such a scenario, the small numbers determination by default corresponds to the maximum annual taking covered by the regulation (and the LOA). But even when there is only one applicant for LOAs under a regulation, NMFS does not tally take across the five-year period for purposes of assessing small numbers. Rather, NMFS assesses annual levels of take. (This also promotes consistency between 101(a)(5)(A) and 101(a)(5)(D) to avoid incentivizing IHAs at the expense of LOAs issued under more comprehensive rules.)

Finally, NRDC's statement that the public is impermissibly cut out of the agency's findings is incorrect. The proposed rule set forth the maximum total taking and annual taking that would be allowable (via the issuance of LOAs) for the five-year period that the regulations will be effective, which was based on information contained in BOEM's publicly available application and PEIS. Those figures decreased for all but two species. For the two species where the figures increased, we evaluated those changes and determined they do not represent a meaningful change for our analyses. See Changes From the Proposed Rule.

The proposed rule included a 60-day public comment period. We also believe that our rulemaking afforded a full and focused opportunity for public review of and comment on the full scope of survey activities and proposed mitigation, rather than through dozens of individual IHAs, each with 30-day public comment periods and shorter timeframes for NMFS to consider the public comments. Thus the public had a meaningful opportunity to comment.

Comment: Citing their interpretation of the statute and multiple judicial decisions, the MMC suggests that NMFS' interpretation and implementation of the small numbers standard is contrary to law and further recommends that NMFS adopt a policy interpreting the small numbers requirement of section 101(a)(5)(A) such that it:

- Requires determinations be made when issuing incidental take regulations (as opposed to when LOAs are issued);
- makes such determinations based on the total take authorized incidental to the specified activity and for the full duration covered by those regulations (as opposed to for each LOA and on an annual basis); and
- provides an opportunity for public notice and comment on all small numbers determinations.

Response: As explained in the responses above and discussion under the Small Numbers section of this preamble, NMFS disagrees, based on our analysis of the statute, the legislative history, the implementing regulations, and relevant case law.

NMFS issues incidental take authorizations under section 101(a)(5)(A) through LOAs, provided that we satisfy the relevant statutory standards. Analysis of that statutory provision and relevant legislative history, including when read in conjunction with section 101(a)(5)(D), leads NMFS to conclude that the small numbers limitation may be applied at the LOA stage, provided that we make the negligible impact finding for the total taking allowable under the regulations for the specified activity and

[7] We further note that population biology often focuses on annual cycles. See, *e.g.,* 50 CFR 216.103 (negligible impact defined in terms of impacts on annual rates of recruitment or survival); 16 U.S.C. 1386(a), (c) (requiring stock assessment reports to estimate the annual human-caused mortality and serious injury of the stock, and annual review of stock assessments when significant new information is available that may indicate the stock assessment should be revised); 16 U.S.C. 1362(26) (defining ''net productivity rate'' as the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to mortality); 16 U.S.C. 1383a(l)(ii) (requiring MMC's recommended guidelines to govern the incidental taking of marine mammals in the course of commercial fishing operations, to the maximum extent practicable, to include as a factor to be considered and utilized in determining permissible levels of taking ''the abundance and annual net recruitment of such stocks'').

[8] The one exception to date is NMFS' regulation governing the incidental take from explosive removal of offshore structures in the GOM (EROS), promulgated at the request of the Minerals Management Service on behalf of multiple private removal companies that individually submitted LOA requests. NMFS' rulemaking for the EROS regulations evaluated the estimated annual take based on MMS' projections for the specified activity as a whole, *i.e.,* for all operators combined. Our rule here is consistent with the EROS rulemaking as it relates to the approach for the negligible impact evaluation. However, the EROS rule also concluded the total annual taking (by species) for all operators combined met the small numbers requirement. Thus NMFS did not have occasion before now to consider whether it could apply the small numbers provision at an individual LOA level where there are multiple concurrent LOA holders. Having now considered the question, NMFS believes the MMPA affords the discretion to do so.

set the small numbers standard for future LOAs in the notice and comment rulemaking.

As noted above, the term ''small numbers'' is not defined in the statute. Over the years NMFS has grappled with how to define the term, particularly given the limited legislative history (*i.e.,* ''accidental, infrequent, or unavoidable''; ''not capable of being expressed in absolute numerical terms''). Recent court decisions lend support for NMFS' proportional approach to the concept. See *Center for Biological Diversity* v. *Salazar,* 695 F.3d 893 (9th Cir. 2012). In terms of what proportion may constitute ''small numbers'' for purposes of what the Secretary may authorize, NMFS has determined that small numbers means up to one-third of a species or stock. NMFS has further determined that this limit can be applied at the LOA level, subject to a finding that the total taking allowable (through any and all LOAs issued under the activity-specific rule and corresponding regulations) satisfies the negligible impact standard.

The MMC inaccurately states that the ''interpretation of the small numbers requirement proposed by NMFS in many ways seeks to maximize the numbers of takes of marine mammals that may be authorized under a single rulemaking.'' With one exception, the points raised by the MMC reflect NMFS' existing practice. The decision to make small numbers findings on an LOA-specific basis is the only new development and, as explained in the response to the previous comment, came about only when the issue arose for the first time in the context of this rulemaking. NMFS considered the specific issue, determined that section 101(a)(5)(A) does not unambiguously speak to it, and reasonably exercised its discretion in determining that small numbers findings could apply at the LOA stage, provided that the standard is set forth in the rule itself, which it is.

We acknowledge that section 101(a)(5)(A) does not expressly contemplate the issuance of LOAs, which are a creature of NMFS and U.S. Fish and Wildlife Service (FWS) joint implementing regulations for section 101(a)(5)(A). (See 50 CFR 216 subpart I (NMFS regulations); 50 CFR 18.27 (FWS regulations)). Those implementing regulations, in effect since 1989, established LOAs as the regulatory instrument to authorize lawful incidental take under section 101(a)(5)(A), after the promulgation of activity-specific regulations that undergo notice and comment rulemaking.

Although not the typical scenario, NMFS' implementing regulations allow for the issuance of LOAs to more than one ''U.S. citizen'' taking marine mammals under a specified activity regulation, see, *e.g.,* 50 CFR 216.105(a); 216.106(e); (54 FR 40338 (September 29, 1989)), provided that the negligible impact finding is made for the total taking for the specified activity as a whole, by all entities conducting that activity.

NMFS also administers section 101(a)(5)(D), a very similar provision enacted in 1994 that established an expedited process for the issuance of one-year incidental take authorizations for the taking of small numbers of marine mammals by harassment only when the taking from the specified activity is found to have a negligible impact on the affected species or stocks of marine mammals (referred to as incidental harassment authorizations, or ''IHAs''). See the Small Numbers section later in this Notice. The small numbers standard in section 101(a)(5)(D) applies to each individual one-year IHA, yet the same small numbers language also appears in section 101(a)(5)(A). In NMFS' view, the statute is silent on how to apply the same small numbers limitation in these two provisions across potentially different scales and timeframes. In the case such as here, where serious injury or mortality is not expected from the activity (and would not be authorized in any LOA), each prospective LOA applicant could instead opt to apply for an IHA under section 101(a)(5)(D). It would be an absurd result to deny an LOA for a single geophysical survey on the sole basis that small numbers is not satisfied because the take numbers from that survey must be aggregated with the takes from other surveys occurring under the same regulations, only to turn around and issue an IHA for the same survey, simply because the applicant has decided to avail itself of section 101(a)(5)(D) instead. But that would be the result under the MMC's approach. Given NMFS' implementing regulations for section 101(a)(5)(A), which are authorized under 16 U.S.C. 1382(a), and when viewed in light of section 101(a)(5)(D) and applying our administrative experience, NMFS has determined our approach is a reasonable interpretation of how to carry out section 101(a)(5)(A) and the implementing regulations in the context of these two statutory provisions. This is a reasoned approach that draws on NMFS' expertise.

Further, authorization of take incidental to geophysical survey activity within the covered regions of the GOM under this ITR allows for the more comprehensive evaluation and management of take of marine mammals than if NMFS were to authorize take for those same activities under IHAs. NMFS worked with BOEM and its predecessor agency over many years to ensure a process that holistically analyzed the impacts from expected geophysical surveys in the GOM. This is preferable first and foremost for its greater likelihood of achieving the best substantive impact analysis and comprehensive management (including mitigation and monitoring) scheme, but the process is also efficient for stakeholders (regulated industry and interested members of the public) and results in more efficient use of administrative agency resources.

The MMC argues that NMFS' implementing regulations support the MMC's view of the application of small numbers, because ''whereas the regulatory section governing the issuance of incidental take regulations (50 CFR 216.105) includes a reference to the small numbers requirement, the section governing LOAs (50 CFR 216.106) omits any reference to that requirement.'' However, the implementing regulations originally defined small numbers as synonymous with negligible impact. NMFS no longer interprets small numbers in that way, but as a result of that original approach, the MMC's particular citations do not shed light on the permissible approach for making a small numbers determination as that term is now interpreted.

NMFS agrees with the MMC that workload alone would not be a sufficient basis for our interpretation, and it is not what we rely on. Rather, the analysis we presented leads us to conclude that NMFS has discretion to apply small numbers at the LOA level and, in this case, policy considerations supported that approach.

Comment: NRDC states that NMFS' interpretation of small numbers ''leads to absurd results and permits excessive take.''

Response: NMFS' negligible impact assessment evaluated the risk to the affected species and stocks of marine mammals, taking into account the amount and severity of anticipated take (and take the agency is prepared to authorize) as well as the status of the species and mitigation/monitoring. Of note, and as indicated in Changes from the Proposed Rule, as a result of BOEM's updated scope of the activities and the associated revisions to the levels of effort, both the maximum allowable amount of take under the rule, as well as the maximum annual take, has decreased (significantly in some cases) for all species and stocks except two, for which maximum allowable take and/or maximum annual take increased slightly, and the severity of many of the impacts has been lessened via the elimination and/or reduction of take in areas of greater biological importance previously considered as mitigation areas.

The numbers of potential incidents of take or animals taken are only part of an assessment and are not, alone, decisively indicative of the degree of impact. In order to adequately evaluate the effects of noise exposure at the population level, the total number of take incidents must be further interpreted in context of relevant biological and population parameters and other biological, environmental, and anthropogenic factors and in a spatially and temporally explicit manner. The effects to individuals of a ''take'' are not necessarily equal. Some take events represent exposures that only just exceed a Level B harassment threshold, which would be expected to result in lower-level impacts, while other exposures (fewer, as the exposure modeling effort illustrates) occur at higher received levels and would typically be expected to have comparatively greater potential impacts on an individual. Further, responses to similar received levels may result in significantly different impacts on an individual dependent upon the context of the exposure or the status of the individuals (*e.g.,* if it occurred in an area and time where concentrated feeding was occurring, or to individuals weakened by other effects). Last, impacts of a similar degree on a proportion of the individuals in a stock may have differing impacts to the stock based on its status, *i.e.,* smaller stocks may be less able to absorb deaths or reproductive suppression and maintain similar growth rates as larger stocks.

Comment: The MMC recommended that if such determinations are made based on a proportion of a species' or stock's abundance, NMFS adopt a policy interpreting the small numbers requirement of section 101(a)(5)(A) such that it: (1) Include a sliding scale, such that a lower proportion is allowed as stock size increases, and (2) include an evaluation of the relative risk that the established threshold would be exceeded if the best available population estimate or some other metric, such as a minimum or intermediate population, is used.

Response: NMFS disagrees with these recommendations. Under the ''one-third'' interpretation offered here, and on which we will base our small numbers analyses when evaluating LOA applications under this rule, take equating to greater than one-third of the predicted individuals in the population would generally not be considered small numbers. The MMC presents an example from a very large population, asserting that an amount of take that would meet NMFS' proportional small numbers standard would not appropriately be considered ''small'' because it is large in terms of absolute magnitude. The MMC does not present a rationale for why its proposed sliding scale approach is more appropriate, nor does it provide an explanation of what the drawbacks are (biological or otherwise) of authorizing takes of large numbers of marine mammals (in the absolute sense) from a significantly large (and arguably healthier and more robust) population (even where still less than one-third of the population under NMFS' proportional approach). We have determined that a proportional approach is the appropriate way to interpret small numbers, not an absolute ''on its face'' numeric standard. Accordingly, absolute numbers would not be relevant to our small numbers determinations. 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 recommendation.

Mitigation, Monitoring, and Reporting

Comment: NRDC states that NMFS should include a year-round area closure for Bryde's whales. Specifically, NRDC states that this should include the following: (1) Excluding airgun surveys year-round from the whales' occupied habitat; (2) excluding airgun surveys from areas identified, through modeling, as most likely to propagate low-frequency sound into the Bryde's whales' habitat; and (3) establishing mitigation to reduce noise in the whales' unoccupied habitat, *i.e.,* areas they are likely to have inhabited according to the whaling records and have habitat characteristics similar to those of the De Soto canyon. The MMC also recommends that NMFS include a year-round area closure for Bryde's whales, while agreeing that the area defined by NMFS in the proposed rule is appropriate. In addition, a private citizen commented that a year-round closure is more appropriate than a seasonal closure, because Bryde's whales use the area year-round. The Associations and other industry commenters argue to the contrary, stating that there should be no restriction within the Bryde's whale area and that, if a restriction is required, it should be seasonal rather than year-round. The Associations also state that if implemented, the restriction area should be smaller. With regard to the other alternative offered by NMFS for comment—no restriction but a requirement to conduct real-time whale detection through use of a moored listening array—the Associations state, ''the final ITR should not impose a moored array requirement because the limits inherent in such data are outweighed by the impracticability of such arrays.'' The CRE also comments, with no supporting information, that there should be no restriction on survey effort in the Bryde's whale core habitat area.

Response: As described in the proposed rule, NMFS agrees with NRDC and the MMC that the status (*e.g.,* small population size, restricted distribution, anthropogenic effects, small population effects) of the recently ESA-listed GOM Bryde's whale warranted the consideration of a year-round closure to airgun surveys within the area described as core habitat for the whale (Area #3). We disagree with the Associations' arguments that no requirement is warranted. However, the comments specifically relating to the need (or lack thereof) to impose a restriction on survey effort in Bryde's whale core habitat, the duration of any such restriction, or any additional requirements in the core habitat area, are no longer relevant following BOEM's updated scope of activity. This update means that no survey effort within Bryde's whale core habitat is considered through this rulemaking and the vast majority of any anticipated or authorized impacts to this species have been eliminated. Please see Table 1 and Figure 2, earlier in this notice.

Regarding NRDC's recommendations for establishing Bryde's whale mitigation measures beyond the core habitat area identified in the notice of proposed rulemaking, NMFS does not believe these are warranted. We initially note that the comment uses the terms ''occupied and ''unoccupied'' to describe habitat. These are terms of art in the Endangered Species Act and implementing regulations for designation of ''critical habitat.'' For this MMPA rulemaking, the correct standard is measures to effect the ''least practicable adverse impact'' on the affected species or stocks and their habitat. NMFS has now determined that additional geographic-based mitigation for Bryde's whales is not warranted. Following BOEM's update to the scope of their specified activity, expected takes of Bryde's whales are significantly reduced in the remaining area where the specified activity will occur under this rule (*i.e.,* there are now no more than 10 anticipated instances of take annually; see Table 9).

Regarding NRDC's comments that additional protections are needed in areas that are ''unoccupied'' by the Bryde's whale, we disagree. NMFS' objective in requiring a closure would be to minimize the effects of airgun surveys on Bryde's whales while in important habitat. In areas where modeling and/or observational data show a species or stock is unlikely to occur during the period of the rule, it is generally unlikely that a geographic or other mitigative restriction would reduce impacts from the specified activities on the species or stock and its habitat, and therefore is not justifiable absent some other compelling basis. Finally, we are unsure of what NRDC might mean in recommending exclusion of surveys from areas identified as most likely to propagate low-frequency sound into Bryde's whale habitat, or whether such areas are still covered by the rule given BOEM's updated scope, and NRDC provides no meaningful justification for the recommendation, nor any useful recommendations for how such areas could be identified.

Comment: In reference to NMFS' statement that the agency does not consider towed passive acoustic monitoring (PAM) to be a useful tool with regard to detection of Bryde's whales, the Associations state that they do believe more typical real-time detection-based mitigation, such as use of towed PAM, should provide sufficient protection for Bryde's whales, and assert that we did not provide sufficient information to meaningfully comment on the conclusion.

Response: It is generally well-accepted fact that, even in the absence of a firing airgun, using a towed passive acoustic sensor to detect baleen whales (including Bryde's whales) is not typically effective because the noise from the vessel, the flow noise, and the cable noise are in the same frequency band and will mask the vast majority of baleen whale calls. Further, Bryde's whales have relatively short calls, further exacerbating the problem. As background, airguns produce loud, broadband, impulsive signals at low frequencies (*e.g.,* Hildebrand, 2004). Source characteristics are variable but typically peak pressures are in the 5–300 Hz frequency range, with source levels as high as 260 dB peak re 1 μPa at 1 m output pressure (Hildebrand, 2009). Pulse rates are typically one per 10–20 s (Hildebrand, 2009). Seismic survey noise can raise background noise levels by 20 dB or more over large areas while present. Because the seismic pulse and the whale's call are within the same frequency range, and the seismic pulse is much louder than the whale's call (see below), it is extremely unlikely that a baleen whale can be detected during the pulse. In addition to the actual seismic pulse (approximately every 10–20 s), the background noise level is expected to be significantly increased as a result of the reverberant field generated from seismic pulses (Guerra *et al.,* 2011; Guan *et al.,* 2015), *i.e.,* during the inter-pulse interval. The level of elevated inter-pulse noise levels can be as high as 30–45 dB within 1 km of an active 3,147 in^3 airgun array (Guerra *et al.,* 2011). Given that towing hydrophones for PAM used for marine mammal monitoring would be within 1 km from the airgun source, the received noise spectral density during the inter-pulse interval is expected to be very high.

Vessels also produce low-frequency noise, primarily through propeller cavitation, with main energy also in the 5–300 Hz frequency range. Source levels range from about 140 to 195 dB re 1 μPa at 1 m (NRC, 2003; Hildebrand, 2009), depending on factors such as ship type, load, and speed, and ship hull and propeller design. Studies of vessel noise show that it appears to increase background noise levels in the 71–224 Hz range by 10–13 dB (Hatch *et al.,* 2012; McKenna *et al.,* 2012; Rolland *et al.,* 2012). PAM systems employ hydrophones towed in streamer cables approximately 500 m behind a vessel. Noise from water flow around the cables and from strumming of the cables themselves is also low-frequency and typically masks signals in the same range.

GOM Bryde's whale calls have relatively low source levels (155 dB re 1μPa) and frequency ranges (78–110 Hz; Širović *et al.,* 2014) that overlap the sounds described above. In addition, GOM Bryde's whales call only infrequently (*i.e.,* a 3.5 hour research encounter with 4 whales resulted in detections of 14 calls). The chances of acoustically detecting these whales is low under ideal research circumstances, is much lower with elevated background noise from the ship and towing cable, and essentially impossible with an airgun array shooting. Whales are routinely detected acoustically using moored systems and sonobuoys, or using autonomous gliders. However, these platforms are all quiet. A leading provider of observer services for the seismic industry, including PAM, reports that they have never detected a baleen whale (other than rare detections of humpback whales, which have significantly higher frequency content in their call) using PAM aboard a working seismic vessel (S. Milne, RPS Group, pers. comm.). Experienced PAM operators participating in a recent workshop (Thode *et al.,* 2017) emphasized that a PAM operation could easily report no acoustic encounters, depending on species present, simply because background noise levels rendered any acoustic detection impossible. The same workshop report stated that a typical eight-element array towed 500 m behind a seismic vessel could be expected to detect delphinids, sperm whales, and beaked whales at the required range, but not baleen whales, due to expected background noise levels (including seismic noise, vessel noise, and flow noise).

Comment: The Associations provided comments regarding NMFS' proposed power-down exception to the general shutdown requirements for certain species of dolphin, as well as the related alternative of no shutdown or power-down requirement. The Associations stated that no shutdowns for dolphins are warranted, and added that an exception should not be limited to small dolphins but rather should be expanded to all delphinid species. The MMC recommended that NMFS not require a shutdown or power-down when small delphinids enter the exclusion zone, and relatedly suggested that NMFS should provide clarification as to the basis for exempting only small delphinids from shutdowns. The MMC stated their agreement with NMFS that shutting down when small delphinids enter the exclusion zone is not warranted and may result in additional survey activity. Furthermore, as indicated in the MMC comments, power-down may not be effective. The MMC stated that, given the variation in array characteristics and configuration, a requirement to ''power-down'' does not provide sufficient assurance that the resulting received levels would be below the Level B harassment threshold. CGG provided a detailed analysis of the potential operational costs associated with dolphin shutdowns or power-downs, supporting their comment that these costs would be substantial and that shutdown or power-down should not be required. NRDC provided multiple objections to NMFS' proposals, stating that of the two proposals they favor power-down.

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, and that the alternative power-down requirement may not be effective and yet could impose costs on operators. (Here we refer to ''large delphinids'' and ''small delphinids'' as shorthand for generally deep-diving versus surface-dwelling/bow-riding groups, respectively, as the important distinction is their dive behavior rather than their size.) As NMFS discussed in the notice of proposed rulemaking, mid- and high-frequency cetaceans are relatively insensitive to the frequencies where the most energy in an airgun signal is found. In order to demonstrate this quantitatively, a ''spectral ratio'' may be calculated for each hearing group. This ratio essentially compares the energy in a group-specific weighted airgun source spectrum with the energy in an unweighted airgun source spectrum, providing a representation of the proportion of total energy from the unweighted airgun spectrum that is available for animals to hear based on their group-specific general auditory filter shapes, which presumably influences the probability of behavioral response. Using M-weighting (*i.e.,* Type I filters), spectral ratios for the three hearing groups are as follows: LF, 0.71; MF, 0.03; HF, 0.02.

However, NMFS does 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), Stone *et al.* (2017), and Barkaszi and Kelly (2018) 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.

As noted above, the proposed rule included an alternative in which a power-down requirement would be required. However, following review of public comments, NMFS believes 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. 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.

NMFS disagrees with comments that no shutdown requirements should apply to any delphinid species regardless of behavior. As noted above, industry commenters have asserted that no shutdown requirements are warranted for any delphinid species, stating that the best available science does not support imposing such requirements. The industry 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 can accrue to affect fitness. As described in greater detail in the notice of proposed rulemaking, 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, NMFS finds that there is support for the effectiveness of the standard shutdown requirement as applied to the large delphinid species group.

Further, the claim 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, recent synthesis of observer data in the GOM shows that large delphinids were sighted only rarely, and that of these sightings, almost half were not within the 500-meter exclusion zone. We note that the Associations provided a quantitative analysis of ''historical PSO and PAM data from over 32,000 survey activity hours conducted in the GOM between 2007 and 2017,'' but provide no citation for these data (nor the data itself). Therefore, we cannot verify or meaningfully evaluate the industry-supplied analysis. Nevertheless, as detailed herein, NMFS agrees in substantial part with the comments received and accordingly do not require shutdown or power-down for small delphinids detected within the exclusion zone.

Comment: Several commenters criticized our proposal to require shutdowns upon detection of certain species or circumstances (*e.g.,* beaked whales, Bryde's whales) at any distance. The Associations suggest that such requirements are ''arbitrary and unlawful'' because they require shutdowns in ''circumstances in which no disturbance or harassment will occur.'' The Associations contend that PSOs are likely to make frequent ''precautionary'' shutdown calls for uncertain observations ''at any distance,'' and that these measures will have negative impacts on the effectiveness of visual PSOs. CGG makes similar claims, stating that ''there is no proven or likely efficacy to initiate a shutdown for cetaceans that are well outside of incidental take range'' and concluding that the standard 500-m exclusion zone should be applied in these circumstances. The MMC commented that, in reference to the two proposals of ''at any distance'' or ''within 1 km,'' they support the implementation of shutdowns for detections at any distance (rather than within 1 km of the airgun array), based on the status of the applicable species, their small population sizes, and their sensitivity to seismic sound.

Response: As discussed below and in Mitigation, an extended shutdown distance of 1.5 km is included in the final rule, in lieu of the ''at any distance'' shutdown included in the proposed rule. We first note that the industry comments against proposed shutdowns for certain species, in their view beyond the range at which harassment may occur, appears to reflect an assumption that the single-step 160-dB threshold is the relevant metric for harassment. Even if this were the case, the minimum distance to the 160-dB isopleth, based on 60 different propagation modeling scenarios, would be beyond the likely detection distance for visual observers. The smallest threshold radius to the 160-dB isopleth is more than 7 km. However, the multi-step probabilistic risk function used here assumes that 10 percent of the population exposed above 140 dB would experience harassment; isopleth distances to 140 dB, based on the same modeling exercise, are typically greater than 50 km (minimum of approximately 29 km). Even the 90 percent harassment isopleth (*i.e.,* 180 dB) has a mean distance of 1.6 km. Therefore, the claims that shutdowns upon detection ''at any distance'' would occur in circumstances where there is no harassment are incorrect. The Associations' comments are also inconsistent in that they imply both that marine mammals are likely to be detected at ranges significantly distant from the vessel, where shutdowns would be effected on detection of animals not subject to harassment, and that marine mammals cannot be adequately identified beyond close distances, resulting in unnecessary ''precautionary'' shutdowns. NMFS agrees that visual monitoring under typical circumstances is unlikely to be effective at ranges much beyond the extended distance shutdown of 1.5 km, while under ideal circumstances acoustic detectability will also be limited to within the exclusion zone distance. (NMFS presented a detailed analysis in the notice of proposed rulemaking demonstrating that acoustic detections of sperm whales during active firing of an airgun array are not likely beyond approximately 500 m). Moreover, we specify in these regulations that shutdowns are required on positive identification of relevant species (as determined through professional judgment), meaning that there is no real likelihood that there would be numerous shutdowns based on false positive detections. Overall, it is unlikely that there will be ''unnecessary'' shutdowns to any significant degree.

The MMC provided the following supporting rationale to their comment: ''Bryde's whales are LF cetaceans with particular sensitivity to the predominantly low-frequency energy output of airguns. Beaked whales are well-documented to react behaviorally to sound levels well below those thought to cause injury, and larger exclusion zones have been recommended for beaked whales and other deep-diving whales (such as *Kogia* spp. and sperm whales) as they are more likely to exhibit a stress response when disturbed (Wright *et al.,* 2011).'' NMFS agrees with these comments. In these cases, we have identified species or circumstances with particular sensitivities for which we determined 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).

NMFS disagrees with industry comments regarding the likelihood that trained, experienced professional PSOs would misunderstand the intent of a requirement to shut down upon detection ''at any distance'' and would therefore 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). Nevertheless, in order to ensure that this potential is minimized, and to address commenters' concerns regarding the potential costs associated with shutdowns at any distance, especially in light of the diminished benefits of the measure beyond 1.5 km, 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: NRDC states that NMFS should require that ramp-up occur over several stages in order to minimize exposure.

Response: NMFS agrees with NRDC on this point, which appears to restate the ramp-up procedures described by NMFS in the notice of proposed rulemaking. NMFS believes this approach is consistent with the Australian study referenced by NRDC.

Comment: NRDC states that the standard 500-m exclusion zone is ''not conservative,'' asserting that NMFS did not explain why the proposed zone achieves the least practicable adverse impact and stating that NMFS must consider other exclusion zone distances.

Response: NMFS has 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 explained in the notice of proposed rulemaking, NMFS' 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. The 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, NMFS believes it is based on 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, which NMFS seeks to avoid.

NMFS agrees 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, this distance was modeled as 457 m (though we acknowledged that the actual distance would be dependent on the specific airgun array and could be larger). However, we require an extended exclusion zone of 1.5 km for certain sensitive species, including *Kogia* spp. Potential auditory injury for low-frequency cetaceans is based on the accumulation of energy, and is therefore not a straightforward consideration. However, the extended exclusion zone is required for the only low-frequency cetacean in the GOM (Bryde's whale). In keeping with the four broad goals outlined above, and in context of the information given here, the standard 500-m exclusion zone is appropriate. NRDC does not provide any substantive reasoning for a larger zone.

Comment: Several industry commenters criticized the requirement for use of buffer zones in addition to the standard exclusion zones, claiming in part that there is no scientific basis for monitoring a zone larger than the exclusion zones.

Response: NMFS disagrees with the suggestion that there is no scientific basis for this requirement. It is 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 previously required a 1,000-m pre-clearance zone before recently extending the exclusion zone to encompass the entire 1,000-m zone (IBAMA, 2005, 2018), 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: CGG comments that shutdowns based on acoustic detections should be required only when the acoustic PSO is confident that the vocalization is from a non-delphinid species within the exclusion zone, as opposed to when the PSO is confident that the animal is outside of the exclusion zone.

Response: We are unclear as to the practical impact of what appears to be a fairly nuanced difference, but clarify that shutdown upon acoustic detection of non-delphinids within the exclusion zone is required when the animal is detected acoustically and localized within the exclusion zone. However, we also note that PSO decision-making regarding shutdown implementation shall be informed to a reasonable extent by professional judgment.

Comment: NRDC suggests that NMFS is remiss in not limiting the amount of activity that can occur overall (to a lesser amount than analyzed in the rule). Relatedly, NRDC suggests that NMFS must consider ''placing a cap on the amount of allowable seismic activity.''

Response: Such a requirement is not within NMFS' authority under the MMPA, assuming that the requisite findings are made. NMFS' responsibility is to evaluate the potential effects of the specified activity as presented by the applicant (BOEM in this case, acting on behalf of future industry applicants) and to determine whether the total taking will have a negligible impact on the affected species or stocks (among other things). If NMFS is unable to make the necessary finding, the applicant may then consider a revision to the specified activity that could lead to NMFS being able to make the necessary finding of negligible impact (or in some cases additional mitigation may enable a negligible impact finding). However, in this case, NMFS has made a finding of negligible impact, and it is not within NMFS' authority to unilaterally impose a reduction in activity levels to some degree (NRDC does not specify the degree or distribution of reduction in time or space that they would find acceptable).

Comment: NRDC expressed concern regarding the efficacy of the prescribed visual and acoustic monitoring methods, stating that species could go undetected.

Response: While NMFS disagrees with some specific comments regarding efficacy, we generally 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 more effective monitoring method (for certain species) during periods of impaired visibility, there is no expectation that these methods will detect all marine mammals present. In general, NRDC appears to misunderstand what NMFS claims 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 monitoring in reaching the necessary findings. We acknowledge these limitations in prescribing these monitoring requirements, while stating why NMFS believes that visual and acoustic monitoring, and the related protocols we have prescribed, are an appropriate part of the suite of mitigation measures here that satisfy the MMPA's least practicable adverse impact standard. However, the negligible impact finding is not conditioned on the presumption of a specific degree of monitoring efficacy.

Comment: The MMC recommends that NMFS expand its shutdown requirement for sperm whales to include both visual and acoustic detections at extended distance, stating that vital functions of sperm whales, including both foraging and resting, should be afforded the additional protection of the extended shutdown zone. NRDC asserts that acoustic shutdowns for sperm whales, which they believe are not required under the ITR, would not be effective. The CRE comments that they ''agree with [NMFS] that sperm whale shutdowns are not warranted.''

Response: NMFS agrees with the MMC's recommendation and has made the recommended change (albeit within a revised extended distance shutdown zone of 1.5 km; see Mitigation). However, we note the MMC's statement that ''[t]he requirement for implementing shut-down procedures upon acoustic detection of a sperm whale was inadvertently omitted from the proposed regulatory text.'' NMFS disagrees with this statement. The proper interpretation of the proposed regulatory text was that such shutdowns would be required. Nevertheless, the revised, final regulatory text makes this requirement clearer, in addition to making the change to be inclusive of visual detections at the greater distance. Regarding the CRE's comment, NMFS did not determine that ''sperm whale shutdowns are not warranted.'' Shutdowns for sperm whales have been required in the GOM for over a decade, and NMFS does not make any findings that this should change.

With regard to NRDC, we reference this comment only to provide necessary clarification. Because NRDC mistakenly claims that ''NMFS hasn't included an acoustic shutdown requirement for sperm whales in its proposed regulation,'' we refer the reader to the notice of proposed rulemaking, in which we state that shutdown of the acoustic source is required upon acoustic detection of a sperm whale (29274–29275). (''We are proposing that shutdown of the acoustic source should also be required in the event of certain other observations [. . .]. Circumstances [. . .] include [. . .] acoustic detection of a sperm whale.'') This requirement is carried forward in this final ITR, as modified (see Mitigation).

With regard to the efficacy of the measure, we are confused as to NRDC's comments. NRDC first asserts that sperm whales are the only species for which acoustic detection may reasonably be assumed, but then seemingly states that implementation of the measure is not sufficiently effective as to be considered in context of reducing impacts to sperm whales. As discussed in greater detail elsewhere, NMFS believes that shutdowns for sperm whales at an extended distance, on the basis of both acoustic and visual detections (the latter added in this final ITR), will meaningfully reduce impacts to the species.

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: NMFS disagrees with this comment. 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. In the notice of proposed rulemaking, NMFS 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 the notice of proposed rulemaking 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 the measures identified in the notice of proposed rulemaking measures would reduce impacts on ''acoustic habitat.'' Following BOEM's update to the scope of activity, two of the three time-area restrictions identified and proposed by NMFS now fall outside the area in which survey activity may be considered under this rule.

Comment: NRDC recommends that NMFS should consider a year-round restriction on geophysical survey activity within coastal waters in the footprint of the DWH oil spill, and that NMFS must expand its proposed GOM-wide coastal restriction temporally to include the month of January. Conversely, the Associations state that no coastal restriction should be required. The MMC recommends that the proposed coastal closure be expanded temporally such that the timeframe is from January through August.

Response: NMFS finds aspects of both NRDC's and the Associations' statements with which we agree and disagree and, as discussed in Mitigation, have revised the time-area restriction. This restriction on airgun survey activity (''Area 1'') was proposed as including all GOM waters inside the 20-m isobath, from February through May. The revised restriction is limited to those waters inside the 20-m isobath from 90° to 84° W. Temporally, the restriction is expanded to be in effect from January through May.

The Associations provide extensive comments relating to the impacts on practicability presented by the proposed restriction. The potential economic consequences of the measure are addressed in greater detail in the regulatory impact analysis (RIA), which analysis we adopt as a portion of our practicability assessment for the revised measure. NMFS agrees that there will likely be negative economic and operational consequences of the restriction, though these consequences are difficult to assess (and cannot reasonably be assessed quantitatively) (see the RIA for full analysis). While the Associations express concerns regarding the practicability analysis as being too vague, they fail to provide additional specific information that would help to improve the analysis. For example, the Associations state that data from the area contained within the restriction are outdated and that the restriction will impede industry's ability to identify prospects in coastal areas, but provide no specific information to support these claims, such as information about the data that do exist or the areas where industry anticipates having interest in identifying prospects. Despite the lack of information provided in support of the practicability concerns, NMFS takes seriously the Associations' concerns, and therefore did consider eliminating the restriction.

The Associations also assert that the restriction would not result in any meaningful benefit to coastal bottlenose dolphin populations. NMFS disagrees that this is the case. Although dolphins are less sensitive to the frequencies at which the greatest energy in an airgun signal is found, we have described the large body of evidence of adverse or aversive behavior by various dolphin species during airgun firing (*e.g.,* Goold and Fish, 1998; Stone and Tasker, 2006; Barkaszi *et al.,* 2012; Stone, 2015a; Barkaszi and Kelly, 2018). Considered in context of a generic dolphin population with no notable issues affecting the population as part of the environmental baseline, it may be reasonable to assume that such effects 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. However, as was described in the notice of proposed rulemaking, and as discussed in NRDC's comment, coastal bottlenose dolphins in the GOM—particularly the northern coastal stock of bottlenose dolphins—were severely impacted by the DWH oil spill.

As explained in the notice of proposed rulemaking, while none of the dolphin strandings or deaths have been attributed to airgun survey activities, stocks in the area are stressed and the northern coastal stock in particular is in extremely poor health. The Associations' discussion of NMFS' analysis—claiming that our justification for the restriction was premised merely on ''the broad understanding that 'marine mammals react to underwater noise' ''—is factually mistaken. As we stated, 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 may be expected to induce responses involving the neuroendocrine system, which controls reactions to stress and regulates many body processes (NAS, 2017), and there is strong evidence that petroleum-associated chemicals can adversely affect the endocrine system, providing a potential pathway for interactions with other stressors (Mohr *et al.,* 2008, 2010). Romano *et al.* (2004) found that upon exposure to noise from a seismic watergun, bottlenose dolphins had significantly elevated levels of a stress-related hormone and, correspondingly, a decrease in immune cells. As we stated, the restriction is intended specifically to avoid additional stressors to these coastal bottlenose dolphin populations during the time period believed to be of greatest importance as a reproductive period. The Associations do not contradict this information, instead weakly relating the concern to the potential for dolphins to experience damage to auditory structures (which NMFS agrees is unlikely) or to the idea that ''reactions'' to noise are innocuous.[9]

Population-level impacts related to energetic effects or other impacts of noise are difficult to determine, but the addition of other stressors can add

[9] The Associations also apparently misunderstand some discussion of stranding events (which have occurred primarily as a result of military use of mid-frequency active sonar) provided in the notice of proposed rulemaking, interpreting this discussion as NMFS' ''suggestion that seismic surveys are similar to mid-frequency sonar (which has been implicated in strandings) simply because seismic signatures include a mid-frequency component.'' We suggested no such thing and agree with the Associations that airguns and sonar are very different sound sources with very different potential to cause strandings.

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. We cannot undo the effects of the DWH oil spill, but the potentially synergistic effects of noise due to the activities that are the subject of this rule may be mitigated. However, NMFS does acknowledge that the two populations of greatest concern—the western and northern coastal stocks of bottlenose dolphin—do not have the same status. As identified in the notice of proposed rulemaking, while both stocks were impacted by the DWH oil spill, the northern coastal stock in particular was perhaps the single most heavily impacted stock, with 82 percent of animals belonging to the stock expected to have been exposed to oil, resulting in a possible population reduction of 50 percent (this latter figure was only five percent for the western stock). The northern coastal stock was also subject to a recent Unusual Mortality Event (UME), described later in this notice (see Description of Marine Mammals in the Area of the Specified Activity). NMFS acknowledges the uncertainty associated with predicting the ways in which different stressors may interact, or how the effects of a stressor might be exacerbated in an unhealthy population. However, as an example, Schwacke *et al.* (2014a) described findings indicating that a significant proportion of the population is expected to exhibit adrenal insufficiency as a result of oil exposure. Adrenal insufficiency can lead to adrenal crisis and death in animals that are challenged with other stressors (Venn-Watson *et al.,* 2015b). NMFS agrees that the potential practicability concerns warrant consideration and, in light of the differential baselines for the potentially affected coastal stocks, has determined it appropriate to contract the restriction. However, the post-DWH oil spill baseline condition of the northern coastal stock, as exacerbated by the recent UME, requires caution. This restriction may reasonably be anticipated to provide additional protection to these populations during their peak reproductive activity. We note that NRDC's proposed focus area for heightened restriction aligns generally with this area of concern, but that in aligning with the footprint of the spill rather than with the stock boundaries, this recommendation would not necessarily encompass the animals of greatest concern and which we assume are the population targeted by the proposal.

With regard to the timing of the closure, there is no definitive definition of the ''peak reproductive activity'' associated with the stock and, additionally, there is some uncertainty as to whether the more important focus is on effects to pregnant mothers or on the post-partum period when energetic or stress effects would lead to greater risk for lactating mothers and/or disruption of mother-calf bonding and ultimate effects on rates of neonate and/or calf survivorship. We acknowledged this uncertainty in discussing the recommendations of NMFS' subject matter experts and describing the proposed temporal extent of February through May in the notice of proposed rulemaking. Upon review of the information presented in the comments of NRDC (*e.g.,* reference to the data presented by, *e.g.,* Carmichael *et al.,* 2012; Mattson *et al.,* 2006; Urian *et al.,* 1996), which supported NRDC's assertion that, in summary, inclusion of January would cover the remainder of the dolphins' peak calving and late gestation periods as well as the beginning of the period of highest reproductive failure, NMFS agrees that this temporal expansion is appropriate (within the contracted region of our revised restriction area). In contrast, the MMC does not provide compelling information in support of the recommendation to expand the restriction by an additional three months (through August), stating only that ''calves can be born at any time of the year'' and referencing a bimodal peak in neonate strandings from the Sarasota Bay area. Given the exacerbation of practicability concerns that this expansion would entail and the lack of information to support it, NMFS does not believe it appropriate to expand the restriction through August.

We do note that one concern of the Associations, which is that the restriction may result in an inability to complete surveys within one year, may be alleviated to some degree by the ability under this ITR to issue LOAs for any term up to five years. The Associations recommend that, if the restriction is included in the ITR, NMFS allow for multi-year LOAs, which we have done.

Comment: The Associations state that the proposed time-area restriction in the Dry Tortugas region of the eastern GOM should not be required. However, the MMC concurs with NMFS' proposal, stating that the imposition of this restriction is appropriate.

Response: NMFS appreciates the comments. The proposed time-area restriction referenced here is no longer relevant following BOEM's update to the geographic scope of activity, as no survey activity within this area can be considered through this rule.

Comment: NRDC comments that NMFS must consider restrictions and limitations on survey activity in the Central Planning Area (CPA) restriction area analyzed in the proposed rule. NRDC states that NMFS' practicability analysis must focus on (1) how much oil and gas development is projected to occur within the proposed areas over the next five years; (2) what effect the proposed mitigation area would have on that projected development; and (3) whether that projected development would be offset by exploration in other parts of the GOM.

Response: NRDC accurately characterizes the area as being important for sperm whales [10] and beaked whales, as was described by NMFS in the notice of proposed rulemaking, and accurately describes that this area is projected to be subject to significant survey effort. NMFS acknowledges these issues. However, NRDC provides no serious rebuttal of NMFS' practicability analysis, which includes incorporation by reference of the findings of the RIA for this rule, instead providing only a cursory rejection of the analysis as inadequate. We also note that the third prong of NRDC's suggested analysis is not reasonable: Development foregone due to a lack of survey data in the closure areas cannot be ''offset by exploration'' elsewhere.

As discussed in detail in the RIA, there are significant uncertainties associated with assessing the indirect costs of restricting survey effort within the described area. Notable areas of uncertainty include the demand for and timing of oil and gas production in the GOM over the next five years, the suitability of existing data to direct oil and gas production in the closure areas, and the most likely substitute sites for oil and gas production. These uncertainties foreclose the possibility of the analysis demanded by NRDC. However, what information is available strongly suggests that the economic impacts of the evaluated CPA restrictions would be significant. A mitigation requirement that could lead

[10] However, we note that NRDC mischaracterizes sperm whale buzz rates as ''a measure of foraging success,'' as opposed to a measure of foraging effort. The study referenced by NRDC did not find that sperm whale foraging success ''declined substantially'' on exposure to airgun noise. Moreover, the measured decline in foraging effort was not a statistically significant result and, therefore, cannot appropriately be referred to as a substantial decline. See Miller *et al.* (2009).

to regional- to national-scale economic impacts is not practicable.

The impacts of year-round area closures are highly dependent on volatile oil and gas market conditions over the next five years, which dictate the demand for activities in the GOM. The greater the demand for oil and gas, the greater the expected impacts of the restrictions. The extent to which oil and gas production is delayed because of the need for newer, better data is a key source of uncertainty. Some sites may be able to employ existing data from recent surveys. However, even for relatively recent data, the inability to collect new seismic data could affect oil and gas development given that oil companies typically use targeted seismic data to refine their geologic analysis before drilling a well.

It is possible that some fraction of reductions in production from the closure areas may be made up for with production in other areas in the GOM, mitigating potential regional economic impacts. However, uncertainty with regard to the location of ''substitute'' production has potentially critical impacts on the ultimate economic impacts of the closure. If a closure requirement reduces exploration and development activity in the GOM, the displaced capital expenditures would likely shift to the next-lowest-cost opportunities promising the greatest development potential. Given that oil is produced and sold in a global market, the next-lowest-cost areas may be elsewhere within the GOM, but also may be international locations. To the extent that substitute areas are outside of the GOM but within the United States, national-level impacts of the closure areas would likely be limited. However, to the extent that industry moves displaced activities outside of the United States, national-level impacts associated with industry income and employment could be substantial. Recent levels of leasing and drilling activity in the CPA indicate that the closure areas considered are among the most productive in the entire GOM.[11] Given this, it is less likely that other GOM areas will offer equivalent alternative opportunities. As a result, the analyzed area closures have greater potential to reduce domestic oil and gas production, industry income, and related regional employment opportunities.

NRDC asks NMFS to conduct analyses that cannot be supported by existing data. Further, NRDC asks NMFS to speculate as to the impacts of restricting exploration activity outside the development of existing leases. However, such a restriction, while less impactful than a complete area-wide restriction, would necessarily foreclose the ability of both the government and industry to assess fair market value of leases already planned for sale. While NMFS believes that the evaluated restriction area would be beneficial for sperm whales and beaked whales, such restrictions are at this time not practicable. NRDC does not provide any information contradicting this conclusion, and provides no specific, viable alternatives for NMFS' evaluation.

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

Response: NMFS did consider habitat-based protections for species additional to those discussed in the time-area restrictions section of Mitigation. For all affected species, NMFS 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. NMFS determined that the available information supported development of the measures described in the notice of proposed rulemaking for the Bryde's whale, sperm whales, and beaked 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, when considered in combination with practicability concerns.

NRDC asserts that ''marine mammal populations in the northern Gulf of Mexico can no longer be considered by the agency to be too 'data poor' or broadly distributed to justify specific mitigation measures for their protection, including time-area closures.'' This is not a representation NMFS made in the notice of proposed rulemaking. NRDC then erroneously claims that NMFS ''limits its analysis to two deep-diving species, sperm whales and beaked whales [. . .]. In doing so, however, it omitted other populations whose conservation status or modeled impacts pose particular concern.'' First, NMFS did conduct core abundance analyses for all GOM stocks. Second, NRDC declines to elaborate on which stocks they believe ''pose particular concern,'' other than noting that *Kogia* spp. may be subject to Level A harassment. However, despite NRDC's statement that species can no longer be considered to be too broadly distributed to justify specific time-area mitigation measures, our core abundance analysis for *Kogia* spp. shows exactly that. Based on the Roberts *et al.* (2016) models, the two species are broadly distributed in shelf-break waters essentially throughout the GOM, and there is no identified biologically important area or specific bathymetric feature that would allow us a more refined understanding of an area suitable for protection (if it were warranted). NRDC does not suggest any specific area for protection of *Kogia* spp.

NRDC also suggests that NMFS should prohibit seismic activity in the Flower Garden Banks National Marine Sanctuary (FGBNMS) but offers no strong justification other than stating that marine mammals occur there. In addition, BOEM and/or BSEE will consult with NOAA's Office of National Marine Sanctuaries when they receive an application that indicates that survey activity may occur within or near the FGBNMS.

Overall, NRDC offers no useful recommendation as to the designation of protections for additional species. NMFS' consideration 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 GOM.

Comment: Several commenters recommended establishing wider buffer zones around the proposed time-area closures. The Associations state that no buffers should be required around any time-area restriction (if required; the Associations also disagree that any restrictions should be required, as discussed previously).

Response: NRDC indicates that NMFS' stated objective in establishing the proposed buffer zones around time-area restrictions was unclear in terms of evaluating the proposed buffer zone relative to the objective. The stated objective was to exclude noise that is likely to result in harassment, which NMFS interpreted to mean site-specific modeled distances to the 160-dB isopleth (*i.e.,* 50 percent midpoint of the Level B harassment risk probability function). Following review of public comments, NMFS provides further context here regarding the multi-step Level B harassment risk function employed for purposes of evaluating modeled noise exposures.

[11] Leases within the closure areas considered within the Central Planning Area accounted for approximately 50 percent of total oil production in the GOM between 2012 and 2016 and 24 percent of total gas production. Existing reserves within the closure areas represent 57 percent of estimated oil reserves and 37 percent of estimated gas reserves in the GOM.

With regard to the establishment of a buffer zone, NMFS agrees with certain commenters that it is generally appropriate to buffer an area to be avoided by some degree, as discussed in the notice of proposed rulemaking. However, we disagree that a buffer must be developed to fully eliminate the potential for Level B harassment, as some commenters may have inferred from our use of the distance to the 160-dB isopleth (*i.e.,* historically used as a 100 percent single-step function for evaluation of Level B harassment; here the 50 percent midpoint of the Level B harassment risk function). Rather, the buffer concept, as described in the notice of proposed rulemaking, serves to reasonably minimize the extent and severity of what limited harassment may occur as a result of acoustic exposure to relatively low received levels of noise.

The Associations asserted that NMFS did not consider the use of buffer areas in the practicability analyses and provides no biological basis for including buffers. We disagree. As noted earlier, the RIA analysis (which forms a substantial part of the practicability analysis for these measures) includes analysis of the economic impacts of the time-area restrictions *inclusive of the buffer.* As noted above, the logical biological rationale is to provide a buffer around an area determined to be of particular biological importance such that the effects of noise from outside the restriction area intruding within the area is minimized.

However, BOEM's update of the geographic scope for this rule eliminates the need for proposed time-area restrictions #3 and 4 (*i.e.,* the Bryde's whale core habitat area and the ''Dry Tortugas area'' designed for protection of beaked whales and sperm whales). Therefore, comments addressing the proposed buffers for those areas are no longer relevant. Regarding the coastal bottlenose dolphin restriction (Area #1), NMFS has determined that the addition of a buffer to this area is not warranted, based on the objectives of the restriction (described in detail in a previous response to comment) and on the manner in which the area was delineated. Areas #3 and 4 were delineated based on NMFS' review of the available scientific information and expert opinion and in order to denote areas expected to be of particular biological importance for particular species. In contrast, the coastal dolphin restriction area was based simply on the stock boundaries for coastal bottlenose dolphins (*i.e.,* the seaward extent of the area is set at the 20-m isobath). As this boundary does not mark an area of specific biological importance or high density for the stock, but is rather an approximation of stock presence, NMFS has determined following review of public comments, in which valid practicability concerns were raised, that the inclusion of a buffer to this area is not warranted.

Comment: Noting that the proposed ITR included requirements to conduct visual monitoring following conclusion of active shooting, the MMC recommends that NMFS require operators to also continue conducting acoustic monitoring following conclusion of active shooting.

Response: The proposed ITR stated that acoustic monitoring must occur for 30 minutes prior to and during all active firing of airguns for deep penetration surveys, but was silent on the issue of acoustic monitoring following the survey. However, visual monitoring is required to continue for 60 minutes following cessation of survey activity during good visibility. NMFS agrees with the MMC that ''both visual and acoustic monitoring should occur concurrently, as acoustic detections can provide additional information not readily available via visual detections alone regarding changes in foraging and social behavior during survey activities and after activities cease.'' Accordingly, acoustic monitoring is also required to continue following cessation of survey activity for a period of 60 minutes.

Comment: BP comments that they welcome use of industry standard PAM/operator software such as PAMGuard. Noting the operational challenges associated with accommodating increased numbers of PSOs on survey vessels, BP also comments that they would welcome the inclusion of an option to implement PAM during survey activities using remote shore-based operators.

Response: NMFS agrees that this may be appropriate, depending on various factors. While we are not currently aware of the state of existing technology towards achieving this end, NMFS would consider the use of remote PAM monitoring, assuming reliability and the ability to achieve the same performance as shipboard PAM monitoring. NMFS believes the adaptive management process will be an appropriate venue for further consideration of this approach.

Comment: BP comments that, while they recognize the value of prospective formal standards for PAM operations (*e.g.,* hardware, software, training), the standards have not yet been finalized. BP requests that the standards be considered for use only after an initial draft has been circulated via relevant standards development and issuance processes.

Response: NMFS may adopt elements of the prospective standards, as it deems appropriate (as discussed in Monitoring and Reporting). However, we agree that wholesale adoption of the standards would not be appropriate until appropriate review and other necessary processes are complete.

Comment: Industry commenters state that non-airgun high-resolution geophysical (HRG) surveys should not be subject to pre-clearance and shutdown requirements. Relatedly, BP and Chevron comment that exclusion zones should not be required for HRG surveys, as these surveys typically operate using acoustic sources deployed on an automated underwater vehicle (AUV) running 40 m above the seafloor. Therefore, they state that there is no environmental benefit to a requirement for a surface exclusion zone.

Response: The Associations note that the acoustic footprint of sources typically used in non-airgun HRG surveys are too small to warrant the proposed exclusion and buffer zone distances and that, more importantly, due to the typically highly directional nature of these acoustic sources, animals observed at the surface will generally not be exposed to the signal. NMFS agrees with these comments, and notes that the proposed shutdown and exclusion zone requirements were offered in accordance with BOEM's HRG survey protocols (Appendix B of BOEM, 2017). Following review of these comments, as well as the available scientific information regarding the typical interaction of these signals with the environment and likely lack of efficacy of typical standard operational protocols developed for omnidirectional sources, NMFS has eliminated these requirements. However, we also clarify that certain electromechanical sources may be subject to the pre-clearance and shutdown requirements associated with shallow penetration surveys. In addition, the exclusion and buffer zone distances for shallow penetration surveys have been reduced (while adding an extended distance shutdown zone for certain circumstances) in recognition of the typically smaller harassment zones associated with use of the acoustic sources considered here to be used in shallow penetration surveys.

As noted here, NMFS has eliminated the requirement for implementation of an exclusion zone during HRG surveys. We also agree with BP's comment that exclusion zones should not be required for surveys using an AUV-deployed acoustic source running at short distances above the seafloor.

Comment: NRDC states that NMFS fails to prescribe adequate mitigation for

HRG surveys and, relatedly, that NMFS must not issue LOAs for use of lower-frequency multibeam echosounders (MBES).

Response: As evidenced by the previous comment response, in which describing elimination of certain mitigation measures that were proposed for HRG surveys, NMFS disagrees with NRDC. NRDC provides no reasonable justification for the recommendation to consider additional mitigation requirements. They reference the 2008 Madagascar stranding of melon-headed whales, implying that a similar occurrence may be a reasonably anticipated outcome of HRG survey work in the GOM. Although it is correct that an investigation of the event indicated that use of a high-frequency mapping system (12-kHz MBES) was the most plausible and likely initial behavioral trigger of the event (with the caveat that there was no unequivocal and easily identifiable single cause), the panel also noted several site- and situation-specific secondary factors that may have contributed to the avoidance responses that led to the eventual entrapment and mortality of the whales (Southall *et al.,* 2013). Specifically, regarding survey patterns prior to the event and in relation to bathymetry, the vessel transited in a north-south direction on the shelf break parallel to the shore, ensonifying deep-water habitat prior to operating intermittently in a concentrated area offshore from the stranding site. This may have trapped the animals between the sound source and the shore, thus driving them towards the lagoon system. Shoreward-directed surface currents and elevated chlorophyll levels in the area preceding the event may also have played a role.

The relatively lower output frequency, higher output power, and complex nature of the system implicated in this event, in context of the other factors noted here, likely produced a fairly unusual set of circumstances that indicate that such events would likely remain rare and are not necessarily relevant to use of more commonly used lower-power, higher-frequency systems such as those evaluated for this analysis. The risk of similar events recurring is expected to be very low, given the extensive use of active acoustic systems used for scientific and navigational purposes worldwide on a daily basis and the lack of direct evidence of such responses previously reported. The only report of a stranding that may be associated with this type of sound source is the one reported in Madagascar.

NRDC also references Cholewiak *et al.* (2017), stating that virtually no beaked whale vocalizations were detected acoustically during the time that the shipboard echosounder was operational. NRDC mischaracterizes the literature, including a speculative description of what they imagine the beaked whales were doing while not vocalizing (''suggesting that the whales broke off their foraging behavior and engaged in [. . .] silent flight''). Cholewiak *et al.* (2017) do describe finding that beaked whales were significantly less likely to be detected acoustically while echosounders were active. However, it is not clear that this response should be considered as Level B harassment when considered in the context of what is likely a brief, transient effect, given the mobile nature of the surveys and the fact that some beaked whale populations are known to have high site fidelity. In support of this conclusion, Quick *et al.* (2017) describe an experimental approach to assess potential changes in short-finned pilot whale behavior during exposure to an echosounder. Tags attached to the animals recorded both received levels of noise as well as orientation of the animal. Results did not show an overt response to the echosounder or a change to foraging behavior of tagged whales, but the whales did increase heading variance during exposure. The authors suggest that this response was not a directed avoidance response but was more likely a vigilance response, with animals maintaining awareness of the location of the echosounder through increased changes in heading variance (Quick *et al.,* 2017). Visual observations of behavior did not indicate any dramatic response, unusual behaviors, or changes in heading, and cessation of biologically important behavior such as feeding was not observed. More recently, Varghese *et al.* (2020) reported the results of an investigation of the effects of a 12-kHz MBES system on beaked whale foraging behavior off of California. Echolocation clicks from Cuvier's beaked whales were detected and classified into foraging events called group vocal periods (GVP), and compared across exposure periods before, during, and after MBES activity. Of the metrics used to assess beaked whale foraging behavior, only the number of GVPs per hour was statistically different during MBES activity versus a non-MBES period. GVPs per hour increased during MBES activity compared with before MBES activity, demonstrating that beaked whales did not stop foraging and were not displaced by the activity. These results suggest that there was not a negative impact of MBES activity on foraging behavior of this sensitive species (Varghese *et al.,* 2020).

Finally, NRDC references the work of Deng *et al.* (2014) and Hastie *et al.* (2014) in describing ''leakage'' of ''substantial noise'' at frequencies within marine mammal hearing range during use of active acoustic systems that are operated at higher frequencies. The referenced studies reported some behavioral reaction by marine mammals to acoustic systems operating at user-selected frequencies above 200 kHz. This work was discussed in the notice of proposed rulemaking. In general, the referenced literature indicates only that sub-harmonics could be detectable by certain species at distances up to several hundred meters. As NMFS has noted elsewhere, behavioral response to a stimulus does not necessarily indicate that Level B harassment, as defined by the MMPA, has occurred. Source levels of the secondary peaks considered in these studies—those within the hearing range of some marine mammals—mean that these sub-harmonics would either be below the threshold for Level B harassment or would attenuate to such a level within a few meters. The work cited by the commenters is consistent with previously observed occurrences of sub-harmonics. Essentially, the first sub-harmonic's source level (*e.g.,* if the primary frequency is 200 kHz, the first sub-harmonic is 200/2 or 100 kHz, the second is 200/3 or 66.7 kHz) is at least 20–30 dB less than the primary frequency's source level, with each subsequent sub-harmonic's source level decreasing rapidly from there. These sub-harmonics are typically so reduced in source level that, for most side-scan and multi-beam sonar systems, they are not strong enough to produce impacts beyond tens of meters from the source (distances at which reactions to the vessel itself are likely to supersede reactions to an acoustic signal). Additionally, for any potential impacts to occur, an animal must be within this range and within the very narrow beams produced by the systems (for these sub-harmonic frequencies).

In addition, recent sound source verification testing of these and other similar systems did not observe any sub-harmonics in any of the systems tested under controlled conditions (Crocker and Fratantonio, 2016). While this can occur during actual operations, the phenomenon may be the result of issues with the system or its installation on a vessel rather than an issue that is inherent to the output of the system. As concluded in the notice of proposed rulemaking, there is no evidence to suggest that Level B harassment of marine mammals should be expected in relation to use of active acoustic sources at frequencies exceeding 180 kHz. NRDC's comments did not address NMFS' prior statements regarding this topic.

NRDC fails to adequately support the claims of harm to marine mammals that are reasonably likely to occur as a result of HRG surveys and, thus, fails to justify their recommendation for enhanced mitigation. The recommended measures include ''extended safety zone and monitoring requirements'' and a ''bar on nighttime operations.'' Even when animals are receiving echosounder signals, they may not be harassed, as described above. However, given the directional nature of these sources, animals observed at the surface will almost certainly not be within the acoustic beam, thus negating the benefit of detection-based measures such as shutdowns. Any exposure to the echosounder would likely be only in the ensonified cone below the vessel, and responses to the vessel itself at such close ranges would influence likelihood of acoustic exposure. The package of active acoustic systems modeled as representative of a typical HRG survey included a 200-kHz echosounder. Regarding the suggestion that this bars use of any system with a lower frequency output, NMFS disagrees. NMFS' analysis also includes use of different lower-frequency sources (*i.e.,* single airguns and boomers). Moreover, the specific sources selected for analysis do not limit the actual sources that may be used, assuming the actual sources are reasonably similar to the full suite of analyzed sources, as is the case here.

Comment: The Associations and other industry commenters claim that the proposed PSO staffing requirements compromise personnel safety, cannot be effectively implemented, and are unnecessary and unsupported.

Response: In the notice of proposed rulemaking, NMFS described in detail the importance of detection-based mitigation as a component of standard operational mitigation protocols. Detection-based mitigation cannot occur effectively without both visual and acoustic monitoring, with the latter being the only effective method of detection during periods of poor visibility or at any time for cryptic species (*e.g.,* beaked whales) or species with high availability bias (*e.g.,* sperm whales). Therefore, visual monitoring is required during daylight hours and acoustic monitoring is required throughout the period of survey operations. When these monitoring techniques are required, two visual PSOs must be on duty in order to effectively monitor 360 degrees around the vessel, communicate with the operator as necessary, and record data, and an acoustic PSO must be on duty to monitor the PAM system. In order to effectively carry out monitoring duties, PSOs must have sufficient periods of rest to minimize fatigue that would compromise their performance. Based on these considerations, and in consideration of the literature relating to mitigation and monitoring requirements and standard practice for scientific surveys, NMFS proposed minimum duty requirements.

While NMFS agrees that there is likely to be some increased logistical burden associated with these requirements, which are expanded to some degree from current practice in the GOM in the absence of compliance with the MMPA, the Associations do not demonstrate that this burden is so large as to be impracticable. Similarly, they do not provide information supporting claims that these requirements would compromise personnel safety (and certainly do not support the claim that the requirements are ''unnecessary and unsupported''). The Associations' comment states that survey vessels are typically at maximum capacity. NMFS acknowledges that in some cases, increased PSO staffing may result in a need for operators to balance staffing in other areas, such as in the seismic crew (25 to 30) or the three to seven client representatives that the Associations state are typically aboard a survey vessel, in order to accommodate necessary PSO staffing while not exceeding a vessel's maximum capacity. However, assuming that a vessel's maximum capacity is not exceeded, the claim that increasing the number of people aboard necessarily increases ''the risk of injuries, illnesses, and evacuation for medical reasons'' is unsupported. The comment is inconsistent regarding the number of PSO staff that the requirements would add, at various places stating that the requirements would result in the addition of six to eight or three to five PSO staff. Overall, the Associations state that only three (and possibly up to four) PSOs should be allowed, without explaining how this may achieve the objective of the proposed detection-based mitigation requirements.

However, in recognition of the likely increase in logistical burden and the possibility that individual LOA applicants may be able to demonstrate legitimate practicability issues, NMFS allows for the potential that an exception may be obtained specifically for the requirement that PSOs may be on duty for a maximum period of two hours, followed by a minimum period of one hour off. If an exception is granted based on practicability, the historical practice of a maximum on-duty period of four hours, followed by a minimum period of two hours off, would be substituted.

Comment: The Associations and other industry commenters comment that the proposed requirement for visual observation before and during nighttime ramp-ups would be ineffective and potentially present safety concerns.

Response: NMFS agrees that reduced efficacy should be expected for visual monitoring at night and, in consideration of comments asserting that this may present a safety concern, we have eliminated this requirement (noting that passive acoustic monitoring is still required for all nighttime operations of large airgun arrays). NMFS also agrees with the Associations' comment that employment of a PSO for the dedicated purpose of documenting entanglements with ocean-bottom node (OBN) cables is unnecessary and has eliminated this requirement. Elimination of these requirements is expected to help somewhat in alleviating the logistical concerns expressed by the Associations.

Comment: The Associations suggest that entanglement avoidance requirements should be removed from the ITR. The MMC comments that they support these requirements, and that the requirements are consistent with best management practices developed for avoiding entanglements.

Response: The Associations' comment, offered only in a footnote, is unclear as to whether the Associations' suggestion is to remove all entanglement avoidance requirements or only the requirement to use negatively buoyant coated wire-core tether cable. (Note that NMFS does agree with the suggested elimination of a requirement for use of a dedicated PSO for purposes of documenting entanglement.) Regardless, the Associations' suggestion that this requirement should be removed is keyed only to concern regarding practicability. NMFS disagrees that this requirement is impracticable, and the Associations offer no information to the contrary. Moreover, this measure is designed to prevent serious injury or mortality, which cannot be authorized under this rule.

Here, no mortality was requested or proposed for authorization and, therefore, potential for death by entanglement must be avoided. There is demonstrated potential for entanglement of protected species in association with OBN survey operations. As described in the notice of proposed rulemaking, a GOM OBN operator remarkably entangled three different protected species within a year—including an Atlantic spotted dolphin, as well as an ESA-listed turtle and a manta ray. BSEE subsequently issued two enforcement actions against the operator for incidents of non-compliance, indicating that it is appropriate to be stringent regarding requirements relating to entanglement avoidance. Specific appropriate measures were determined in consultation between NMFS, BOEM, and BSEE, including consultation with NMFS' gear engineering experts, and were subsequently included in permits issued by BOEM (*e.g.,* OCS Permit L17–009, issued July 11, 2017). NMFS proposed these specific measures for this ITR and no comments offering useful suggestions regarding potential modifications to the measures were received. A generic suggestion that no entanglement avoidance requirements are necessary is not credible.

Comment: NRDC claims that NMFS fails to consider mitigation to reduce ship strike, particularly within Bryde's whale habitat. Separately, NRDC states that NMFS should consider extending ship-speed requirements to all project vessels. The Associations state that vessel strike avoidance measures should not be required, or that there should be modifications and/or exemptions to the measures.

Response: NMFS disagrees with NRDC's contention. NMFS' required vessel strike avoidance protocol is expected to further minimize any potential interactions between marine mammals and survey vessels, relative to the already low likelihood of vessel strike in relation to the activities considered herein. Please see ''Vessel Strike Avoidance'' for a full description of requirements, which include: 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.

We also note that NRDC's comment that ''vessels supporting the seismic operation are not similarly constrained'' is in error. All project vessels are required to adhere to vessel strike avoidance requirements, including speed requirements in certain circumstances. As stated clearly in the proposed and final regulatory text, ''[v]essel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal [. . .].'' Regarding whether ship speed requirements are warranted for all project vessels in the Bryde's whale core habitat area to minimize risk of strike for Bryde's whales, the consideration is no longer relevant to this rule, as activity within the Bryde's whale core habitat area referenced by NRDC can no longer be considered through this rule following BOEM's update to the scope of action. Further, we disagree that similar risk exists for sperm whales and beaked whales, as would be necessary to warrant vessel speed restrictions in the Mississippi Canyon area. There are very few records of vessel strikes for sperm whales, as compared with mysticete whales in general, and Bryde's whales' dive behavior in particular makes them potentially more susceptible to vessel strike.

The Associations' comments state that they are not aware of any incidence of ship strike associated with a geophysical survey, implying that no strike avoidance measures are necessary. The lack of recorded incidents of strike does not mean that none have occurred and, more importantly, does not mean that none will occur. Therefore, it is NMFS' responsibility to prescribe measures that will achieve the least practicable adverse impact via avoidance of vessel strike. The comments go on to assert that there is ''no evidence'' that strike avoidance measures benefit marine mammals, despite the wealth of scientific evidence described in the notice of proposed rulemaking that slower vessel speeds result in fewer strikes and, if a strike does occur, a significantly lower likelihood of mortality. Separation requirements are common sense—a moving vessel should maintain some minimum distance from a whale to avoid striking it—and are similar to generic strike avoidance guidelines found elsewhere. The comments implying that these requirements are unwarranted and burdensome are unpersuasive, particularly given that BOEM has required essentially identical strike avoidance measures in the GOM via notices to lessees for many years (currently, via BOEM NTL No. 2016–G01).

Nevertheless, NMFS recognizes that there are legitimate concerns regarding vessels towing gear and human safety issues. We have clarified in the strike avoidance measures that vessel strike avoidance 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.

Comment: The Associations and other industry commenters raise concerns regarding the PSO requirements, including that NMFS' requirements for PSOs will result in labor shortages, and make an accompanying recommendation that these be ''preferred'' training requirements that LOA-holders would not have to meet.

Response: NMFS disagrees with the comments. The Associations' statement that requirements for PSOs to have bachelor's degrees or to satisfy a positive experience requirement are ''difficult, if not impossible, to achieve'' is not persuasive. As explained in the notice of proposed rulemaking, NMFS discussed these PSO requirements with BSEE and with third-party observer providers. Both parties indicated that the requirements should not be expected to result in any labor shortage. We pointed out that during a period when a significantly greater amount of survey activity was occurring in the GOM than at present (*i.e.,* with as many as 30 source vessels), requirements similar to those proposed did not result in any labor shortage. Moreover, NMFS specifically requested comment on the assumption that the requirements would not result in any labor shortage. The Associations' expressed concern regarding the potential for a labor shortage, but do not provide any specific information to support the claims. We also clarify 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 most recent relevant experience. As described in the notice of proposed rulemaking and herein, a minimum of one visual PSO and two acoustic PSOs must have such experience (rather than all PSOs).

Comment: The Associations provide a list of specific proposed monitoring and reporting requirements that they assert are unreasonable or otherwise problematic. Some of these comments are echoed by other industry commenters.

Response: We address the specific issues raised by the Associations in turn.

1. The Associations state that bigeye binoculars should not be required, because they are expensive, require installation on the vessel, and are not appropriate for monitoring of the exclusion zone.

NMFS disagrees with this comment. While it is correct that procurement of bigeye binoculars will incur costs, these costs were analyzed in NMFS' RIA.

While bigeye binoculars may not be an individual PSO's tool of choice for observing marine mammals at close range to the vessel, they are an indispensable tool for observing marine mammals at greater distance upon initial detection, are a standard component of marine mammal observation (for scientific purposes, but also as a part of standard mitigation monitoring conducted aboard surveys for which incidental take authorizations are issued), and will be helpful in more accurately identifying animals at greater distances, such that the precautionary shutdowns of concern to the Associations are avoided.

2. The Associations state that PSOs should not report on factors that may be contributing to impaired observations, as such reporting may be speculative, unverifiable, and/or incorrect.

NMFS disagrees with this comment. Reporting on such conditions is not connected to any requirement for action, but it is important to understand whether visual observation is able to be conducted in an effective fashion, whether it be due to weather conditions or to conditions on the vessel.

3. The Associations suggest that the reporting requirement to estimate numbers of animals observed by cohort is overly complicated, and that the rule should require only recording of juveniles and adults.

NMFS agrees with this comment and has made corresponding edits to the regulatory text.

4. The Associations express some confusion regarding language addressing the information that visual PSOs should be compiling on a daily basis and whether these daily ''reports'' include estimates of actual animals taken.

NMFS clarifies that the language cited by the Associations was not intended to mean that PSOs should be estimating ''takes'' on a daily basis, and confirm that the Associations' statement that such information should be included only in annual reporting is correct.

5. Regarding NMFS' consideration of an approach recommended by the MMC to produce estimates of actual take from observations of animals during survey effort, the Associations express concern about the appropriate application of this process, and suggest that the protocol be applied at the end of a period long enough to accumulate sufficient data to adequately evaluate the appropriateness and proper application of the process as part of the adaptive management process.

NMFS shares many of the Associations' concerns on this subject and regarding the specific methodology proposed by the MMC. NMFS looks forward to working with the Associations (as well as BOEM and BSEE) towards the development of appropriate methods through the adaptive management process.

6. In reference to the requirement for the lead PSO to submit to NMFS a statement concerning mitigation and monitoring implementation and effectiveness, CGG adds that, because there is a lead PSO on each offshore rotation, the LOA-holder should submit collated statements.

NMFS agrees that this may be a more practical approach.

Comment: The MMC recommends that NMFS require LOA-holders to implement electronic reporting systems for field-based PSO data entry and expedited reporting.

Response: NMFS agrees that this would be appropriate and would better ensure expedited field entry and quality control checking of PSO data, as well as facilitate data transfer, quality control, data analysis, and automated report generation. Overall, such a requirement is helpful to ensure the efficient synthesis of data, as required by the comprehensive reporting process.

Comment: The Associations express support for NMFS' proposed approach to comprehensive monitoring and development of a structured adaptive management process, and highlight their support for efforts that improve the quantity and quality of information related to determining the nature and magnitude of the potential effects of offshore geophysical activities on marine mammals, including industry-supported independent third-party research.

Response: NMFS appreciates the comments and looks forward to continued engagement with the regulated community, as well as BOEM and BSEE, to improve the collection and use of the best available science consistent with the requirements and limits of the MMPA.

Comment: The MMC comments that they support an annual adaptive management process for the issuance of LOAs in the GOM and recommend that they be included in the process along with representatives from BOEM, BSEE, and industry.

Response: NMFS appreciates the comments and will ensure that the adaptive management process includes participation of the parties noted, where appropriate.

Comment: NRDC asserts that NMFS fails to prescribe requirements sufficient to monitor and report takings of marine mammals. The MMC recommends that NMFS and BOEM work together to develop a coordinated long-term monitoring and research plan, and further recommends that, to facilitate the completion of the plan, NMFS and BOEM establish a GOM scientific advisory group, composed of agency and industry representatives and independent scientists, to assist in the identification and prioritization of monitoring needs and hypothesis-driven research projects to better understand the short- and long-term effects of geophysical surveys on marine mammals in the GOM. 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.

Response: Section 101(a)(5)(A) of the MMPA indicates that any regulations NMFS issues shall include ''requirements pertaining to the monitoring and reporting of such taking.'' 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' implementing regulations do not provide a specific standard regarding what required monitoring and reporting measures ''must'' accomplish. However, NMFS' implementing regulations require incidental take applications to include 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, as well as suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. 50 CFR 216.104(a)(13). The comment extracts pieces of this language to suggest that future LOA applicants are required to coordinate with each other's monitoring efforts, ignoring the fact that the relevant 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.'' 50 CFR 216.104(a)(13). NRDC attempts to further the argument that coordination across projects is required by statute by referencing a monitoring plan that they state is in development by BOEM. The MMC also references development of a ''long-term monitoring plan'' that they attribute to BOEM. NMFS is not aware that any such monitoring plan has been developed and, therefore, such a plan is not ''already applicable to persons conducting such activity.''

NRDC discusses a litigation settlement agreement related to the activities that are the subject of this rule, stating that ''BOEM must analyze 'the development of a long-term adaptive monitoring plan that addresse[s] cumulative and chronic impacts from seismic surveys on marine mammal populations in the Gulf of Mexico.' '' *NRDC et al.* v. *Bernhardt et al.,* 2:10–cv–1882, ECF No. 118 (E.D. La. June 18, 2013). NRDC also cites BOEM's PEIS in discussing this plan. That requirement in the settlement agreement does not pertain to NMFS' statutory authority under the MMPA, which does not provide authority for NMFS to require the development of a ''long-term monitoring plan'' via the promulgation of ITRs or as a condition of an incidental take authorization. As noted above, NMFS' statutory authority is to prescribe ''requirements pertaining to the monitoring and reporting of such taking.'' Although applicants that anticipate the need for consecutive periods of five-year regulations to cover ongoing activities may develop monitoring and reporting plans that extend past the five-year effectiveness period of a rule, section 101(a)(5)(A) requires only monitoring and reporting to cover the specified activities undertaken during the period of the rule. Were a long-term monitoring plan to be developed by BOEM, it would therefore be a voluntary undertaking on the part of participants, rather than a requirement under the MMPA. While certainly an exemplar of what a strong comprehensive monitoring plan can look like, the U.S. Navy's Integrated Comprehensive Monitoring Program (ICMP), which NRDC references as a relevant analogue to the monitoring plan that they assert is required in the GOM to satisfy the requirements of the MMPA, should not be hailed as a model that should always be copied or a standard that must be achieved for all MMPA ITRs. The Navy's ICMP was developed in close coordination with NMFS and reflects several factors that are not present for all ITRs (including these regulations) and that lay the groundwork for what is an exceptionally comprehensive program. Specifically, as the single entity for which take is authorized and that has the responsibility for implementing a monitoring program, the Navy has an existing organizational and funding structure that can support a truly integrated and comprehensive plan that would be far more difficult under a rule allowing for authorization of take by disparate applicants with varying activity levels, resource availability, and familiarity with regulatory requirements and marine mammal issues. Also, the Navy has an independent environmental stewardship mandate that influences their monitoring approach and supports a robust program intended to work in concert with the work funded through their Office of Naval Research and Living Marine Resources programs to create essentially full coverage of the science necessary to support vigorous environmental assessment and compliance across all Navy actions. Last, Navy training and testing utilize a large variety and number of platforms and sound sources, many of which can result in the take of marine mammals but cannot be monitored at the source. Accordingly, the Navy employs the robust, problem-based, often off-site monitoring program currently in place in order to answer targeted questions with controlled studies.

Although NMFS' authority with regard to the prescription of monitoring requirements does not include mandating long term monitoring, the MMPA does require an assessment of impacts from the total taking by all persons conducting the activity. Thus, meaningful monitoring and reporting for a specified activity under section 101(a)(5)(A) should be designed to help us better understand the total taking that is considered for authorization under the regulations for all persons conducting the specified activities under the five-year regulations. This necessitates coordination across applicants with regard to comprehensive analysis and reporting of information collected in relation to ''the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities.'' 50 CFR 216.104(a)(13). We discuss these comprehensive reporting requirements in greater detail in Monitoring and Reporting. These requirements are appropriate to the necessary function of informing the assessment of the overall impact of the incidental take allowable under the regulations and acknowledge the need to conduct aggregation and analysis of the data in a manner that directly informs the question of whether and the degree to which marine mammal populations addressed may be affected by the incidental take authorized by LOAs.

We appreciate the MMC's acknowledgement of the investments made by BOEM and industry (via the E&P Sound and Marine Life Joint Industry Program) towards better understanding of marine mammal abundance and distribution, the characterization of anthropogenic sound sources in the GOM, and the effects of sound on marine mammal hearing and behavior, among other initiatives. We also note that much of the research recommended by NRDC has been conducted via the BOEM-sponsored Gulf of Mexico Marine Assessment Program for Protected Species initiative. However, while these voluntary efforts are commendable, section 101(a)(5)(A) does not require hypothesis-driven, focused research pertaining to the impact and mitigation of chronic noise exposure on populations of special concern, nor does it require a ''coordinated long-term monitoring and research plan,'' as expressed by the commenters.

Regarding the MMC's recommendation that NMFS establish a GOM ''scientific advisory group, composed of agency and industry representatives and independent scientists, to assist in the identification and prioritization of monitoring needs and hypothesis-driven research projects,'' NMFS would be willing to explore with the MMC the appropriate mechanisms for convening such a group, including consideration of the MMC's authorities under the MMPA.

The monitoring approach described in this preamble includes LOA-specific monitoring and reporting set forth in the regulations and, separately, outlines a framework for potential data collection, analysis, research, or collaborative efforts that are not specified in these regulations but which work towards satisfying the information elements identified in our implementing regulations. NMFS is committed to working with industry and BOEM through the adaptive management process to ensure that LOA-specific monitoring and reporting will be used appropriately to help better understand the impacts of the total taking from the specified activity contemplated in this ITR on the affected populations, as well as how the more overarching voluntary efforts will be identified and carried out.

Comment: The Associations reiterate their belief that NMFS, as the regulating agency, has the responsibility to collect, organize, and assess all of the data reported to NMFS under the terms of issued LOAs.

Response: NMFS disagrees with this comment. The MMPA requires NMFS to prescribe regulations setting forth requirements pertaining to the monitoring and reporting of ''such taking.'' 16 U.S.C. 1371(a)(5)(A)(i)(II)(bb). (In contrast, the other required component of activity-specific regulations, relating to mitigation requirements, refers to ''taking pursuant to such activity.'' 16 U.S.C. 1371(a)(5)(A)(i)(II)(aa). In NMFS' view, these monitoring and reporting requirements in our activity-specific regulations refer to the total taking from the specified activity as a whole, and they are requirements that can be imposed on those entities availing themselves of LOAs issued under the activity specific regulations. Therefore, it is incumbent upon LOA-holders, collectively, to provide this information to NMFS in a reasonably synthesized form such that NMFS may adequately assess the effects of the specified activity on an ongoing basis. This information may in some cases be essential to NMFS' ability to carry out 50 CFR 216.105(e) (''Letters of Authorization shall be withdrawn or suspended, *either on an individual or class basis,* as appropriate, if, after notice and opportunity for public comment, the Assistant Administrator determines that: (1) The regulations prescribed are not being substantially complied with; or (2) The taking allowed is having, or may have, more than a negligible impact on the species or stock or, where relevant, an unmitigable adverse impact on the availability of the species or stock for subsistence uses'' (emphasis added).) While NMFS recognizes that the Associations are not subject to the ITR (including any reporting requirements in the ITR or related LOAs), LOA-holders (many of which are likely to be Association members) will collectively be responsible for the comprehensive reporting requirements described herein. The Associations in their comment commit to participate in the annual assessment process, and NMFS welcomes that participation.

Comment: The MMC recommends that NMFS require industry operators to measure and report the horizontal leakage of their various airgun arrays and investigate options to minimize horizontal sound leakage from those array configurations.

Response: As stated in the notice of proposed rulemaking, NMFS encourages the minimization of unnecessary horizontal propagation. However, while the MMC's recommendation would likely lead to a better understanding of actual horizontal propagation (or ''leakage'') that does occur, it is not clear that the product of such measurements (termed ''waste ratios'' by the MMC) would necessarily lead to a viable path to reducing such leakage. In addition, the MMC does not specify what it recommends as a sufficient amount of data concerning waste ratios to allow consideration of a potential threshold. Thus, the comment implies that all operators would be required to conduct field measurements of the acoustic output of airgun arrays under this recommendation, which NMFS believes would not be practicable. NMFS appreciates the comment and will further consider the utility of the recommendation, and methods of implementation, through the adaptive management process.

We do note that BOEM currently requires operators to confirm through the permitting process that the airgun arrays used have been calibrated or tuned to maximize subsurface illumination and to minimize, to the extent practicable, horizontal propagation of noise.

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

Response: NMFS appreciates the suggestion and agrees 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 acknowledges certain of these limitations in their comment, including that the systems have lesser utility in warmer temperatures. The GOM, however, is a warm environment. NRDC does not provide specific suggestions with regard to recommended systems or characteristics of systems. NMFS does not consider requirements to use systems such as those recommended by NRDC to currently be practicable.

Comment: NRDC states 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: NMFS agrees with NRDC 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 either are not practicable or are not within NMFS' authority to require. To some degree, NRDC misunderstands the discussion of this issue as presented in the notice of proposed rulemaking. NMFS recognizes, 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 require an impracticable expenditure to replace the airguns planned for use. NRDC offers no explanation for why such a large 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. We note that BOEM's PEIS concluded that alternative technologies are in various stages of development, and that none of the systems with the potential to replace airguns as a seismic source are currently commercially available for use on a scale of activity such as that considered herein. Although some alternative technologies are available now, or will be in the next several years, for select uses, none are, or will likely be in the next five years, at a stage where they can replace airgun arrays outright. However, some may be used in select environments when commercially available. According to BOEM, the suggestion in this comment would not provide the oil and gas industry or the government with sufficiently accurate data on the location, extent, and properties of hydrocarbon resources or the character of formation fluids or gases, or information on shallow geologic hazards and seafloor geotechnical properties, in order to explore, develop, produce, and transport hydrocarbons safely and economically. Such technologies may be evaluated in the future as they become commercially available and on a scale commensurate to the need. In summary, while NMFS agrees that noise quieting technology is beneficial, the suggestions put forward by NRDC are either impracticable or outside the authority provided to NMFS by the MMPA. However, NMFS would consider participating in or learning about related efforts by parties interested in investigating these technologies. We note that NMFS has described a process by which new and unusual technologies may be considered for use under this rule (see Letters of Authorization).

Comment: NRDC recommended that NMFS consider compensatory mitigation for the adverse impacts of the specified activity on marine mammals and their habitat that cannot be prevented or mitigated.

Response: NMFS has prescribed a robust comprehensive suite of measures that are expected to reduce the amount of Level A and Level B harassment take, as well as the severity of any incurred impacts on the species or stock and their habitat. Compensatory mitigation is not required under the MMPA. Importantly, NRDC did not recommend any specific measure(s), rendering it impossible to evaluate their recommendation. In addition, many of the methods of compensatory mitigation that have proven successful in terrestrial settings (*e.g.,* purchasing or preserving land with important habitat, improving habitat through plantings) are not applicable in a marine setting with such far-ranging species. NMFS concludes that the concept is too speculative at this time to warrant specific action.

Letters of Authorization

Comment: The Associations assert that it is ''arbitrary and inappropriate'' for NMFS to provide an opportunity for public notice and comment in the event that an LOA applicant wishes to deviate from the modeling approach used herein (which was subject to public review and comment). The Associations state that such a requirement is contrary to the legal requirement to base the authorization of incidental take under the MMPA on the best available science, as better information may become available during the period of effectiveness for the ITR.

Response: LOAs issued under the authority of section 101(a)(5)(A) and NMFS' implementing regulations must be preceded by both substantive findings (including a negligible impact finding) and a process that includes rulemaking after notice and comment. In the case of LOA applications whose take estimates are not based on the modeling used for the rulemaking, NMFS has determined that it may be appropriate to subject those to notice and comment in certain circumstances. Such a process requirement does not impede or contradict the requirement to use the best available information.

Comment: The Associations and other industry commenters assert that there is no legal justification for NMFS to use the ITR as a mechanism to limit the number of activities that may occur in the GOM, stating that authorization of the activities themselves are subject to BOEM's jurisdiction.

Response: NMFS clarifies that we do not intend to use the ITR in the manner suggested by the Associations, and that the language cited in the Associations' comment (''cap on the number of authorizations that could be issued'') was inartful. We also acknowledge BOEM's jurisdiction regarding the authorization of the subject activities themselves. However, the total taking analyzed in the negligible impact analysis necessarily bounds the taking that may be authorized under these activity-specific regulations, as described in the Estimated Take section.

Comment: Referencing a cap on the number of authorizations that could be issued, the MMC recommends that NMFS (1) provide details to the public on how NMFS plans to implement the proposed cap and the basis for it; and (2) allow for an additional 30-day comment period to review such details sufficiently in advance of issuing the final rule.

Response: As discussed in the preceding comment response, the language referenced by the MMC was meant only to affirm what is inherent in the regulations, *i.e.,* that the amount of take analyzed for making a finding of negligible impact necessarily bounds the amount of take that may be authorized through LOAs issued under this rule (provided they also satisfy the small numbers requirement). The MMC places undue emphasis on this aspect of rule implementation. In claiming a ''lack of transparency,'' the MMC assigns complexity that does not exist, and no additional details exist to give. Therefore, we do not implement the MMC's recommendation for additional public comment.

Comment: The Associations and other industry commenters express concern regarding the implementation of the ITR, including the evaluation and processing of LOA requests. The Associations recommend that the final ITR clearly address how NMFS plans to process LOA applications in a timely and efficient manner, and encourage NMFS to retain flexibility in the final ITR for the development of efficient and effective LOA processes through workshops or other engagement with BOEM and the regulated community.

Response: NMFS appreciates the concerns expressed by the commenters. We believe we have addressed these issues in the updated preamble to this ITR (see Letters of Authorization) and are committed to ongoing, proactive engagement with BOEM, BSEE, and the regulated community towards efficient implementation of the ITR.

Comment: BP comments that a low-frequency geophysical survey source they refer to as ''Wolfspar'' should be considered to be within the range of potential impacts modeled in the ITR and, therefore, able to be used under an LOA issued pursuant to the ITR.

Response: NMFS will look forward to evaluating the Wolfspar source according to the ''New and Unusual Technology'' review process detailed in the Letters of Authorization section of this preamble. Only upon review of additional information regarding the source can NMFS make a determination in this regard.

Regulatory Impact Analysis

Comment: The Associations provide a bulleted list of criticisms of the RIA. We summarize these here and provide brief responses below. For full detail, we refer the reader to the final RIA, available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.* The Associations' critiques of the RIA are not accompanied by any specific recommendations regarding potential changes to the analysis or additional data.

- The Associations assert that the RIA assumes that the only indirect costs of closures are delays, and state that such measures ''may render some survey proposals economically unattractive to the point at which prospects will not be explored.'' The Associations also state that closures may be assumed to be permanent, thereby having an additional dampening impact on exploration activity.

Response: The RIA accompanying the proposed rule did not assume that the costs of closures are simply delays. The RIA stated that the ''closures have the potential to affect the overall levels of G&G [geological and geophysical] activities that occur in the GOM over the five-year timeframe of the analysis. In the case that the closures delay or reduce the ability of industry to collect the necessary data to identify and recover oil and gas resources, the overall level of oil and gas production in the GOM may in turn be delayed or reduced.'' The RIA for the proposed rule discussed the possibility of both delays *and* reductions in activity due to the uncertainty surrounding rule impacts. In addition, NMFS reiterates that closures and any other measures are in effect only during the five-year period of effectiveness of the ITR. It is unclear why closures may be ''assumed to be permanent'' if the regulations requiring them are effective only for five years. We note here that two of the closure areas included in the proposed rule and evaluated in the RIA are no longer in the final rule because they fall outside the area considered for this rule, following BOEM's update of the rule's scope.

- The Associations assert that the RIA ''incorrectly assumes that the costs of closures are highly uncertain or even low because geologic potential of some areas is low,'' stating that geophysical surveys are essential to understanding the geologic potential of the areas.

Response: There is significant uncertainty regarding the development potential of the areas considered for closure, and the RIA did not simply assume that it is ''low.'' The RIA accompanying the proposed rule provided the best available information regarding lease activity and reserves in the proposed closure areas and characterized the associated uncertainty.

- The Associations assert that the RIA ''wrongly assumes that the GOMESA moratorium prevents exploration of the Eastern GOM,'' when in fact the moratorium is currently set to expire in 2022. The Associations go on to state that ''the RIA seriously misleads readers about the costs of closure and increased restrictions in the Eastern GOM,'' and that the potential cost of the closure should be considered equivalent to that of the closure considered for the Central GOM because ''high-potential resources may underlie'' the Eastern GOM closure.

Response: The RIA made no such assumption, and in fact acknowledged that the moratorium does not restrict exploration per se. However, the Eastern GOM closure referenced by the commenter is no longer part of the rule, as BOEM's update to the scope of the rule has removed the area from consideration.

- The Associations state that the RIA fails to account for the environmental benefit associated with avoiding unnecessary drilling via use of geophysical surveys. Chevron echoes this comment. Neither commenter provides any specific recommendation as to how they believe it should be considered.

Response: The RIA does acknowledge the benefit of geophysical technology. However, we note that the magnitude of this benefit depends on the extent to which exploration and development companies move forward with drilling in cases where they have less seismic data than they otherwise would because of the requirements of the ITR.

- The Associations assert that the RIA for the proposed rule incorrectly assumes current geophysical data in the Eastern GOM is suitable, stating that ''there is high demand for state-of-the-art new data for Eastern GOM frontier areas where older data is considered unsuitable to support new investment.''

Response: The RIA did not state that current geophysical data for the Eastern GOM is ''suitable.'' Rather, the RIA stated that ''the suitability of existing G&G data to direct oil and gas production in the closure areas is unknown.'' As noted herein, the area of concern to the commenter is no longer considered through this rule.

- The Associations assert that the RIA ''fails to account for possible increased industry interest in Eastern GOM geophysical surveys'' and, therefore, that the RIA inappropriately relies on old statistics on survey interest for estimating costs.

Response: The RIA acknowledged that industry interest in Eastern GOM geophysical surveys is likely to increase leading up to the expiration of the moratorium. As noted herein, the area of concern to the commenter is no longer considered through this rule.

Comment: Chevron comments that NMFS should ensure in the final ITRs that all costs are evaluated, including the cost of reduced environmental benefits from effective geophysical surveys. The Associations echo these concerns.

Response: NMFS has appropriately evaluated the regulatory impacts of the ITR according to the requirements of E.O. 12866. See section 5.3 of the Final RIA, which describes this benefit of geophysical technology. The magnitude of this benefit depends on the extent to which exploration and development companies move forward with drilling in cases where they have less seismic data than they otherwise would because of the rule.

National Environmental Policy Act

Comment: NRDC reiterates (and resubmitted) comments that it submitted on BOEM's draft PEIS, stating that as it relates to marine mammals, the PEIS is deficient on its face due to the range of alternatives and mitigation considered, significance criteria, take and impact estimates, and cumulative impacts analysis.

Response: As a cooperating agency, NMFS reviewed all responses to comments on the draft PEIS that were relevant to its management authorities and provided input where we deemed it appropriate. See Appendix M of the Final PEIS.

Comment: NRDC also states that NMFS cannot rely on the PEIS because it ''does not adequately address NMFS' own actions and responsibilities under the MMPA,'' given that BOEM's PEIS is ''framed around a fundamentally different purpose and need'' relating to its mandates under the Outer Continental Shelf Lands Act (OCSLA) that is ''incongruent with NMFS obligations under the MMPA.''

Response: The proposed action at issue is BOEM's issuance of permits or authorizations for G&G activities in the GOM. PEIS Chapter 1.1.1. The PEIS also recognizes that NMFS' proposed action is a decision on whether to approve BOEM's petition for incidental take regulations. NOAA is a cooperating agency on BOEM's PEIS, as NOAA has jurisdiction by law and special expertise over marine resources impacted by the proposed action, including marine mammals and federally listed threatened and endangered species. The PEIS explicitly recognizes that the PEIS would be used in support of NMFS' decision on BOEM's petition for incidental take regulations. See PEIS Appendix B.

Consistent with the Council on Environmental Quality's (CEQ's) regulations, it is accepted NEPA practice for NOAA to adopt a lead agency's NEPA analysis when, after independent review, NOAA determines the document to be sufficient in accordance with 40 CFR 1506.3. Specifically here, NOAA is satisfied that BOEM's PEIS adequately addresses the impacts of issuing the MMPA incidental take authorization and that NOAA's comments and concerns have been adequately addressed. There is no requirement in CEQ regulations that NMFS, as a cooperating agency, issue a separate purpose and need statement in order to ensure adequacy and sufficiency for adoption. Nevertheless, the statement of Purpose and Need in the PEIS explicitly acknowledges NMFS' own separate action of issuing an MMPA incidental take authorization, and the PEIS is replete with discussion of issues relating to the issuance of an MMPA authorization, including discussion of marine mammal impacts, mitigation, and take estimates. NMFS' early participation in the NEPA process and the agency's continuing role in shaping and informing analyses using its special expertise ensured that the analysis in the PEIS is sufficient for purposes of NMFS' own NEPA obligations related to its issuance of an incidental take authorization under the MMPA.

Regarding the alternatives, NMFS' early involvement in the development of the PEIS and role in evaluating the effects of incidental take under the MMPA ensured that the PEIS would include adequate analysis of a reasonable range of alternatives. The PEIS includes a no action alternative specifically to address what could happen if NMFS did not issue an MMPA authorization. Some of the alternatives explicitly reference marine mammals or mitigation designed for marine mammals in their title. More importantly, these alternatives fully analyze a comprehensive variety of mitigation measures for marine mammals. This mitigation analysis supported NMFS' evaluation of our options in potentially issuing an MMPA authorization. This approach to evaluating a reasonable range of alternatives is consistent with NMFS' policy and practice for issuing MMPA incidental take authorizations. NOAA independently reviewed and evaluated the PEIS, including the purpose and need statement and range of alternatives, and determined that the PEIS fully satisfies NMFS' NEPA obligations related to its decision to issue the MMPA final rule and associated Letters of Authorization. Accordingly, NMFS has adopted the PEIS.

Finally, we disagree with the notion that the district court's decision in *Conservation Council for Hawaii* v. *NMFS* somehow would preclude NMFS from adopting the PEIS here. In *Conservation Council,* the court concluded that the FEIS NMFS adopted was deficient because it did not consider a true ''no action'' alternative from NMFS' perspective, in that the ''no action'' alternative assumed continuation of Navy's baseline activities, and therefore avoided the task facing NMFS, *i.e.,* whether to authorize the requested take. 97 F. Supp. 3d at 1236. In contrast, the PEIS here for NMFS' rule for GOM geophysical surveys includes a ''no action'' alternative from the perspectives of both NMFS and BOEM. See PEIS, Chapter 2.9.1, pp. 2–20 to 2–22.

Information Quality Act

Comment: The CRE states that NMFS' Technical Guidance violates Information Quality Act (IQA) requirements, because it (1) does not include an IQA Pre-dissemination Review Certification; (2) relies heavily on models that have not been peer reviewed to determine whether they are validated and comply with the Environmental Protection Agency's Council for Regulatory Environmental Modeling (CREM) guidance; and (3) relies heavily on models that were not peer reviewed in compliance with the Office of Management and Budget's (OMB) Final Information Quality Bulletin for Peer Review (70 FR 2664; January 14, 2005).

Response: The CRE is incorrect. NMFS performed appropriate pre-dissemination review and documentation according to relevant agency guidance (NMFS Policy Directive PD 04–108, Policy on the Data Quality Act; NMFS Instruction 04–108–03, Section 515 Pre-Dissemination Review and Documentation Guidelines). All aspects of development of the 2016 Technical Guidance were peer reviewed (*www.cio.noaa.gov/services_programs/prplans/ID43.html*). Also of note, the same information and methodology that supported development of NMFS' Technical Guidance (NMFS, 2016, 2018) were more recently published in a peer-reviewed journal (Southall *et al.,* 2019a).

Comment: CRE states that NMFS' use of models in the acoustic exposure modeling process for this rule violates the IQA because ''they are incomplete, unfinished, inaccurate, unreliable, have never been validated, and have never been peer reviewed.'' CRE also asserts that NMFS has not conducted pre-dissemination review and documentation as required by the IQA and implies that, because NMFS did not address the IQA in the notice of proposed rulemaking, we must be in violation of it.

Response: CRE is incorrect; NMFS is in compliance with the requirements of the IQA. NMFS conducted the required pre-dissemination review at both the proposed and final stages of this rulemaking and appropriate documentation is included in the administrative record for this action.

CRE asserts that the models used in NMFS' rulemaking process are not properly evaluated or validated. CRE asserts that as a result, NMFS ''grossly overestimate[s] exposures and takes.'' According to the CRE, the supposed failings of the modeling necessarily lead to the overestimation of takes, as opposed to error in potentially different directions and of different magnitude in association with the various components of the modeling process. CRE comments at length that NMFS should use only the relatively simple approach of ''Line Transect,'' which they believe will result in lower numbers of estimated takes (see more detailed response to these suggestions earlier in Comments and Responses).

In asserting that the models used in support of this rule have not been adequately validated or peer reviewed, CRE refers to a similarly sophisticated, proprietary modeling package (Marine Acoustics, Inc.'s Acoustic Integration Model (''AIM'')) that underwent a dedicated external peer review, stating that AIM is ''therefore properly validated and acceptable for regulatory use.'' However, the AIM package functions virtually the same as the models used for this analysis, and was used for an essentially identical modeling process developed in support of BOEM's 2014 PEIS for geological and geophysical survey activities on the Mid- and South Atlantic Outer Continental Shelf.

The IQA concerns expressed in the comment are unfounded. As stated in the NOAA Information Quality Guidelines, information quality is composed of three elements: Utility, integrity, and objectivity.

Utility means that disseminated information is useful to its intended users. The disseminated information at issue here—modeled exposures of marine mammals to underwater noise—is useful to NMFS in that it forms the basis for subsequent analysis allowing NMFS to make determinations necessary under the MMPA. It is useful to the public in that it enables appropriate review of NMFS' action and supporting determinations. It is useful to the regulated entities in that it will allow for an efficient regulatory regime, in which potential LOA applicants may make use of the existing modeling effort (while being afforded the opportunity to engage in different modeling if desired) in service of a streamlined LOA application process.

Integrity refers to security, *i.e.,* the protection of information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification. The integrity of the information disseminated herein was not questioned, but it meets all relevant standards for integrity (as demonstrated in the administrative record for this action).

Finally, objectivity ensures that information is accurate, reliable, and unbiased, and that information products are presented in an accurate, clear, complete, and unbiased manner. Objectivity consists of two distinct elements: Presentation and substance. The presentation element includes whether disseminated information is presented in an accurate, clear, complete, and unbiased manner and in a proper context. NMFS has appropriately presented the disseminated information, and CRE does not assert otherwise. The substance element involves a focus on ensuring accurate, reliable, and unbiased information. Disseminated information reflects the inherent uncertainty of the scientific process, which is inseparable from the concept of statistical variation. In assessing information for accuracy, the information is considered accurate if it is within an acceptable degree of imprecision or error appropriate to the particular kind of information at issue and otherwise meets commonly accepted scientific and statistical standards, as applicable. This concept is inherent in the definition of ''reproducibility,'' as used in the OMB IQA Guidelines and adopted by NOAA. Therefore, original and supporting data that are within an acceptable degree of imprecision, or an analytic result that is within an acceptable degree of imprecision or error, are by definition within the agency standard and are therefore considered correct. CRE does not assert that the modeling results disseminated by NMFS are outside the bounds of an acceptable degree of imprecision or error.

The modeling report goes into great detail regarding potential error associated with different facets of the modeling process, and provides specific analysis of uncertainty in both the acoustic and animal phases of the modeling process (discussed in detail in the notice of proposed rulemaking and in the modeling report). Uncertainty associated with all aspects of the modeling was clearly identified and evaluated as to the effect on the overall modeling results. In order to best represent the overall uncertainty associated with the modeling, the report presents the exposure estimates as a distribution. The exposure estimate distribution provides the public with an understanding of the probability of certain events occurring, including the probability that an operation would not result in any animals being exposed above a defined threshold.

Regarding reproducibility and transparency, the NOAA Information Quality guidelines state that ''reproducibility means that the information is capable of being substantially reproduced, subject to an acceptable degree of imprecision [. . .] With respect to analytic results, 'capable of being substantially reproduced' means that independent analysis of the original or supporting data using identical methods would generate similar analytic results, subject to an acceptable degree of imprecision or error.'' We have no reason to believe that similar modeling (for example, using the AIM modeling package) using the same data inputs would not return similar analytic results, and CRE provides none. Transparency is not defined in the OMB Guidelines, but is at the heart of the reproducibility standard. At its most basic, transparency—and ultimately reproducibility—is a matter of showing how you got the results you got. NMFS has produced a painstakingly detailed accounting of the modeling process and decisions made, such that an independent party using a different set of models would be able to perform a similar modeling effort in order to evaluate the similarity of the results. The modeling report includes a full description of all assumptions and reference material used for both sound sources and species of interest. CRE provides no meaningful argument to the contrary.

The NOAA Information Quality guidelines expressly address and allow for the use of proprietary models and other supporting information which cannot be disclosed. In such cases, the guidelines call for ''especially rigorous robustness checks.'' As summarized below and described in detail in the notice of proposed rulemaking and modeling report, NMFS has conducted rigorous robustness checks of the proprietary models used in support of this rule.

The models used in estimating the acoustic exposures described herein have been appropriately validated and reviewed. As described in detail in the notice of proposed rulemaking and in the modeling report, the acoustic exposure modeling effort requires the use of a package of models. Acoustic exposure modeling in general is not novel, controversial, or precedent-setting, and similar modeling has been performed for various applications for over 15 years. This type of modeling requires modeling of the acoustic output of a source, in this case a specified airgun array (as well as a single airgun and certain electromechanical sources that were modeled separately). The output of the source model is an input to a model or models used to model underwater sound propagation as a function of range from the source. The output of this process is a 3D sound field. Subsequently, an animal movement model is used to simulate the behavior of virtual animats in relation to the modeled sound field. Each animat acts as a virtual dosimeter, producing individual records of exposure history. There were many animats in the simulations, and together their received levels represent the probability, or risk, of exposure for each survey.

In this case, the source model used was JASCO Applied Sciences' proprietary Airgun Array Source Model (AASM). The AASM accepts airgun volume, pressure, and depth and has internal parameters that must be fit to real signature data. The model was originally fit to a large library of empirical airgun data spanning a range of airgun volumes and operating depths. Subsequently, the model was improved to better predict airgun radiation at frequencies above 1 kHz. Development and validation of this improved version were made possible by high quality airgun source signature data from field studies conducted under the industry-sponsored Joint Industry Program on Sound and Marine Life. Desktop evaluation and validation of AASM have been conducted against commercial geophysical source models such as Gundalf and Nucleus.

JASCO's proprietary Marine Operations Noise Model (MONM) was used to generate the 3D sound fields necessary for sound exposure estimates. MONM is based on standard and proven acoustic propagation models. In this case, propagation at frequencies less than 2 kHz was computed using a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic

Model (RAM), which is based on a parabolic equation (PE) solution to the wave equation and extensively verified and validated under the Navy Ocean and Atmospheric Master Library process. The PE method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins *et al.,* 1996), and RAM's predictions (as generated within the MONM infrastructure) have been validated against experimental data in several underwater acoustic measurement programs conducted by JASCO (*e.g.,* Aerts *et al.,* 2008; Funk *et al.,* 2008; Ireland *et al.,* 2009; Blees *et al.,* 2010; Warner *et al.,* 2010). At frequencies greater than 2 kHz, increased sound attenuation due to volume absorption at higher frequencies is accounted for with the widely-used BELLHOP Gaussian beam ray-trace propagation model (Porter and Liu, 1994). Both of these complementary, non-proprietary propagation models (RAM and BELLHOP) have been extensively tested over many years and are accepted by the acoustics community. Implementation of these codes within the MONM infrastructure has been evaluated and validated against other PE codes including RAMS, RAM-Geo and original RAM, and against normal mode or wavenumber integration (fast field) methods in standard codes. Finally, JASCO has conducted end-to-end validation of source and propagation modeling against field data collected in sound source verification experiments, demonstrating that the results of the acoustic field modeling are in agreement with field data. The comparison of model results and measurements show that MONM can produce reliable results in challenging acoustic propagation conditions (Hannay and Racca, 2005).

The non-proprietary, peer-reviewed Marine Mammal Movement and Behavior (3MB) model (Houser, 2006) was used to generate realistic paths of simulated animals (animats) in the modeled area. JASCO's Exposure Modeling System (JEMS) was used to combine animal movement data (*i.e.,* the output from 3MB), with pre-computed acoustic fields (*i.e.,* the output from MONM described above). The JEMS is a relatively simple piece of software that acts as an indexer that finds the sound level from the computed fields for the location of each animat through time. The numerous, rigorous robustness checks described for the multiple modeling components are sufficient to comply with the IQA requirements, and no additional peer review is required.

While certain components of the modeling process (AASM, MONM, and JEMS) are proprietary in the sense that JASCO does not make the code publicly available, they are all based on standard physics or mathematical models generally accepted in the field and based on peer-reviewed models (*e.g.,* 3MB). In addition, ample opportunity has been provided for public input and review of the underlying scientific information and modeling efforts contained herein (including by scientists, peer experts at other agencies, and non-governmental organizations). Relevant data is provided such that an entity using similar models could reproduce or challenge the results. While the modeling results disseminated here may reasonably be considered to be influential for purposes of the OMB Peer Review Bulletin—meaning that the information may reasonably be considered to have a clear and substantial impact on important public policies, such as this ITR—the modeling is not a ''highly influential scientific assessment,'' (HISA) which is defined as a scientific assessment that: (i) Could have a potential impact of more than $500 million in any year, or (ii) is novel, controversial, or precedent-setting or has significant interagency interest. As described above, similar approaches to acoustic exposure modeling have been performed by numerous disparate entities for multiple applications. In 2014, during the aforementioned modeling workshop co-sponsored by the American Petroleum Institute and International Association of Geophysical Contractors, at least a half-dozen expert presenters (representing private and governmental entities from both the United States and Europe) discussed various available packages that function much the same way as what is described here. There is nothing novel, controversial, or precedent-setting about the modeling described here, and the additional peer review requirements associated with HISAs are not applicable.

Miscellaneous

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 NMFS 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, determined that it would not be reasonable or practicable to develop such metrics (see Appendix L in BOEM, 2017). NMFS does not believe it appropriate to address disagreements with these conclusions to us. NRDC further claims that NMFS' 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 NMFS encourages NRDC to engage with BOEM regarding these alleged shortcomings of the panel's findings. The subject matter is outside NMFS' expertise, and we have no basis upon which to doubt the panel's published findings.

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, NMFS disagrees that these requirements would be practicable. While NMFS agrees 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 for this specified activity, given the few vessels used in any given survey and relative to commercial shipping. NMFS looks forward to continued collaboration with NRDC and others towards ship quieting.

Comment: NRDC states that NMFS must consider mitigation that limits and reduces the amount of survey activity, including ''prohibit[ing]'' duplicative surveys, and should consider ''consolidating'' surveys. Similarly, the MMC recommends that NMFS ''work with BOEM'' to require industry operators to increase collaboration on seismic surveys whenever possible.

Response: NRDC states that NMFS should ''require and enforce a cap'' on surveys, without explaining how they believe this is within NMFS' statutory authority or suggesting ways to appropriately apportion the amount of effort that might be allowed. NMFS cannot arbitrarily limit planned effort and has no legitimate means of changing the specified activity absent a conclusion that the activity would have more than a negligible impact. However, NMFS has made the necessary findings under the MMPA for issuance of this rule. NRDC goes on to state that NMFS should ''require BOEM to eliminate unnecessary duplication of survey effort'' but does not explain how they believe that this suggestion is within NMFS' statutory authority. As the permitting agency, BOEM has the authority 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' purview. NMFS may not demand that BOEM discharge its authority under OCSLA in any particular manner. As stated previously, 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 or removal of activities based on some presumption of duplication that NMFS is not qualified to judge. 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.

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, the MMC provides no useful recommendations as to how such collaboration might be achieved. Given the absence of appropriate statutory authority, NMFS is willing to explore with the MMC possible mechanisms for fostering such collaboration between geophysical data acquisition companies and relevant Federal agencies, within the context of our respective authorities.

NMFS also notes that, although surveys may be perceived as ''duplicative'' simply because other surveys have also occurred in the same location, they are in fact designed specifically to produce proprietary data that satisfies the needs of survey funders. As noted by NRDC, BOEM convened an expert panel to study the issue of duplicative surveys (see Appendix L in BOEM, 2017) and developed standards for consideration of what surveys are duplicative. NRDC provides extensive discussion of their thoughts regarding the insufficiency of BOEM's duplicative survey standard and its implementation. We respectfully suggest that these comments are more appropriately directed at BOEM.

Comment: Chevron states that NMFS ''must be mindful of the mandates under OCSLA to assess and then balance the costs and benefits of alternative restrictions on geophysical activities against a requirement for 'expeditious and orderly development' of GOM resources.''

Response: NMFS' statutory obligations arise under the Marine Mammal Protection Act (with associated requirements under the Endangered Species Act, National Environmental Policy Act, and Administrative Procedure Act, among others). NMFS has no statutory obligation relative to OCSLA.

Comment: CRE provides several comments relating to E.O. 12866. CRE reiterates their view that there is ''no harm from seismic,'' and therefore, that it is not surprising that NMFS has not produced a quantitative statement of benefits. They also conclude that ''[s]ince the benefits of the proposed rule are minimal at best, the resultant benefit-cost ratio is less than one, making the proposed rule non-compliant'' with E.O. 12866.

Response: NMFS disagrees with the commenter's premise that there is no potential for harm, and accordingly evaluated the impacts of the specified activity and prescribed appropriate mitigation in the ITR, as required under the MMPA. With respect to E.O. 12866, the RIA provides a qualitative description of potential ecological benefits and their economic implications due to uncertainty preventing quantification. Similar to the qualitative evaluation of costs associated with the proposed area closures, the qualitative treatment of benefits does not indicate a lesser magnitude, but rather more data limitations or uncertainty.

Comment: Regarding E.O. 13211, Chevron comments that NMFS has provided inconsistent statements that should be resolved.

Response: NMFS has clarified its discussion regarding E.O. 13211. Overall, within the five-year timeframe of the analysis, the ITR is not expected to constitute a significant adverse effect on energy supply, distribution or use, according to the thresholds described by E.O. 13211, given that the direct compliance costs represent a small fraction (on the order of less than one percent) of the total costs of exploration and development in the GOM.

Comment: Chevron notes that E.O. 13795 required evaluation of NMFS' 2016 Technical Guidance (review of which was ongoing at the time of publication of the notice of proposed rulemaking). Chevron also asserts that assumptions of the 2016 Technical Guidance ''are multiplied with those in other elements of the modeling to reach 'unrealistic' conclusions.'' Because the 2016 Technical Guidance was used in the modeling, Chevron asserts that the modeling is inconsistent with the requirements of E.O. 13795. The CRE also claims that use of the 2016 Technical Guidance is in violation of E.O. 13795 and that the guidance should be rescinded or substantially revised. CRE also states that NMFS must emphasize that use of the Technical Guidance is not required.

Response: Review of the Technical Guidance under E.O. 13795 was completed in 2018. In response to the feedback received during the public comment period and the Interagency Consultation meeting, the Secretary of Commerce approved NMFS to issue a 2018 Revised Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (2018 Revised Technical Guidance) (NOAA Technical Memorandum NMFS–OPR–59) (June 21, 2018). NMFS' use of the guidance is, therefore, in compliance with E.O. 13795.

The 2018 Revised Technical Guidance retains the thresholds and weighting functions presented in the original 2016 Technical Guidance. Chevron's comment that the Technical Guidance somehow contributes to what they characterize as ''unrealistic'' conclusions is, in context of industry's overall comments on the modeling effort, unpersuasive. The industry-funded supplementary modeling variable analysis (Zeddies *et al.,* 2017b) found that use of the Technical Guidance was the single most influential factor in reducing the modeled exposures (for Level A harassment).

We acknowledge that the Technical Guidance is indeed guidance, and its use is voluntary (as stated in the Executive Summary of the Technical Guidance). The Technical Guidance provides more detail on if/when an alternative approach may be used.

Description of Marine Mammals in the Area of the Specified Activities

Sections 3 and 4 of the petition summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species. NMFS refers the reader to those descriptions, descriptions of the affected environment in Appendix E of BOEM's PEIS, as well as NMFS' Stock Assessment Reports (SAR; *www.fisheries.noaa.gov/national/*

marine-mammal-protection/marine-mammal-stock-assessments), incorporated here by reference, instead of reprinting the information. Additional general information about these species (*e.g.,* physical and behavioral descriptions) may be found on NMFS' website (*www.fisheries.noaa.gov/find-species*).

Table 4 lists all species with expected potential for occurrence in the GOM and summarizes information related to the population or stock, including potential biological removal (PBR). For taxonomy, we follow Committee on Taxonomy (2020). 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' 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' 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. For many GOM stocks, information regarding distribution and range-wide abundance is limited, as available data are generally limited to U.S. waters of the northern GOM. Abundance and distribution for GOM stocks occurring in the Mexican EEZ or the high seas are poorly understood. As discussed in additional detail below, U.S. waters only comprise about 40 percent of the entire GOM, and 65 percent of GOM oceanic waters are south of the U.S. EEZ. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance within 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' GOM SARs assess stocks of *Mesoplodon* spp. and *Kogia* spp. as guilds. Here, we consider beaked whales and *Kogia* spp. as guilds. In the following discussion, reference to ''beaked whales'' includes the Cuvier's, Blainville's, and Gervais beaked whales, and reference to ''*Kogia* spp.'' includes both the dwarf and pygmy sperm whale.

Twenty-one species (with 24 managed stocks) have the potential to co-occur with the prospective survey activities. Extralimital species or stocks unlikely to co-occur with survey activity include 31 estuarine bottlenose dolphin stocks, the blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), sei whale (*B. borealis*), minke whale (*B. acutorostrata*), humpback whale (*Megaptera novaeangliae*), North Atlantic right whale (*Eubalaena glacialis*), and the Sowerby's beaked whale (*Mesoplodon bidens*). All mysticete species listed here (as well as Sowerby's beaked whale) are considered only of accidental occurrence in GOM and are generally historically known only from a very small number of strandings and/or sightings (Würsig *et al.,* 2000; Würsig, 2017). In addition, following BOEM's update to the scope of activity considered through this rule, the eastern coastal stock of bottlenose dolphin, which was considered in the notice of proposed rulemaking, would no longer be potentially impacted by activities that may be authorized under this rule. For detailed discussion of these species, please see the notice of proposed rulemaking (83 FR 29212; June 22, 2018). In addition, the West Indian manatee (*Trichechus manatus latirostris*) may be found in coastal waters of the GOM. 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' U.S. Atlantic SARs.

All values presented in Table 4, which are available in the most recent final SARs (Hayes *et al.,* 2020) and have not changed since the proposed rule was published, are the most recent available at the time the analyses for this final rule were completed. We also reviewed new information for many GOM stocks in unpublished draft 2020 SARs. The unpublished draft SARs include updates to most GOM stocks, including to abundance estimates, PBR values, and annual mortality and serious injury (M/SI) estimates. The most notable change is that, through the introduction of M/SI estimates related to the Deepwater Horizon (DWH) oil spill, M/SI values are generally larger than in past SARs and in some cases are larger than the PBR values. NMFS has considered this information and determined that it is previously accounted for as part of the baseline, through our existing analysis of the effects of the DWH oil spill. We have fully considered the underlying information in our analysis and have determined that the unpublished draft SAR updates do not impact our conclusions.

TABLE 4—MARINE MAMMALS POTENTIALLY PRESENT IN THE SPECIFIED GEOGRAPHICAL REGION

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2,7]	Predicted mean (CV)/maximum abundance [3]	PBR	Annual M/SI (CV) [4]
Order Cetartiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)							
Family Balaenopteridae (rorquals):							
Bryde's whale	*Balaenoptera edeni*	Gulf of Mexico	E/D; Y	33 (1.07; 16; 2009)	44 (0.27)/n/a	0.03	0.8
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)							
Family Physeteridae:							
Sperm whale	*Physeter macrocephalus*	GOM	E/D; Y	763 (0.38; 560; 2009)	2,128 (0.08)/2,234.	1.1	0

TABLE 4—MARINE MAMMALS POTENTIALLY PRESENT IN THE SPECIFIED GEOGRAPHICAL REGION—Continued

Common name	Scientific name	Stock	ESA/ MMPA status; Strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2,7]	Predicted mean (CV)/ maximum abundance [3]	PBR	Annual M/SI (CV) [4]
Family Kogiidae:							
Pygmy sperm whale	*Kogia breviceps*	GOM	-; N	186 (1.04; 90; 2009) [5]	2,234 (0.19)/ 6,117 [5].	0.9	0.3 (1.0)
Dwarf sperm whale	*K. sima*	GOM	-; N				
Family Ziphiidae (beaked whales):							
Cuvier's beaked whale:.	*Ziphius cavirostris*	GOM	-; N	74 (1.04; 36; 2009)	2,910 (0.16)/ 3,958 [5].	0.4	0
Gervais beaked whale.	*Mesoplodon europaeus*	GOM	-; N	149 (0.91; 77; 2009) [5]		0.8	0
Blainville's beaked whale.	*M. densirostris*	GOM	-; N				
Family Delphinidae:							
Rough-toothed dolphin.	*Steno bredanensis*	GOM	-; N	624 (0.99; 311; 2009)	4,853 (0.19)/n/a.	2.5	0.8 (1.0)
Common bottlenose dolphin.	*Tursiops truncatus truncatus*.	GOM Oceanic	-; N	5,806 (0.39; 4,230; 2009)	138,602 (0.06)/ 192,176 [5].	42	6.5 (0.65)
		GOM Continental Shelf	-; N	51,192 (0.10; 46,926; 2011–12).		469	0.8
		GOM Coastal, Northern	-; N	7,185 (0.21; 6,044; 2011–12).		60	0.4
		GOM Coastal, Western	-; N	20,161 (0.17; 17,491; 2011–12).		175	0.6
Clymene dolphin	*Stenella clymene*	GOM	-; N	129 (1.00; 64; 2009)	11,000 (0.16)/ 12,115.	0.6	0
Atlantic spotted dolphin	*S. frontalis*	GOM	-; N	37,611 (0.28; 29,844; 2000–01) [6].	47,488 (0.13)/ 85,108.	Undet.	42 (0.45)
Pantropical spotted dolphin.	*S. attenuata attenuata*	GOM	-; N	50,880 (0.27; 40,699; 2009).	84,014 (0.06)/ 108,764.	407	4.4
Spinner dolphin	*S. longirostris longirostris*	GOM	-; N	11,441 (0.83; 6,221; 2009).	13,485 (0.24)/ 31,341.	62	0
Striped dolphin	*S. coeruleoalba*	GOM	-; N	1,849 (0.77; 1,041; 2009)	4,914 (0.17)/ 5,323.	10	0
Fraser's dolphin	*Lagenodelphis hosei*	GOM	-; N	726 (0.7; 427; 1996–2001) [6].	1,665 (0.73)/n/a.	Undet.	0
Risso's dolphin	*Grampus griseus*	GOM	-; N	2,442 (0.57; 1,563; 2009)	3,137 (0.10)/ 4,153.	16	7.9 (0.85)
Melon-headed whale	*Peponocephala electra*	GOM	-; N	2,235 (0.75; 1,274; 2009)	6,733 (0.30)/ 7,105.	13	0
Pygmy killer whale	*Feresa attenuata*	GOM	-; N	152 (1.02; 75; 2009)	2,126 (0.30)/n/a.	0.8	0
False killer whale	*Pseudorca crassidens*	GOM	-; N	777 (0.56; 501; 2003–04) [6].	3,204 (0.36)/n/a.	Undet.	0
Killer whale	*Orcinus orca*	GOM	-; N	28 (1.02; 14; 2009)	185 (0.41)/n/a	0.1	0
Short-finned pilot whale	*Globicephala macrorhynchus*.	GOM	-; N	2,415 (0.66; 1,456; 2009)	1,981 (0.18)/n/a.	15	0.5 (1.0)

[1] ESA status: Endangered (E)/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.

[3] This information represents species- or guild-specific abundance predicted by habitat-based cetacean density models (Roberts *et al.,* 2016). These models provide the best available scientific information regarding predicted density patterns of cetaceans in the U.S. Gulf of Mexico, and we provide the corresponding abundance predictions as a point of reference. Total abundance estimates were produced by computing the mean density of all pixels in the modeled area and multiplying by its area.

[4] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.,* commercial fisheries, ship strike). A CV associated with estimated mortality due to commercial fisheries is presented in some cases.

[5] 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' 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 as a guild for beaked whales (*Ziphius cavirostris* and *Mesoplodon* spp.). Finally, Roberts *et al.* (2016) produced a density model for bottlenose dolphins that does not differentiate between oceanic, shelf, and coastal stocks. The modeled abundance estimate provided here for all bottlenose dolphins includes abundance that may be attributed to the eastern coastal stock.

[6] NMFS' abundance estimates for these species are not considered current. PBR is therefore considered undetermined, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimate.

[7] We note that Dias and Garrison (2016) present abundance estimates for oceanic stocks that were calculated for use in DWH oil spill injury quantification. For most stocks, these estimates are based on pooled observations from shipboard surveys conducted in 2003, 2004, and 2009 and corrected for detection bias. Estimates for beaked whales and *Kogia* spp. were based on density estimates derived from passive acoustic data collection (Hildebrand *et al.,* 2012). The abundance estimate for Bryde's whales incorporated the results of additional shipboard surveys conducted in 2007, 2010, and 2012. Here we retain NMFS' official SAR information for comparison with model-predicted abundance (Roberts *et al.,* 2016).

For the majority of species potentially present in the specified geographical region, NMFS has designated only a single generic stock (*i.e.,* ''Gulf of Mexico'') for management purposes, although there is currently no information to differentiate the stock from the Atlantic Ocean stock of the same species, nor information on whether more than one stock may exist in the GOM (Hayes *et al.,* 2020).

For the bottlenose dolphin, NMFS defines an oceanic stock, a continental shelf stock, and three coastal stocks. As in the northwestern Atlantic Ocean, there are two general bottlenose dolphin ecotypes: ''coastal'' and ''offshore.''

These ecotypes are genetically and morphologically distinct (Hoelzel *et al.,* 1998; Waring *et al.,* 2016), though ecotype distribution is not clearly defined and the stocks are delineated primarily on the basis of management rather than ecological boundaries. The offshore ecotype is assumed to correspond to the oceanic stock, with the stock boundary (and thus the de facto delineation of offshore and coastal ecotypes) defined as the 200-m isobath. The continental shelf stock is defined as between two typical survey strata: The 20- and 200-m isobaths. While the shelf stock is assumed to consist primarily of coastal ecotype dolphins, offshore ecotype dolphins may also be present. There is expected to be some overlap with the three coastal stocks as well, though the degree is unknown and it is not thought that significant mixing or interbreeding occurs between them (Waring *et al.,* 2016). The coastal stocks are defined as being in waters between the shore, barrier islands, or presumed outer bay boundaries out to the 20-m isobath and, as a working hypothesis, NMFS has assumed that dolphins occupying habitats with dissimilar climatic, coastal, and oceanographic characteristics might be restricted in their movements between habitats, thus constituting separate stocks (Waring *et al.,* 2016). Shoreward of the 20-m isobath, the eastern coastal stock extends from Key West, FL to 84° W longitude; the northern coastal stock from 84° W longitude to the Mississippi River delta; and the western coastal stock from the Mississippi River delta to the Mexican border. The latter is assumed to be a trans-boundary stock, though no information is available regarding abundance in Mexican waters. As noted above, the eastern coastal stock will not be affected by activities considered through this rule.

At the time of publication of the notice of proposed rulemaking, the GOM Bryde's whale was proposed for listing as an endangered species under the ESA (81 FR 88639; December 8, 2016). Since that time, NMFS has listed the GOM Bryde's whale as endangered under the ESA, effective on May 15, 2019 (84 FR 15446; April 15, 2019). The proposed listing was based largely on NMFS' status review of Bryde's whales in the GOM (Rosel *et al.,* 2016), and no significant new information has become available since that time. No critical habitat has yet been designated for the species, and no recovery plan has yet been developed. NMFS' analysis related to the GOM Bryde's whale in the notice of proposed rulemaking was conducted in context of the same information that informed the proposal to list the GOM Bryde's whale and, therefore, the final listing decision itself does not introduce new information for consideration in the analysis for this final rulemaking.

In Table 4 above, NMFS reports two sets of abundance estimates: Those from NMFS' SARs and those predicted by Roberts *et al.* (2016)—for the latter, we provide both the annual mean and the monthly maximum (where applicable). Please see footnotes 2–3 of Table 4 for more detail. NMFS' SAR estimates are typically generated from the most recent shipboard and/or aerial surveys conducted. GOM oceanography is dynamic, and the spatial scale of the GOM is small relative to the ability of most cetacean species to travel. As an example, no groups of Fraser's dolphins were observed during dedicated cetacean abundance surveys during 2003–2004 or 2009, yet the SAR states that it is probable that Fraser's dolphins were present in the northern GOM but simply not encountered, and therefore declines to present an abundance estimate of zero (Waring *et al.,* 2013). U.S. waters only comprise about 40 percent of the entire GOM, and 65 percent of GOM oceanic waters are south of the U.S. EEZ. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance within U.S. waters. NMFS' SAR estimates also typically do not incorporate correction for detection bias. Therefore, they should generally be considered underestimates, especially for cryptic or long-diving species (*e.g.,* beaked whales, *Kogia* spp., sperm whales). Dias and Garrison (2016) state, for example, that current abundance estimates for *Kogia* spp. may be considerably underestimated due to the cryptic behavior of these species and difficulty of detection in Beaufort sea state greater than one, and density estimates for certain species derived from long-term passive acoustic monitoring are much higher than are estimates derived from visual observations (Mullin and Fulling, 2004; Mullin, 2007; Hildebrand *et al.,* 2012).

The Roberts *et al.* (2016) abundance estimates represent the output of predictive models derived from multi-year observations and associated environmental parameters and which incorporate corrections for detection bias. Incorporating more data over multiple years of observation can yield different results in either direction, as the result is not as readily influenced by fine-scale shifts in species habitat preferences or by the absence of a species in the study area during a given year. NMFS' abundance estimates show substantial year-to-year variability in some cases. For example, NMFS-reported estimates for the Clymene dolphin vary by a maximum factor of more than 100 (2009 estimate of 129 versus 1996–2001 estimate of 17,355), indicating that it may be more appropriate to use the model prediction versus a point estimate, as the model incorporates all available data (from 1992–2009). The latter factor—incorporation of correction for detection bias—should systematically result in greater abundance predictions. For these reasons, the Roberts *et al.* (2016) estimates are generally more realistic and, for these purposes, represent the best available information. For purposes of assessing estimated exposures relative to abundance—used in this case to understand the scale of the predicted takes compared to the population—NMFS generally believes that the Roberts *et al.* (2016) abundance predictions are most appropriate because they were used to generate the exposure estimates and therefore provide the most relevant comparison. Roberts *et al.* (2016) represents the best available scientific information regarding marine mammal occurrence and distribution in the Gulf of Mexico.

As a further illustration of the distinction between the SARs and model-predicted abundance estimates, the current NMFS stock abundance estimates for most GOM species are based on direct observations from shipboard surveys conducted in 2009 (from the 200-m isobath to the edge of the U.S. EEZ) and not corrected for detection bias, whereas the exposure estimates presented herein for those species are based on the abundance predicted by a density surface model informed by observations from surveys conducted over approximately 20 years and covariates associated at the observation level. To directly compare the estimated exposures predicted by the outputs of the Roberts *et al.* (2016) model to NMFS' SAR abundance would therefore not be meaningful.

Biologically Important Areas (BIA)—As part of our description of the environmental baseline, we discuss any known areas of importance as marine mammal habitat. These areas may include designated critical habitat for ESA-listed species (as defined by section 3 of the ESA) or other known areas not formally designated pursuant to any statute or other law. Important areas may include areas of known importance for reproduction, feeding, or migration, or areas where small and resident populations are known to occur.

Although there is no designated critical habitat for marine mammal species in the specified geographical region, BIAs for marine mammals are recognized. For example, the GOM Bryde's whale is a very small population that is genetically distinct from other Bryde's whales and not genetically diverse within the GOM (Rosel and Wilcox, 2014). Further, the species is typically observed only within a narrowly circumscribed area within the eastern GOM. Therefore, this area is described as a year-round BIA by LaBrecque *et al.* (2015). Although survey effort has covered all oceanic waters of the U.S. GOM, whales were observed only between approximately the 100- and 300-m isobaths in the eastern GOM from the head of the De Soto Canyon (south of Pensacola, Florida) to northwest of Tampa Bay, Florida (Maze-Foley and Mullin, 2006; Waring *et al.,* 2016; Rosel and Wilcox, 2014; Rosel *et al.,* 2016). NOAA subsequently conducted a status review of the GOM Bryde's whale (Rosel *et al.,* 2016). The review expanded this description by stating that, due to the depth of some sightings, the area is more appropriately defined to the 400-m isobath and westward to Mobile Bay, Alabama, in order to provide some buffer around the deeper sightings and to include all sightings in the northeastern GOM. However, the recorded Bryde's whale shipboard and aerial survey sightings between 1989 and 2015 have mainly fallen within the BIA described by LaBreque *et al.* (2015). The entirety of this area is now excluded from the scope of this rule following BOEM's update to that scope.

LaBrecque *et al.* (2015) also described eleven year-round BIAs for small and resident BSE bottlenose dolphin populations in the GOM. Additional study would likely allow for identification of additional BIAs associated with other GOM BSE dolphin stocks.

Deepwater Horizon Oil Spill—In 2010 the *Macondo* well blowout and explosion aboard the *Deepwater Horizon* drilling rig (also known as the *Deepwater Horizon* explosion, oil spill, and response; hereafter referred to as the DWH oil spill) caused oil, natural gas, and other substances to flow into the GOM for 87 days before the well was sealed. Total oil discharge was estimated at 3.19 million barrels (134 million gallons), resulting in the largest marine oil spill in history (DWH NRDA Trustees, 2016). In addition, the response effort involved extensive application of dispersants at the seafloor and at the surface, and controlled burning of oil at the surface was also used extensively as a response technique. The oil, dispersant, and burn residue compounds present ecological challenges in the region. NMFS discussed the impacts of the DWH oil spill on marine mammals in detail in the notice of proposed rulemaking (83 FR 29212; June 22, 2018) and we refer the reader to that document for additional detail.

At its maximum extent, oil covered over 40,000 km² of ocean. Cumulatively, over the course of the spill, oil was detected on over 112,000 km² of ocean. Currents, winds, and tides carried these surface oil slicks to shore, fouling more than 2,100 km of shoreline, including beaches, bays, estuaries, and marshes from eastern Texas to the Florida Panhandle. In addition, some lighter oil compounds evaporated from the slicks, exposing air-breathing organisms like marine mammals to noxious fumes at the sea surface.

The Oil Pollution Act requires that a natural resource damage assessment (NRDA) be conducted following oil pollution incidents. An injury assessment undertaken as part of the NRDA first requires a determination of whether an incident injured natural resources. Trustees assessing natural resource injuries must establish that a pathway existed from the oil discharge to the resource, confirm that resources were exposed to the discharge, and evaluate the adverse effects that occurred as a result of the exposure (or response activities). Subsequently, the assessment requires injury quantification (including degree and spatiotemporal extent), essentially by comparing the post-event conditions with the pre-event baseline. For a fuller overview of the injury assessment process in this case, please see Takeshita *et al.* (2017). Critical pathways of exposure for marine mammals included the contaminated water column, where they swim and capture prey; the surface slick at the air to water interface, where they breathe, rest, and swim; and contaminated sediment, where they forage and capture prey.

DWH oil was found to cause problems with the regulation of stress hormone secretion from adrenal cells and kidney cells, which will affect an animal's ability to regulate body functions and respond appropriately to stressful situations, thus leading to reduced fitness. Bottlenose dolphins living in habitats contaminated with DWH oil showed signs of adrenal dysfunction, and dead, stranded dolphins from areas contaminated with DWH oil had smaller adrenal glands (Schwacke *et al.,* 2014a; Venn-Watson *et al.,* 2015b). Other factors were ruled out as a primary cause for the high prevalence of adverse health effects, reproductive failures, and disease in stranded animals. When all of the data were considered together, the DWH oil spill was determined to be the only reasonable cause for the full suite of observed adverse health effects.

Due to the difficulty of investigating marine mammals in pelagic environments and across the entire region impacted by the event, the injury assessment focused on health assessments conducted on bottlenose dolphins in nearshore habitats and used these populations as case studies for extrapolating to coastal and oceanic populations that received similar or worse exposure to DWH oil, with appropriate adjustments made for differences in behavior, anatomy, physiology, life histories, and population dynamics among species. Investigators then used a population modeling approach to capture the overlapping and synergistic relationships among the metrics for injury, and to quantify the entire scope of DWH marine mammal injury to populations into the future, expressed as ''lost cetacean years'' due to the DWH oil spill (which represents years lost due to premature mortality as well as the resultant loss of reproductive output). This approach allowed for consideration of long-term impacts resulting from immediate losses and reproductive failures in the few years following the spill, as well as expected persistent impacts on survival and reproduction for exposed animals well into the future (Takeshita *et al.,* 2017). For a more detailed overview of the injury quantification for these stocks and their post-DWH population trajectory, please see Schwacke *et al.* (2017), and for full details of the overall injury quantification, see DWH MMIQT (2015).

The results of the quantification exercise for each affected shelf and oceanic stock, and for northern and western coastal stocks of bottlenose dolphin, are presented in Table 5. This is likely a conservative estimate of impacts, because: (1) Shelf and oceanic species experienced long exposures (up to 90 days) to very high concentrations of fresh oil and a diverse suite of response activities, while estuarine dolphins were not exposed until later in the spill period and to weathered oil products at lower water concentrations; (2) oceanic cetaceans dive longer and to deeper depths, and it is possible that the types of lung injuries observed in estuarine dolphins may be more severe for oceanic cetaceans; and (3) cetaceans in deeper waters were exposed to very high concentrations of volatile gas compounds at the water's surface near the wellhead. No analysis was performed for Fraser's dolphins or killer whales; although they are present in the GOM, sightings are rare and there were no historical sightings in the oil spill footprint during the surveys used in the quantification process. These stocks were likely injured, but no information is available on which to base a quantification effort.

TABLE 5—SUMMARY OF MODELED EFFECTS OF DWH OIL SPILL

Common name	% Population exposed to oil (95% CI)	% Population killed (95% CI)	% Females with reproductive failure (95% CI)	% Population with adverse health effects (95% CI)	% Maximum population reduction (95% CI)	Years to recovery (95% CI)[b]
Bryde's whale	48 (23 – 100)	17 (7 – 24)	22 (10 – 31)	18 (7 – 28)	− 22	69
Sperm whale	16 (11 – 23)	6 (2 – 8)	7 (3 – 10)	6 (2 – 9)	− 7	21
Kogia spp.	15 (8 – 29)	5 (2 – 7)	7 (3 – 10)	6 (2 – 9)	− 6	11
Beaked whales	12 (7 – 22)	4 (2 – 6)	5 (3 – 8)	4 (2 – 7)	− 6	10
Rough-toothed dolphin	41 (16 – 100)	14 (6 – 20)	19 (9 – 26)	15 (6 – 23)	− 17	54
Bottlenose dolphin, oceanic	10 (5 – 10)	3 (1 – 5)	5 (2 – 6)	4 (1 – 6)	− 4	n/a
Bottlenose dolphin, northern coastal	82 (55 – 100)	38 (26 – 58)	37 (17 – 53)	30 (11 – 47)	− 50 (32 – 73)	39 (23 – 76)
Bottlenose dolphin, western coastal	23 (16 – 32)	1 (1 – 2)	10 (5 – 15)	8 (3 – 13)	− 5 (3 – 9)	n/a
Shelf dolphins[a]	13 (9 – 19)	4 (2 – 6)	6 (3 – 8)	5 (2 – 7)	− 3	n/a
Clymene dolphin	7 (3 – 15)	2 (1 – 4)	3 (2 – 5)	3 (1 – 4)	− 3	n/a
Pantropical spotted dolphin	20 (15 – 26)	7 (3 – 10)	9 (4 – 13)	7 (3 – 11)	− 9	39
Spinner dolphin	47 (24 – 91)	16 (7 – 23)	21 (10 – 30)	17 (6 – 27)	− 23	105
Striped dolphin	13 (8 – 22)	5 (2 – 7)	6 (3 – 9)	5 (2 – 8)	− 6	14
Risso's dolphin	8 (5 – 13)	3 (1 – 4)	3 (2 – 5)	3 (1 – 4)	− 3	n/a
Melon-headed whale	15 (6 – 36)	5 (2 – 7)	7 (3 – 10)	6 (2 – 9)	− 7	29
Pygmy killer whale	15 (7 – 33)	5 (2 – 8)	7 (3 – 10)	6 (2 – 9)	− 7	29
False killer whale	18 (7 – 48)	6 (3 – 9)	8 (4 – 12)	7 (3 – 11)	− 9	42
Short-finned pilot whale	6 (4 – 9)	2 (1 – 3)	3 (1 – 4)	2 (1 – 3)	− 3	n/a

Modified from DWH NRDA Trustees (2016).

CI = confidence interval. No CI was calculated for population reduction or years to recovery for shelf or oceanic stocks.

[a] "Shelf dolphins" includes Atlantic spotted dolphins and the shelf stock of bottlenose dolphins (20–200 m water depth). These two species were combined because the abundance estimate used in population modeling was derived from aerial surveys and the species could not generally be distinguished from the air.

[b] It is not possible to calculate YTR for stocks with maximum population reductions of less than or equal to 5 percent.

Coastal and oceanic marine mammals were injured by exposure to oil from the DWH spill. Nearly all of the stocks that overlap with the oil spill footprint have demonstrable, quantifiable injuries, and the remaining stocks (for which there is no quantifiable injury) were also likely injured, though there is not currently enough information to make a determination. Injuries included elevated mortality rates, reduced reproduction, and disease. Due to these effects, affected populations may require decades to recover absent successful efforts at restoration (*e.g.,* DWH NRDA Trustees, 2017). The ability of the stocks to recover and the length of time required for that recovery are tied to the carrying capacity of the habitat, and to the degree of other population pressures. NMFS treats the effects of the DWH oil spill as part of the baseline in considering the likely resilience of these populations to the effects of the activities considered in this regulatory framework.

Unusual Mortality Events (UME)—A UME is defined under Section 410(6) of 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 fourteen formally recognized UMEs affecting marine mammals in the region and involving species under NMFS' jurisdiction. These have primarily impacted coastal bottlenose dolphins, with multiple UMEs determined to have resulted from biotoxins and one from infectious disease. One relevant UME was declared since publication of the notice of proposed rulemaking and is discussed below.

Most significantly, a UME affecting multiple cetacean species in the northern GOM occurred from 2010–2014. NMFS discussed this UME in the notice of proposed rulemaking (83 FR 29212; June 22, 2018). Please see that document for additional information regarding the 2010–2014 UME. Additional information on the UME is also available online at: *www.fisheries.noaa.gov/national/marine-life-distress/2010-2014-cetacean-unusual-mortality-event-northern-gulf-mexico.* In summary, the event included all cetaceans stranded during this time in Alabama, Mississippi, and Louisiana and all cetaceans other than bottlenose dolphins stranded in the Florida Panhandle (Franklin County through Escambia County), with a total of 1,141 cetaceans stranded or reported dead offshore. For reference, the same area experienced a normal average of 75 strandings per year from 2002–09 (Litz *et al.,* 2014). The majority of stranded animals were bottlenose dolphins, though at least ten additional species were reported as well. Since not all cetaceans that die wash ashore where they may be found, the number reported stranded is likely a fraction of the total number of cetaceans that died during the UME. There was also an increase in strandings of stillborn and newborn dolphins (Colegrove *et al.,* 2016). The UME investigation and the *Deepwater Horizon* Natural Resource Damage Assessment determined that the DWH oil spill (discussed above) is the most likely explanation of the persistent, elevated stranding numbers in the northern GOM after the 2010 spill. The evidence to date supports that exposure to hydrocarbons released during the DWH oil spill was the most likely explanation of adrenal and lung disease in dolphins, which has contributed to increased deaths of dolphins living within the oil spill footprint and increased fetal loss. The longest and most prolonged stranding cluster was in Barataria Bay, Louisiana in 2010–11, followed by Mississippi and Alabama in 2011, consistent with timing and spatial distribution of oil, while the number of deaths was not elevated for areas that were not as heavily oiled. Subsequent health assessments of live dolphins from Barataria Bay and comparison to a reference population found significantly increased adrenal disease, lung disease, and poor health, while histological evaluations of samples from dead stranded animals from within and outside the UME area found that UME animals were more likely to have lung and adrenal lesions and to have primary bacterial pneumonia, which caused or contributed significantly to death (Schwacke *et al.,* 2014a, 2014b; Venn-Watson *et al.,* 2015b). The chronic adrenal gland and lung diseases identified in stranded UME dolphins are consistent with exposure to petroleum compounds (Venn-Watson *et al.,* 2015b). Colegrove *et al.* (2016) found that the increase in perinatal strandings resulted from late-term pregnancy failures and development of *in utero* infections likely caused by chronic illnesses in mothers who were exposed to oil.

While the number of dolphin mortalities in the area decreased after the peak from March 2010-July 2014, it does not indicate that the effects of the oil spill on these populations have ended. Researchers still saw evidence of chronic lung disease and adrenal impairment four years after the spill (in July 2014) and saw evidence of failed pregnancies in 2015 (Smith *et al.,* 2017). These follow-up studies found a yearly mortality rate for Barataria Bay dolphins of roughly 13 percent (as compared to annual mortality rates of 5 percent or less that have been previously reported for other dolphin populations) and found that only 20 percent of pregnant dolphins produced viable calves (compared with 83 percent in a reference population) (Lane *et al.,* 2015; McDonald *et al.,* 2017). In addition, compromised health may make dolphins more susceptible to additional environmental stressors.

Since the publication of the proposed rule, another UME involving bottlenose dolphins in the northern GOM was declared. Elevated bottlenose dolphin strandings occurred in Louisiana, Mississippi, Alabama, and the panhandle of Florida (Alabama border through Taylor County) from February 1, 2019, through November 30, 2019. A total of 337 confirmed strandings were documented, with a majority occurring from February through May. Excluding prior UMEs, the annual average for February through May in the affected area is 57 dolphins; at least 260 standings were documented during this period in 2019. The cause of the UME was determined to be environmentally driven by exposure to low salinity waters resulting from extreme freshwater discharge from watersheds that drain into the GOM, including rivers in Florida, Alabama, Mississippi and Louisiana. This unprecedented amount of freshwater discharge during the winter, spring, and summer months of 2019 resulted in a drop in salinity levels across the coastally associated waters in the region. Prolonged exposure to low salinity water has been documented to have harmful health impacts on bottlenose dolphins, ranging from skin lesions and serum electrolyte abnormalities to acute mortality. The location of the UME and the dolphin stocks affected, including the western and northern coastal stocks of bottlenose dolphin, are the same as those impacted by the 2010–2014 UME. For additional information, please visit *www.fisheries.noaa.gov/national/marine-life-distress/2019-bottlenose-dolphin-unusual-mortality-event-along-northern-gulf.*

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 that 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. 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. Twenty-one species of cetacean have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 4. Of the cetacean species that may be present, one is classified as a low-frequency cetacean (*i.e.,* the Bryde's whale), 18 are classified as mid-frequency cetaceans (*i.e.,* all delphinid and ziphiid species and the sperm whale), and two are classified as high-frequency cetaceans (*i.e., Kogia* spp.).

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

In NMFS' notice of proposed rulemaking (83 FR 29212; June 22, 2018), 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 incorporate by reference that information and do not repeat that discussion here, instead referring the reader to the notice of proposed rulemaking.

The Estimated Take section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by the specified activity. The Negligible Impact Analysis and Determinations section includes an analysis of how these activities will impact marine mammals and considers 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 the notice of proposed rulemaking, 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 $\mu Pa^2 - s$) 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 the notice of proposed rulemaking, 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.

Acoustic sources used for high-resolution geophysical (HRG) surveys generally produce higher frequency signals with highly directional beam patterns. These sources are generally considered to be intermittent, with typically brief signal durations. Boomers, considered to be impulsive sources, generate a high-amplitude broadband (100 Hz-10 kHz) acoustic pulse with high downward directivity, though may be considered omnidirectional at frequencies below 1 kHz. Other typical HRG sources are considered non-impulsive. Sub-bottom profiler systems generally project a chirp pulse spanning an operator-selectable frequency band, usually between 1 to 20 kHz, with a single beam directed vertically down. Multibeam echosounders use an array of transducers that project a high-frequency, fan-shaped beam under the hull of a survey ship and perpendicular to the direction of motion. Side-scan sonars use two transducers to project high-frequency beams that are usually wide in the vertical plane (50°–70°) and very narrow in the horizontal plane (less than a few degrees). Other, similar impulsive or non-impulsive sources may be used in conducting shallow penetration or HRG surveys.

Acoustic Habitat

NMFS also included a detailed discussion and analysis of potential impacts to acoustic habitat. Acoustic habitat is the soundscape—which encompasses all of the sound present in a particular location and time, as a whole—when considered from the perspective of the animals experiencing it. Animals listen for sounds produced by conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.,* produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

That discussion summarized a report titled ''*Cumulative and Chronic Effects in the Gulf of Mexico: Estimating Reduction of Listening Area and Communication Space due to Seismic Activities*,'' (''Cumulative and Chronic Effects report'') as well as a subsequent addendum to the report presenting additional analysis relating to sperm whales. The initial report (originally presented as Appendix K in BOEM (2017)) as well as the addendum ((hereafter, ''the CCE report''), are available online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.* The CCE report presented a first-order cumulative and chronic effects assessment for noise produced by oil and gas exploration activities in the U.S. GOM.

The term ''listening area'' refers to the region of ocean over which sources of sound can be detected by an animal at the center of the space. Loss of communication space concerns the area over which a specific animal signal, used to communicate with conspecifics in biologically-important contexts (*e.g.,* foraging, mating), can be heard, in noisier relative to quieter conditions (Clark *et al.,* 2009). Lost listening area concerns the more generalized contraction of the range over which animals would be able to detect a variety of signals of biological importance, including eavesdropping on predators and prey (Barber *et al.,* 2009). Implications for acoustic masking (*i.e.,* when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold; see notice of proposed rulemaking at 29239 for explanation of masking) and reduced communication space resulting from noise produced by airgun surveys in the GOM are expected to be particularly heightened for animals that actively produce low-frequency sounds or whose hearing is attuned to lower frequencies (*i.e.,* Bryde's whales).

Acoustic modeling was conducted for ten locations (''receiver sites'') within the study area to examine aggregate noise produced over a full, generic year. The locations of the receiver sites were chosen to reflect areas of biological importance to cetaceans, areas of high densities of cetaceans, and areas of key biological diversity. The CCE report analyzed multiple scenarios, including a baseline scenario in which no geophysical surveys are conducted and noise consists of natural sounds and a minimum estimate of commercial vessel noise; a survey activity scenario in which projected activities were uniformly distributed throughout the study area, with the exception of coastal waters from February to May; and a closure scenario in which no activities are conducted in certain restriction areas, 25 percent of the activity that would have occurred in the restriction areas is redistributed into non-restriction areas of the same activity zone, and 75 percent of the activities that would have occurred in the restriction areas are not conducted at all. For additional methodological details, see discussion in the notice of proposed rulemaking or the CCE report.

Regarding sperm whales, the analysis shows that the survey activities do not significantly contribute to the soundscape in the frequency band relevant for their lower-frequency slow-clicks, and that there will be no significant change in communication space for sperm whales. Because other sperm whale calls are higher-frequency, they would not be expected to be affected. Please see the CCE report for further discussion of the findings for sperm whales. The remaining discussion that follows is in reference to the findings for Bryde's whales and to general findings for other hearing groups.

The methods used in the CCE report were meant to average the conditions generated by low-frequency dominant noise sources throughout a full year, during which animals of key management interest rely on habitats within the study area. Considered as a complement to assessments of the acute effects of the same types of noise sources in the same region (discussed below in the *Estimated Take* section), the CCE assessment estimates noise produced by the same sources over much larger spatial scales, and considers how the summation of noise from these sources relates to levels without the proposed activity (ambient). The lost listening area method calculates a fractional reduction in listening area due to the addition of anthropogenic noise to ambient noise. Results are presented as a percentage of the original listening area remaining due to the increase in noise levels relative to no activity and between activity scenarios. The communication space assessment provides relative losses of communication space (in both areas and percentages) between the activity scenarios.

At most sites, lost listening area was greater for deeper waters than for shallower waters, which is attributed to the downward-refracting sound speed profile near the surface, caused by the thermocline, which steers sound to deeper depths. Shallow water noise levels were reduced due to surface interactions that increase transmission loss, particularly for low frequencies. Listening area reductions were also generally most severe when weighted for low-frequency hearing cetaceans. Both low- and mid-frequency weighted losses were high in the Mississippi Canyon, while only low-frequency weighted values were high for the De Soto Canyon. Both of these sites are considered important to sperm whales as well as other deep-diving odontocetes. These modeling results suggest that accumulations of noise from survey activities below 5 kHz and often heightened at depth could be degrading the ability of animals that forage at great depths in the GOM to use acoustic cues to find prey as well as to maintain conspecific contact.

Comparison between results provided for the two metrics applied in the CCE report highlights important interpretive differences for evaluating the biological implications of background noise. The strength of the communication space approach is that it evaluates potential contractions in the availability of a signal of documented importance to a population of animals of key management interest in the region. In this case, losses of communication space for Bryde's whales were estimated to be higher in eastern and central GOM canyons and shelf break areas. In contrast, relative maintenance of listening area and communication space was seen within the Bryde's whale core habitat area in the eastern GOM (an area that has since been removed from consideration through this rule). In areas where larger amounts of survey activity were projected, significant loss of low-frequency listening area and communication space for Bryde's whale calls was estimated, though we emphasize that these are not areas where Bryde's whales are expected to occur.

The CCE report is described here in order to summarize information presented in the proposed rule regarding potential longer-term and wider-range noise effects from sources such as airguns. Please see the notice of proposed rulemaking, as well as the CCE report and addendum, for additional information.

Estimated Take

This section provides an estimate of the number and type of incidental takes that may be expected to occur under the specified activity (as it has been revised in scope), which informed NMFS' negligible impact determination. Realized incidental takes would be determined by the actual levels of activity at specific times and places that occur under any issued LOAs.

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). Harassment is the only type of take expected to result from these activities.

Anticipated takes would primarily be by Level B harassment, as use of the described acoustic sources, particularly airgun arrays, is likely to disrupt behavioral patterns of 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. NMFS does not expect auditory injury to occur for mid-frequency species, as discussed in greater detail on the notice of proposed rulemaking (83 FR 29212; June 22, 2018) and in responses to public comments. 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 will be authorized. Below we summarize how the take that may be authorized was estimated using acoustic thresholds, sound field modeling, and marine mammal density data. Detailed discussion of all facets of the take estimation process was provided in the notice of proposed rulemaking (83 FR 29212; June 22, 2018), and nothing has changed since that time. Therefore, that full discussion is not repeated. Please see that notice, and associated companion documents available online, for additional detail.

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 (Level B harassment) or to incur permanent threshold shift (PTS) of some degree (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). Typically, and especially in cases where PTS is predicted, NMFS anticipates that some number of individuals may incur temporary threshold shift (TTS) (considered Level B harassment). However, it is not necessary to separately quantify those takes, as it is unlikely that an individual marine mammal would be exposed at the levels and duration necessary to incur TTS without also being exposed to the levels associated with behavioral harassment and, therefore, NMFS expects any potential TTS takes to be captured by the estimated takes by behavioral harassment.

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 and electromechanical sources used for HRG surveys are intermittent sources. Therefore, the 160 dB rms threshold has typically been used in evaluating effects from the sources planned for use in the specified activities. However, in the notice of proposed rulemaking, NMFS identified a more complex probabilistic risk function for use in evaluating the potential effects of the specified activity considered herein. That function, described in Wood *et al.* (2012), is better reflective of available scientific information (as discussed in detail in the notice of proposed rulemaking, as well as in comment responses provided earlier in this preamble). Such an approach takes the fundamental step of acknowledging the potential for Level B harassment at exposures to received levels below 160 dB rms (as well as the potential that animals exposed to received levels above 160 dB rms will not respond in ways constituting Level B harassment). The approach described by Wood *et al.* (2012) also accounts for differential hearing sensitivity by incorporating frequency-weighting functions. The analysis of Gomez *et al.* (2016) indicates that behavioral responses in cetaceans are best explained by the interaction between sound source type and functional hearing group. Southall *et al.* (2007) proposed auditory weighting functions for species groups based on known and assumed hearing ranges (Type I). Although newer filters are better designed to predict the onset of auditory injury (as discussed below and used for evaluation of potential Level A harassment), the broader Type I filters were retained for use in evaluating potential behavioral disturbance in conjunction with the Wood *et al.* (2012) probabilistic response function.

NMFS received public comments on this topic, including some criticizing the proposed use of the Wood *et al.* (2012) risk function. We responded to all comments received on this topic and, in addition to the more detailed discussion provided in the Estimated Take section of the notice of proposed rulemaking, we provide detailed discussion of these concerns in the responses to comments, provided earlier in this preamble. NMFS retains use of the Wood *et al.* (2012) approach as the basis for estimating take and considering the effects of the specified activity on marine mammal behavior. The Level B harassment criteria upon which the analysis presented herein is based are presented in Table 6.

TABLE 6—BEHAVIORAL EXPOSURE CRITERIA

Group	Probability of response to frequency-weighted rms SPL			
	120 (%)	140 (%)	160 (%)	180 (%)
Beaked whales	50	90	n/a	n/a
All other species	n/a	10	50	90

Level A Harassment—NMFS' *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (NMFS, 2018) (2018 Revised Technical Guidance) 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 2018 Revised 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 that indicates 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, 2019a; 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).

The 2018 Revised Technical Guidance 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 7 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 7—EXPOSURE CRITERIA FOR AUDITORY INJURY

Hearing group	Peak pressure [1] (dB)	Cumulative sound exposure level [2]	
		Impulsive (dB)	Non-impulsive (dB)
Low-frequency cetaceans	219	183	199
Mid-frequency cetaceans	230	185	198
High-frequency cetaceans	202	155	173

[1] Referenced to 1 μPa; unweighted within generalized hearing range.
[2] Referenced to 1 μPa^2-s; weighted according to appropriate auditory weighting function. Airguns and the boomer are treated as impulsive sources; other HRG sources are treated as non-impulsive.

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.

Modeling Overview

Zeddies *et al.* (2015, 2017a) (*i.e.,* ''the modeling report'') provides estimates of the annual marine mammal acoustic exposure caused by sounds from geophysical survey activity in the GOM for ten years of notional activity levels. Here we provide a brief overview of key modeling elements, with more detail provided in the notice of proposed rulemaking (83 FR 29212; June 22, 2018). For full details of the modeling effort, the interested reader should see the report (available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico*).

Initial phases of the modeling effort involved preliminary modeling of a typical 3D WAZ survey, which was simulated at two locations in order to establish the basic methodological approach and to provide results used to evaluate test scenarios that could influence exposure estimates. We discussed each of the six evaluated test scenarios in the notice of proposed rulemaking. Please see that discussion and the modeling report for full details.

The modeling effort produced exposure estimates computed from modeled sound levels as received by simulated animals (animats) in a specific modeling area. The GOM was divided into seven modeling zones with six survey types simulated within each zone to estimate the potential effects of each survey. The zones were designed as described previously (Description of the Specified Activity; Figure 3)—shelf and slope waters were divided into eastern, central, and western zones, plus a single deep-water zone—to account for both the geospatial dependence of acoustic fields and the geographic variations of animal distributions. The selected boundaries considered sound propagation conditions and species distribution to create regions of optimized uniformity in both acoustic environment and animal density. Survey types included deep penetration surveys using a large airgun array (2D, 3D NAZ, 3D WAZ, and coil survey types), shallow penetration surveys using a single airgun (which were assumed to be a reasonable proxy for surveys conducted using a boomer), and high resolution surveys concurrently using a CHIRP sub-bottom profiler, side-scan sonar, and multibeam echosounder. The results from each zone were summed to provide GOM-wide estimates of take for each marine mammal species for each survey type for each notional year. To get these annual aggregate exposure estimates, 24-hr average exposure estimates from each survey type were multiplied by the number of expected survey days from BOEM's effort projections. Because these projections are not season-specific, surveys were assumed to be equally likely to occur at any time of the year and at any location within a given zone.

Acoustic source emission levels and directivity of a single airgun and an airgun array were modeled using JASCO Applied Sciences' Airgun Array Source Model (AASM). AASM is capable of predicting airgun source levels at frequencies up to 25 kHz, and produces a set of notional signatures for each array element based on array layout; volume, tow depth, and firing pressure for each element; and interactions between different elements in the array. The signatures are summed to obtain the far-field source signature of the entire array in the horizontal plane, which is then filtered into one third-octave frequency bands to compute the source levels of the array as a function of frequency band and azimuthal angle in the horizontal plane (at the source depth), after which it is considered to be an azimuth-dependent directional point source in the far field. Source levels for high-resolution sources were obtained from manufacturer's specifications for representative sources. Electromechanical sources were modeled on the basis of transducer beam theory, which is often used to estimate beam pattern of the source in the absence of field measurements, and which is described in detail in the modeling report.

Underwater sound propagation (*i.e.,* transmission loss) as a function of range from each source was modeled using JASCO's Marine Operations Noise Model (MONM) for multiple propagation radials centered at the source to yield 3D transmission loss fields in the surrounding area. The MONM computes received per-pulse SEL for directional sources at specified depths. MONM uses two separate models to estimate transmission loss. At frequencies less than 2 kHz, MONM computes acoustic propagation via a wide-angle parabolic equation (PE) solution to the acoustic wave equation (Collins, 1993), based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM) modified to account for an elastic seabed (Zhang and Tindle, 1995). MONM–RAM incorporates bathymetry, underwater sound speed as a function of depth, and a geoacoustic profile based on seafloor composition, and accounts for source horizontal directivity. At frequencies greater than 2 kHz, MONM accounts for increased sound attenuation due to volume absorption at higher frequencies (Fisher and Simmons, 1977) with the widely-used BELLHOP Gaussian beam ray-trace propagation model (Porter and Liu, 1994). This component incorporates bathymetry and underwater sound speed as a function of depth with a simplified representation of the sea bottom, as sub-bottom layers have a negligible influence on the propagation of acoustic waves with frequencies above 1 kHz. MONM–BELLHOP accounts for horizontal directivity of the source and vertical variation of the source beam pattern. Both propagation models account for full exposure from a direct acoustic wave, as well as exposure from acoustic wave reflections and refractions (*i.e.,* multi-path arrivals at the receiver).

In order to accurately estimate exposure, a simulation must adequately cover the various location- and season-specific environments. The surveys may be conducted at any location within the planning area and occur at any time of the year, so simulations must adequately cover each area and time period. The seven zones within which potential exposures were modeled, corresponding with shelf and slope environments subdivided into western, central, and eastern areas, as well as a single deep zone, were previously introduced (Figure 3). The subdivision depth definitions are: Shelf, 0–200 m; slope, 200–2,000 m; and deep, greater than 2,000 m. Within each of the seven zones, a set of representative survey-simulation rectangles for each of the survey types was defined, with larger areas for the ''large-area'' surveys (*i.e.,* deep penetration airgun) and smaller areas for the ''small-area'' surveys (*i.e.,* shallow penetration airgun and HRG). In Figure 3, the smaller numbered boxes represent the survey area extents for the different survey types. The stars represent acoustic modeling sites along western, central, and eastern transects (Figure 3).

A set of 30 sites was selected to calculate acoustic propagation loss grids as functions of source, range from the source, azimuth from the source, and receiver depth. These were then used as inputs to the acoustic exposure model. The environmental parameters and acoustic propagation conditions represented by these 30 modeling sites were chosen to be representative of the prevalent acoustic propagation conditions within the survey extents. To account for seasonal variation in propagation, winter (most conservative) and summer (least conservative) were both used to calculate exposure estimates. Propagation during spring and fall was found to be almost identical to the results for summer, so those seasons were represented with the summer results. The primary seasonal influence on transmission loss is the presence of a sound channel, or duct, near the surface in winter.

Marine Mammal Density Information

The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). Roberts *et al.* (2016) provided several key improvements over information previously available for the GOM, by incorporating NMFS aerial and shipboard survey data collected over the period 1992–2009; 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 (as is the case for NMFS' SAR abundance estimates for the GOM). 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, beaked whales, or *Kogia* spp. 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. More information concerning the Roberts *et al.* (2016) models, including the model results and supplementary information for each model, is available online at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/.*

Description of Exposure Estimates

The sound received by an animal when near a sound source is a function of the animal's position relative to the source, and both source and animals may be moving. To a reasonable approximation, we know, predict, or specify the location of the sound source, a 3D sound field around the source, and the expected occurrence of animals within 100 km² grid cells (Roberts *et al.,* 2016). However, because the specific location of animals within the modeled sound field is unknown, agent-based animal movement modeling is necessary to complete the assessment of potential acoustic exposure. Realistic animal movement within the sound field can be simulated, and repeated random sampling (Monte Carlo)—achieved by simulating many animals within the operations area—used to estimate the sound exposure history of animals during the operation. Animats are randomly placed, or seeded, within the simulation boundary at a specified density, and the probability of an event's occurrence is determined by the frequency with which it occurs in the simulation. Higher densities provide a finer resolution for an estimate of the probability distribution function (PDF), but require greater computational resources. To ensure good representation of the PDF, the animat density is set as high as is practical, with the resulting PDF then scaled using the real-world animal density (Roberts *et al.,* 2016) to obtain the real-world number of modeled acoustic exposures.

Several models for marine mammal movement have been developed (*e.g.,* Frankel *et al.,* 2002, Gisiner *et al.,* 2006; Donovan *et al.,* 2013). Animats transition from one state to another, with user-specified parameters representing simple states, such as the speed or heading of the animal, or complex states, such as likelihood of an animal foraging, playing, resting, or traveling. This analysis uses the Marine Mammal Movement and Behavior (3MB) model (Houser, 2006). Parameter values to control animat movement are typically determined using available species-specific behavioral studies, but the amount and quality of available data varies by species. While available data often provides a detailed description of the proximate behavior expected for real individual animals, species with more available information must be used as surrogates for those without sufficient available information. In this study, pantropical spotted dolphins are used as a surrogate for Clymene, spinner, and striped dolphins; short-finned pilot whales are surrogates for Fraser's dolphins, *Kogia* spp., and melon-headed whales; and rough-toothed dolphins are surrogates for false killer whales and pygmy killer whales. Observational data for all remaining species in the study were sufficient to determine animat movement.

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 was seeded with approximately 0.1 animats/km^2 which, in most cases, represents a higher density of animats in the simulation than occurs in the real environment. A separate simulation was created and run for each combination of location, survey movement pattern, and marine mammal species. Animats were only allowed to be 'taken' once during a 24-hour evaluation period. That is, an animat whose received level exceeds the peak SPL threshold more than once during an evaluation period was only counted once. Energy accumulation for SEL occurred throughout the 24-hour integration period and was reset at the beginning of each period. Similarly, the maximum received rms SPL was determined for the entirety of the evaluation period and reset at the beginning of each period.

The JASCO Exposure Modeling System (JEMS) combined animal movement data (*i.e.,* the output from 3MB), with pre-computed acoustic fields. The JEMS output was the time-history of received levels and slant ranges (the three-dimensional distance between the animat and the source) for all animats of the 3MB simulation. Animat received levels and slant ranges are used to determine the risk of acoustic exposure. There were many animats in the simulations and together their received levels represent the probability, or risk, of exposure for each survey.

All survey simulations were for 7 days and a sliding 4-hr window approach was used to get the average 24-hr exposure. In this sliding-window approach, 42 exposure estimate samples are obtained for each seven-day simulation, with the mean value then used as the 24-hr exposure estimate for that survey. The 24-hr exposure levels were then scaled by the projected level of effort for each survey type (*i.e.,* multiplied by the number of days) to calculate associated annual exposure levels. The number of individual animals expected to exceed threshold during the 24-hr window is the number of animats exposed to levels exceeding threshold multiplied by the ratio of real-world animal density to model animat density.

Injury—To evaluate the likelihood an animal might experience auditory injury as a result of accumulated sound energy, the cSEL for each animat in the simulation was calculated. To obtain that animat's cSEL, the SEL an animat received from each source over the 24-hr integration window was summed, and the number of animats whose cSEL exceeded the specified thresholds (Table 7) during the integration window was counted. To evaluate the likelihood an animal might be injured via exposure to peak SPL, the range at which the specific peak SPL threshold (Table 7) occurs for each source based on the broadband peak SPL source level was estimated. For each 24-hr integration window, the number of animats that came within this range of the source was counted.

Behavior—To evaluate the likelihood an animal might experience disruption of behavioral patterns (*i.e.,* a ''take''), the number of animats that received a maximum rms SPL exposure within the specified step ranges (Table 6) was calculated. The number of animats with a maximum rms SPL received level categorized into each bin of the step function was multiplied by the probability of the behavioral response specific to that range (Table 6). Specifically, 10 percent of animals exposed to received levels from 140–159 dB rms would be assumed as ''takes,'' while 50 percent exposed to levels between 160–179 dB rms and 90 percent exposed to levels of 180 dB rms and above would be. The totals within each bin were then summed as the total estimated number of exposures above Level B harassment thresholds. This process was repeated for each 24-hr integration window. For beaked whales, for which lower behavioral harassment thresholds are designated, 50 percent of animals exposed to received levels from 120–149 dB rms would be assumed as ''takes,'' while 90 percent exposed to levels of 140 dB rms and above would be.

Take Estimates

In summary, BOEM provided estimated levels of effort for geophysical survey activity in the GOM for a notional ten-year period. Exposure estimates were then computed from modeled sound levels received by animals for several representative types of geophysical surveying. Because animals and acoustic sources move relative to the environment and each other, and the sound fields generated by the sources are shaped by various physical parameters, the sound levels received by an animal are a complex function of location and time. The basic modeling approach was to use acoustic models to compute the 3D sound fields and their variations in time. Animats were modeled moving through these fields to sample the sound levels in a manner similar to how real animals would experience these sounds. From the time histories of the received sound levels of all animats, the numbers of animals exposed to levels exceeding effects threshold criteria were determined and then adjusted by the number of animals expected in the area, based on density information, to estimate the potential number of real-world marine mammal exposures to levels above the defined criteria. The acoustic exposure history of many simulated animals (animats) allows for the estimation of potential exposures due to operations. These modeled exposures are summed and represent the aggregate exposures that may result from future surveys given the specified levels of effort for each survey type in each year and may vary according to the statistical distribution associated with these mean annual exposures.

Exposure estimates above Level A and Level B harassment criteria, developed by Zeddies *et al.* (2015, 2017a) in association with the activity projections for the various annual effort scenarios, were generated based on the specific modeling scenarios (including source and survey geometry), *i.e.,* 2D survey (1 × 8,000 in^3 array), 3D NAZ survey (2 × 8,000 in^3 array), 3D WAZ survey (4 × 8,000 in^3 array), coil survey (4 × 8,000 in^3 array), shallow penetration survey (either single 90 in^3 airgun or boomer), and HRG surveys (side-scan sonar, multibeam echosounder, and sub-bottom profiler). Annual effort scenario-based pooled exposure estimates are therefore available by species.

NMFS presented BOEM's original 10-year activity projections in Table 1 of the notice of proposed rulemaking under ''Detailed Description of Activities.'' For purposes of analysis in the notice of proposed rulemaking, NMFS identified representative ''high,'' ''moderate,'' and ''low'' effort years. Because the duration of these regulations are limited to five years, NMFS needed to determine a reasonable basis for evaluating acoustic exposures that might occur during that timeframe (rather than ten years). Therefore, for the proposed rule, in recognition of relatively low recent levels of geophysical survey activity, from the ten notional years of projected survey effort provided by BOEM, NMFS selected five representative years representing three different potential levels of survey effort as the basis for the assessment. These included one ''high-activity'' year, two separate ''moderate-activity'' years, and two separate ''low-activity'' years. Because the first 5 years of BOEM's original effort projections were relatively high-effort years, NMFS' level-of-effort selections for the proposed rule corresponded with the detailed per-survey type effort projections given for Years 1, 4, 5, 8, and 9, respectively. Exposure estimates resulting from the process summarized here and corresponding with those activity scenarios were shown in Table 8 of the notice of proposed rulemaking. These exposure estimates were then further evaluated to provide an estimate of takes of marine mammals that could occur as a result of a reasonably expected level of geophysical survey activity in the GOM over the course of five years. Take estimates associated with those scenarios, which informed the analysis in the proposed rule, are shown in Table 8 of this document for reference. These values have been updated from those shown in Table 8 of the notice of proposed rulemaking by correctly incorporating discounted estimates of Level A harassment into the estimates of Level B harassment (as pointed out by public commenters).

Level A Harassment

As we explain here, the modeled exposure estimates for onset of permanent threshold shift (*i.e.,* Level A harassment), are not expected to represent realistic results for any species. Overall, there is a low likelihood of take by Level A harassment for any species, though the degree of this low 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 while, for low-frequency cetaceans, potential auditory injury would occur on the basis of the accumulation of energy output over time by an airgun array. Importantly, the modeled exposure estimates do not account for either aversion or the beneficial impacts of the required mitigation measures.

Of even greater import for mid-frequency cetaceans is that 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 leads to a logical conclusion that Level A harassment is so unlikely for species in this hearing group as to be discountable. As stated in the notice of proposed rulemaking, for all mid-frequency cetaceans, following evaluation of the available scientific literature regarding the auditory sensitivity of mid-frequency cetaceans and the properties of airgun array sound fields, NMFS does not expect any reasonable potential for Level A harassment to occur. We discussed this issue in detail earlier in the response to public comments. NMFS expects the potential for Level A harassment of mid-frequency cetaceans to be discountable, even before the likely moderating effects of aversion are considered. When considering potential for aversion, NMFS does not believe that Level A harassment is a likely outcome for any mid-frequency cetacean (as reflected in Table 9).

As discussed in greater detail in the notice of proposed rulemaking, NMFS and BOEM considered the possibility of incorporating quantitative adjustments within the modeling process to account for the effects of mitigation and/or aversion, as both of these factors would lead to a reduction in likely injurious exposure. However, these factors were ultimately not quantified in the modeling because, in summary, there is too much inherent uncertainty regarding the effectiveness of detection-based mitigation to support any reasonable quantification of its effect in reducing injurious exposure and there is too little information regarding the likely level of onset and degree of aversion to quantify this behavior in the modeling process. This does not mean that mitigation is not effective (to some degree) in avoiding incidents of Level A harassment, nor does it mean that aversion is not a meaningful real-world effect of noise exposure that should be expected to reduce the number of incidents of Level A harassment. However, certain public commenters misconstrued statements in the notice of proposed rulemaking regarding the strictly modeling-related investigations of aversion (*i.e.,* that there is not sufficient quantitative data to inform decisions regarding the programming of animats as far as received levels of noise that provoke aversive response, and the degree of response, for relevant species) as meaning that there is not sufficient information to support that aversion happens at all. To the contrary, there is ample evidence in the literature that aversion is one of the most common responses to noise exposure across varied species, though the onset and degree may be expected to vary across individuals and in different contexts. Therefore, NMFS proposed to incorporate a reasonable adjustment to modeled Level A harassment exposure estimates to account for aversion for low- and high-frequency species. That adjustment is retained here, as discussed in greater detail in the responses to public comments. Specifically, NMFS assumes here that an eighty percent reduction in modeled exposure estimates for Level A harassment for low- and high-frequency cetaceans is reasonable and likely conservative in terms of the overall numbers of actual incidents of Level A harassment for these species, as the adjustment does not explicitly account for the effects of mitigation.

As discussed previously, BOEM provided an update to the scope of their proposed action through removal of the area subject to leasing moratorium under GOMESA from consideration in the rule. In support of this revision, BOEM provided revised 5-year level of effort predictions and associated acoustic exposure estimates. BOEM's process for developing this information, described in detail in ''Revised Modeled Exposure Estimates,'' available online, was straightforward. Rather than using the PEIS's 10-year period, BOEM provided revised levels of effort for a 5-year period, using Years 1–5 of the original level of effort projections. BOEM stated that the first five years were selected to be carried forward ''because they were contiguous, they included the three years with the most activity, and they were the best understood in relation to the historical data upon which they are based.'' NMFS concurs with this choice. Levels of effort were revised based on the basic assumption that if portions of areas are removed from consideration, then the corresponding effort previously presumed to occur in those areas also is removed from consideration. The revised levels of effort are shown in Table 2. Associated revised take estimates, which were generated utilizing the methods described above and in the proposed rule and inform the analysis in this final rule, are shown in Table 9. These estimates have been modified from the values provided by BOEM (available online; ''Revised Modeled Exposure Estimates'') in that we have correctly accounted for the type of taking expected, *i.e.,* for mid-frequency cetaceans, Level A harassment is not expected to occur and the calculated takes have been shifted into the totals for Level B harassment. No incidents of Level A harassment for Bryde's whales were predicted under the revised effort scenarios, which exclude the area where most Bryde's whales would be expected to be found. For *Kogia* spp., estimates of Level A harassment were adjusted as discussed previously to account for likely aversion, and the portion of estimated Level A harassment events not expected to occur were shifted into the totals for Level B harassment for these species.

Estimated instances of take, *i.e.,* scenario-specific acoustic exposure estimates incorporating the adjustments to Level A harassment exposure estimates discussed here, are shown in Table 9. This information regarding total number of takes (with Level A harassment takes based on assumptions relating to mid-frequency cetaceans in general as well as aversion), on an annual basis for five years, provides the bounds within which incidental take authorizations may be issued in association with this regulatory framework.

Typically, and especially in cases where PTS is predicted, NMFS anticipates that some number of individuals may incur TTS. However, it is not necessary to separately quantify those takes, as it is unlikely that an individual marine mammal would be exposed at the levels and duration necessary to incur TTS without also being exposed to the levels associated with behavioral disruption and, therefore, NMFS expects any potential TTS takes to be captured by the estimated takes by behavioral disruption (discussed below).

TABLE 8—SCENARIO-SPECIFIC INSTANCES OF TAKE (BY LEVEL A AND LEVEL B HARASSMENT) AND MEAN ANNUAL TAKE LEVELS EVALUATED IN THE PROPOSED RULE [1]

Species	Survey effort scenario [2]											
	High		Moderate #1		Moderate #2		Low #1		Low #2		Mean annual take	
	A	B	A	B	A	B	A	B	A	B	A	B
Bryde's whale	3	572	2	422	2	510	2	395	2	411	2	462
Sperm whale	0	43,549	0	27,300	0	33,378	0	26,681	0	27,689	0	31,719
Kogia spp.	728	19,101	475	13,328	636	16,188	472	12,629	562	13,414	575	14,932
Beaked whale	0	235,667	0	162,172	0	190,824	0	151,745	0	156,622	0	179,406
Rough-toothed dolphin	0	37,816	0	30,306	0	31,231	0	28,775	0	26,420	0	30,910
Bottlenose dolphin	0	655,345	0	979,905	0	598,607	0	941,001	0	581,121	0	751,196
Clymene dolphin	0	111,211	0	73,225	0	87,995	0	69,913	0	73,051	0	83,079
Atlantic spotted dolphin	0	133,758	0	175,128	0	116,988	0	165,221	0	110,126	0	140,244
Pantropical spotted dolphin	0	609,653	0	421,786	0	513,572	0	401,568	0	421,856	0	473,687
Spinner dolphin	0	83,041	0	59,818	0	73,259	0	56,735	0	59,448	0	66,460
Striped dolphin	0	44,232	0	30,069	0	36,431	0	28,652	0	30,023	0	33,881
Fraser's dolphin	0	13,910	0	9,690	0	11,438	0	9,162	0	9,426	0	10,725
Risso's dolphin	0	27,165	0	18,197	0	22,005	0	17,380	0	18,166	0	20,583
Melon-headed whale	0	69,152	0	47,719	0	57,004	0	45,011	0	46,801	0	53,137
Pygmy killer whale	0	18,112	0	12,335	0	14,859	0	11,733	0	12,198	0	13,847
False killer whale	0	25,622	0	17,708	0	20,922	0	16,849	0	17,239	0	19,668
Killer whale	0	1,498	0	1,034	0	1,262	0	987	0	1,039	0	1,164
Short-finned pilot whale	0	19,326	0	12,198	0	14,214	0	11,565	0	11,942	0	13,849

[1] A and B refer to expected scenario-based instances of take by Level A and Level B harassment, respectively. For the Bryde's whale and *Kogia* spp., expected takes by Level A harassment represent modeled exposures adjusted to account for aversion. For *Kogia* spp., exposures above Level A harassment criteria were predicted by the peak SPL metric. For the Bryde's whale, exposures above Level A harassment criteria were predicted by the cSEL metric.

[2] High survey effort scenario corresponds with level of effort projections given previously for Year 1 (see Table 1 of the notice of proposed rulemaking). Moderate #1 and #2 and Low #1 and #2 correspond with Years 4, 5, 8, and 9, respectively.

TABLE 9—REVISED INSTANCES OF TAKE (BY LEVEL A AND LEVEL B HARASSMENT) (YEARS 1–5) AND MEAN ANNUAL TAKE LEVELS [1]

Species	Year 1		Year 2		Year 3		Year 4		Year 5		Mean annual take	
	A	B	A	B	A	B	A	B	A	B	A	B
Bryde's whale	0	10	0	8	0	8	0	6	0	7	0	8
Sperm whale	0	16,405	0	14,205	0	13,603	0	9,496	0	12,388	0	13,219
Kogia spp.	371	10,383	337	9,313	310	8,542	209	6,238	314	8,318	308	8,559
Beaked whale	0	191,566	0	162,301	0	158,328	0	111,415	0	142,929	0	153,308
Rough-toothed dolphin	0	30,640	0	27,024	0	25,880	0	19,620	0	23,219	0	25,277
Bottlenose dolphin	0	603,649	0	973,371	0	567,962	0	1,001,256	0	567,446	0	742,737
Clymene dolphin	0	85,828	0	67,915	0	73,522	0	47,332	0	60,379	0	66,995
Atlantic spotted dolphin	0	128,299	0	183,717	0	112,120	0	191,495	0	111,305	0	145,387
Pantropical spotted dolphin	0	478,490	0	436,047	0	391,363	0	311,316	0	395,987	0	402,641
Spinner dolphin	0	75,953	0	71,873	0	61,098	0	48,775	0	64,357	0	64,411
Striped dolphin	0	33,573	0	29,275	0	27,837	0	20,136	0	26,056	0	27,375
Fraser's dolphin	0	4,522	0	3,843	0	3,792	0	2,726	0	3,455	0	3,668
Risso's dolphin	0	21,859	0	18,767	0	18,218	0	12,738	0	16,634	0	17,643
Melon-headed whale	0	55,813	0	47,784	0	46,584	0	32,581	0	42,224	0	44,997
Pygmy killer whale	0	8,079	0	6,964	0	6,764	0	4,970	0	6,277	0	6,611
False killer whale	0	16,165	0	13,710	0	13,604	0	9,664	0	12,269	0	13,082
Killer whale	0	60	0	56	0	50	0	42	0	52	0	52
Short-finned pilot whale	0	15,045	0	9,824	0	13,645	0	7,459	0	8,959	0	10,986

[1] A and B refer to expected instances of take by Level A and Level B harassment, respectively, for Years 1–5. For *Kogia* spp., expected takes by Level A harassment represent modeled exposures adjusted to account for aversion. For the Bryde's whale, no takes by Level A harassment are predicted to occur. Therefore, no adjustment to modeled exposures to account for aversion was necessary. For *Kogia* spp., exposures above Level A harassment criteria were predicted by the peak SPL metric. For the Bryde's whale, the cSEL metric is used to evaluate the potential for Level A harassment.

Level B Harassment

NMFS has determined the estimated values shown in Table 9 are a reasonable representation of the potential instances of take that may occur (more specifically, each of these ''takes'' representing a day in which one individual is exposed above the Level B harassment criteria, even if only for seconds). However, these take numbers do not represent the number of individuals expected to be taken, given they are higher than the estimated abundance for all species. Accordingly, as described in the notice of proposed rulemaking, NMFS references Test Scenario 1 in the modeling report (''*Long-Duration Surveys and Scaling Methods*'') to inform two important parts of the analyses. Comparing the results of modeling simulations that more closely match longer survey durations (30 days) to the results of 24-hour take estimates scaled up to 30 days (as the instances of take in Table 9 were calculated) provides the comparative ratios of number of individuals taken/calculated (within a 30-day survey) and instances of take, in order to better understand the comparative distribution of exposures across individuals of different species. First, in NMFS' analyses in this rule, the ratio and its inverse are used to inform a better understanding of the nature in which individuals are taken across the multiple days of a longer duration survey given the different behaviors that are represented in the animat modeling, *i.e.,* looking at the ratio of (number of individuals taken in 30-day modeling scenario)/(number of instances of take when 1-day average multiplied by 30 days), if all else is equal within one survey, for the species with a smaller ratio (larger inverse), fewer individuals will be taken but each will be exposed above the threshold on a higher number of days (see Table 16). Second, this ratio may be appropriately be used in combination with the calculated instances of take to predict the number of individuals taken for surveys of similar duration (noting that for surveys of notably longer than 30-day duration, it will still likely result in some degree of overestimate of individuals), in order to support evaluation of take estimates in requests for Letters of Authorization, given the need to meet the ''small numbers of marine mammals'' standard, which is based on the number of individuals taken. A summary of this, which was included in the notice of proposed rulemaking along with a description of the other Test Scenarios and how they inform this analysis, is included below.

Although some survey operations may continue for months, survey simulations were conducted for seven days in order to derive mean 24-hr exposure averages, with these averages then used to scale according to the total number of survey days projected by BOEM. This approach was necessary due to the more computationally-intensive modeling required to model more realistic durations (*i.e.,* 30 days). As summarized above and discussed in detail in the notice of proposed rulemaking, a test scenario was used to evaluate methods for scaling results from shorter-duration simulations to longer duration operations. Results from test modeling conducted for a suite of six representative species over 30-day simulations of a hypothetical 3D WAZ survey were compared to the results of a shorter 5-day simulation, *i.e.,* the number of animats exposed to levels exceeding threshold for 24-hr time periods multiplied by the number of days in the simulations was compared to the number of animats exposed to levels exceeding threshold for the entire duration of the simulations. The results of the test scenario indicated that undesired systematic biases in the modeling procedure, if present, were small relative to the survey design and would not affect scaling up the results in time (*i.e.,* the shorter 7-day simulations ultimately used in the modeling would provide unbiased results). However, the results also indicated that scaling up the 24-hr average SPL exposure estimates to 30 days greatly overestimates the number of notional marine mammals (*i.e.,* animats) exposed to levels exceeding threshold when determined over the entire simulation (although the estimated instances of exposure are reasonably accurate). This occurs because animats were commonly exposed to levels exceeding these thresholds, and the relatively short reset period of 24 hours means that individual animats were, in effect, counted several times during the scale-up (*i.e.,* on multiple days) whereas they would only have been counted once when evaluating over the entire simulation. When a real-world survey extends over longer durations within the same region, it is most likely that the same individuals are repeatedly exposed to survey noise. However, the modeling assumption that populations of animals were reset for each 24-hr period is equivalent to an assumption that each survey day is a completely independent event, *i.e.,* that new individuals are impacted on each subsequent day.

In order to determine more realistic exposure probabilities for individuals across multiple days, modeled results were compared for a 30-day period versus the aggregation of 24-hr population reset intervals (the investigation described above) to determine a species-typical offset of modeled daily exposures. When conducting computationally-intensive modeling over the full assumed 30-day survey period (versus aggregating the smaller 24-hr periods for 30 days), results showed about 10–45 percent of the total number of takes calculated using a 24-hr reset of the population, with differences relating to species-typical movement and residency patterns. Given that many of the evaluated survey activities occur for 30-day or longer periods, particularly some of the larger surveys for which the majority of the modeled exposures occur, using such a scaling process is appropriate in order to evaluate the likely severity of the predicted exposures. This approach is also discussed in more detail in the EWG report (Southall *et al.,* 2017), available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.*

The test scenario modeled six representative GOM species/guilds: Bryde's whale, sperm whale, beaked whales, bottlenose dolphin, *Kogia* spp., and short-finned pilot whale. For purposes of this analysis, bottlenose dolphin was used as a proxy for other small dolphin species, and short-finned pilot whale was used as a proxy for other large delphinids. Tables 22–23 in the modeling report provide information regarding the number of modeled animals receiving exposure above criteria for average 24-hr sliding windows scaled to the full 30-day duration and percent change in comparison to the same number evaluated when modeling the full 30-day duration. This information was used to derive 30-day scalar ratios which, when applied to the total instances of take given in Table 9, captures repeated takes of individuals at a 30-day sampling level. Scalar ratios are as follows: Bryde's whale, 0.189; sperm whale, 0.423; beaked whales, 0.101; bottlenose dolphin, 0.287; *Kogia* spp., 0.321; and short-finned pilot whale, 0.295. Application of the re-scaling method reduced the overall magnitude of modeled takes for all species by slightly more than double to up to ten-fold (Table 10).

These adjusted take numbers (shown in Table 10) provide a more realistic basis upon which to evaluate severity of the expected taking. Please see the Negligible Impact Analysis and Determinations section, later in this document, for additional detail. It is important to recognize that while these scaled numbers better reflect the number of individuals likely to be taken within a single 30-day survey than the number of instances in Table 9, they will still overestimate the number of individuals taken across the aggregated GOM activities, because they do not correct for (*i.e.,* further reduce take to account for) individuals exposed to multiple surveys or fully correct for individuals exposed to surveys significantly longer than 30 days.

As noted in the beginning of this section and in the Small Numbers section, using modeled instances of take (Table 9) and the method described here to scale those numbers (based on Test Scenario 1) allows one to more accurately predict the number of individuals that will be taken as a result of exposure to one survey and, therefore, these scaled predictions should be considered in requests for LOAs to assess whether a resulting LOA would meet the small numbers standard. However, for the purposes of ensuring that the take authorized pursuant to all issued LOAs is within the scope of the analysis conducted to support the negligible impact finding in this rule, authorized instances of take (which are the building blocks of the analysis) also must be assessed. Specifically, reflecting Table 9 and what has been analyzed, the total take authorized for any given species or stock over the course of the five years covered under these regulations should not exceed the sum of the five years of take indicated for the five scenarios in that table, and in any given year, the take of any species should not exceed the highest annual take listed for any of the five scenarios.

TABLE 10—EXPECTED TOTAL TAKE NUMBERS, SCALED [1]

Species	Year 1	Year 2	Year 3	Year 4	Year 5
Bryde's whale	2	2	2	1	1
Sperm whale	6,939	6,009	5,754	4,017	5,240
Kogia spp.	3,452	3,098	2,841	2,069	2,771
Beaked whale	19,348	16,392	15,991	11,253	14,436
Rough-toothed dolphin	8,794	7,756	7,428	5,631	6,664
Bottlenose dolphin	173,247	279,357	163,005	287,360	162,857
Clymene dolphin	24,633	19,492	21,101	13,584	17,329
Atlantic spotted dolphin	36,822	52,727	32,178	54,959	31,945
Pantropical spotted dolphin	137,327	125,145	112,321	89,348	113,648
Spinner dolphin	21,799	20,628	17,535	13,998	18,470
Striped dolphin	9,635	8,402	7,989	5,779	7,478
Fraser's dolphin	1,298	1,103	1,088	782	992
Risso's dolphin	6,448	5,536	5,374	3,758	4,907
Melon-headed whale	16,465	14,096	13,742	9,611	12,456
Pygmy killer whale	2,383	2,054	1,995	1,466	1,852
False killer whale	4,769	4,044	4,013	2,851	3,619
Killer whale	18	17	15	12	15
Short-finned pilot whale	4,438	2,898	4,025	2,200	2,643

[1] Scalar ratios were applied to values in Table 9 as described in preceding text to derive scaled take numbers shown here.

Mitigation

''*Least Practicable Adverse Impact*'' *Standard*

Under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other 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, and on the availability of such species or stock for subsistence uses (hereinafter referred to as ''LPAI'' or ''least practicable adverse impact''). NMFS does not have a regulatory definition for least practicable adverse impact. However, NMFS' implementing regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)). We note that in some cases, certain mitigation may be necessary in order to make a ''negligible impact'' finding for an affected species or stock, which is a fundamental requirement of issuing an authorization—in these cases, consideration of practicability may be a lower priority for decision-making if impacts to marine mammal species or stocks would not be negligible in the measure's absence.

In *Conservation Council for Hawaii* v. *NMFS,* 97 F. Supp. 3d 1210, 1229 (D. Haw. 2015), the district court stated that NMFS ''appear[s] to think [it satisfies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' Later, 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 (SURTASS LFA) Sonar (77 FR 50290, August 20, 2012), the Ninth Circuit 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.'' 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 NMFS' 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 issued by NMFS, such as the Navy Gulf of Alaska rule (82 FR 19530; April 27, 2017); the Navy Atlantic Fleet Testing and Training rule (83 FR 57076; November 14, 2018); the Navy Hawaii-Southern California Training and Testing rule (83 FR 66846; December 27, 2018); and the SURTASS

LFA sonar rule (84 FR 40132; August 13, 2019).

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS' and the 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 [12] and, therefore, are considered in evaluating population level impacts.

As NMFS stated in the preamble to the final rule for the incidental take implementing regulations, 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. [T]he key factor is the significance of the level of impact on rates of recruitment or survival.'' (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 may 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), which are typically identified as mitigation measures.[13]

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, Webster's New Collegiate Dictionary (1981) defines ''species'' to include ''a group of intimately related and physically similar organisms that actually or potentially interbreed [. . .], that ordinarily comprise differentiated *populations* limited geographically [. . .] or ecologically [. . .]'' (emphasis added). See also Merriam-Webster Dictionary, which defines ''species'' to include ''related organisms or *populations* potentially capable of interbreeding.'' *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'' includes ''a group of interbreeding biotypes that represents the level of organization at which speciation begins.'' Webster's New Collegiate Dictionary (1981). See also *www.merriam-webster.com/dictionary/population,* which defines population as ''a group of interbreeding organisms that represents the level of organization at which speciation begins.'' 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 are 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)). Both the negligible impact standard and the least practicable adverse impact standard call for evaluation at the level of the species or stock, and the terms ''species'' and ''stock'' both relate to populations. Therefore, it is appropriate to view both the negligible impact standard and the least practicable adverse impact standard 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 that NMFS conflates 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 mitigation measures to reach a negligible impact finding (see 50 CFR 216.104(c)), no amount of mitigation can enable NMFS to issue an incidental take authorization for an activity that would not meet the negligible impact standard.

Second, 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)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks and their habitat. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement.

Finally, as noted above, the least practicable adverse impact standard 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. By contrast, the negligible impact standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[14]

In *NRDC* v. *Pritzker,* the Ninth Circuit 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

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

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

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

the greatest extent practicable in light of military readiness needs.'' *Pritzker,* 828 F.3d 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''; the standards are not solely focused on or directed at the impact on individual marine mammals.

NMFS has carefully 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 that such an interpretation reflects an incomplete appreciation of the court's decision. In NMFS' view, the decision as a whole turned on the court's determination that the agency had not given separate and independent meaning to the least practicable adverse impact standard apart from the negligible impact standard. NMFS further believes 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 described below.

Implementation of Least Practicable Adverse Impact Standard

In light of the *NRDC* v. *Pritzker* decision, we discuss here how NMFS determines 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 the specified activities meets the ''negligible impact'' standard appears in the Negligible Impact Analysis and Determinations section below.

NMFS' 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 (where 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 measures for applicant implementation. Practicability of implementation may consider such things as cost, impact on activities, 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 and their habitat, NMFS recognizes 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' analysis focuses on measures that are designed to avoid or minimize impacts on individual marine mammals that are likely to increase the probability or severity of population-level effects.

While direct evidence of impacts to species or stocks from a specified activity is rarely available, and additional study is still needed to understand how specific disturbance events affect the fitness of individuals of certain species, there have been 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 often be inferred 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 (or the risk thereof) to species or stocks. NMFS also acknowledges that there is always the potential that new information, or a new recommendation that had not previously been 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 are 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 restriction could be of very high value for reducing the potential for, or severity of, 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 restrictions in an area or time that impede the operator's ability to acquire necessary data (higher impact), or it could mean 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. Consideration of these factors is discussed in greater detail below.

1. *Reduction of adverse impacts to marine mammal species or stocks and their habitat.*[15]

[15] NMFS recognizes 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

Continued

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 (and how many 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 proposed mitigation needs to be evaluated in the context of the specific activity and the species or stocks affected, measures with the following types of effects have greater value in reducing the likelihood or severity of adverse species- or stock-level impacts: Avoiding or minimizing injury or mortality; limiting interruption of known feeding, breeding, mother/young, 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 discretion to weigh a variety of factors when determining appropriate mitigation measures and because the focus of the standard is on reducing impacts at the species or stock level, the least practicable adverse impact standard does not compel mitigation for every kind of take, or every individual taken, if that mitigation is unlikely to meaningfully contribute to the reduction of adverse impacts on the species or stock and its habitat, 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, such as recovering from an oil spill.

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.

NMFS considers available information indicating the likelihood of any measure to accomplish its objective. If evidence shows that a measure has not typically been effective nor successful, then either that measure should be modified or the potential value of the measure to reduce effects should be lowered.

2. *Practicability.*

Factors considered may include those costs, impact on activities, personnel safety, and practicality of implementation.

In carrying out the MMPA's mandate for this action, NMFS applies 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 operators. 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 of the notice of proposed rulemaking, 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 rulemaking). 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 NMFS, 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. NMFS also recognizes 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 Analysis and Determinations), and the information we have regarding habitat for certain species.

In order to satisfy the MMPA's least practicable adverse impact standard, NMFS 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 particularly 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. NMFS reviewed the mitigation measures proposed in the petition, the requirements specified in BOEM's PEIS, seismic mitigation protocols required or recommended elsewhere (*e.g.,* HESS, 1999; DOC, 2013; IBAMA, 2018; Kyhn *et al.,* 2011; JNCC, 2017; DEWHA, 2008; BOEM, 2016; DFO, 2008; GHFS, 2015; MMOA, 2016; Nowacek *et al.,* 2013; Nowacek and Southall, 2016), recommendations received during the public comment period, and the available scientific literature. NMFS 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 the notice of proposed

for evaluating those measures, taking into account both 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.

rulemaking 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 in the petition and/or those specified by BOEM in the preferred alternative identified in their PEIS in order to reflect what NMFS believes to be the most appropriate suite of measures to satisfy the requirements of the MMPA. Additionally, two geographic mitigation measures discussed in the proposed rule are no longer applicable because of the change in the scope of the rule.

For purposes of defining mitigation requirements, we differentiate here between requirements for two classes of airgun survey activity: Deep penetration and shallow penetration, with surveys using arrays greater than 1,500 in^3 total airgun volume considered deep penetration. This delineation is discussed further below, under ''Changes from the Proposed Regulations.'' Shallow penetration surveys also include those using single airguns, boomers, or equivalent sources. A third general class of surveys is also considered, referred to here as high-resolution geophysical (HRG) surveys and including those surveys using the other electromechanical sources described previously. HRG surveys are treated differentially on the basis of water depth, with 200 m as the divider between shallow and deep HRG. Water depth is used as an indicator for surveys (shallow) that should be expected to have less potential for impacts to marine mammals, because HRG sources used in shallow waters are typically higher-frequency, lower power, and/or having some significant directionality to the beam pattern. Finally, HRG surveys using only sources operating at frequencies greater than or equal to 180 kHz are exempt from the mitigation requirements described herein, with the exception of adherence to vessel strike avoidance protocols. (Note that this has been changed from 200 kHz to reflect the best available scientific information regarding generalized hearing ranges for affected marine mammal hearing groups (NMFS, 2018).) No distinction in standard required mitigations is made on the basis of BOEM's planning areas (*i.e.,* Western Planning Area (WPA), Central Planning Area (CPA), Eastern Planning Area (EPA)).

First, we summarize notable changes made to the mitigation requirements as a result of review of public comments and/or new information and then describe mitigation prescribed in the regulations. For additional detail regarding mitigation considerations, including expected efficacy and/or practicability, or descriptions of mitigation considered but not required, please see the notice of proposed rulemaking. Where the practicability analysis was described in the notice of proposed rulemaking and nothing has changed, we do not repeat the description.

Changes to Mitigation From the Proposed Regulations

Here we summarize substantive changes to mitigation requirements from the proposed regulations. All changes were made on the basis of review of public comments received and/or review of new information.

Delineation of Airgun Activity Tiers

In the notice of proposed rulemaking, for purposes of prescribing mitigation, NMFS proposed to define ''deep penetration'' surveys as those using arrays greater than 400 in^3 total volume. As stated in that notice, NMFS had little information upon which to base such a delineation for purposes of defining appropriate mitigation, but considered 400 in^3 as a reasonable cutoff based on descriptions of airgun surveys provided in BOEM's petition. We also noted that the Associations stated in their comments on the petition that deep penetration array volumes used in the GOM range from approximately 2,000 to 8,400 in^3. BOEM has subsequently provided information to NMFS supporting a cutoff at 1,500 in^3. In support of section 3(c) of E.O. 13795, BOEM analyzed available data for single airguns and airgun arrays, including arrays with known characteristics used by the National Science Foundation and U.S. Geological Survey and arrays evaluated through BOEM NEPA analyses. See *e.g.,* Richardson *et al.* (1995); NSF and USGS (2011). These data suggest that the output of an array, in terms of peak source level, increases at a greater rate at volumes above approximately 1,500 in^3. No public comments addressing this issue were received. Therefore, NMFS has elected to redefine the transition from ''shallow penetration'' to ''deep penetration'' from 400 to 1,500 in^3 total volume of the array.

Time-Area Restrictions

Bryde's Whale Core Habitat Area: The proposed regulatory text included a seasonal restriction within an area we termed Bryde's whale core habitat, and the preamble for the proposed rule presented several alternatives to the seasonal restriction for consideration by the public (83 FR 29281; 29302) including a year-round closure for this area, which was considered in the analysis for the preliminary determination of negligible impact. See 83 FR 29280–29281; 83 FR 29297.

However, the entirety of this area is now excluded from consideration through this rule following BOEM's update to the scope of activity (*i.e.,* removal of the GOMESA moratorium area from the geographic scope of the rulemaking). Therefore, consideration of a time-area restriction for the Bryde's whale core habitat area (including the alternatives described above) is moot, and no restriction is included in this final rule.

Dry Tortugas Area: As with the Bryde's whale core habitat area, the entirety of the Dry Tortugas area is now excluded from consideration through this rule following BOEM's update to the scope of activity (*i.e.,* removal of the GOMESA moratorium area from the geographic scope of the rulemaking). Therefore, consideration of a time-area restriction for the biologically important area for sperm whales and beaked whales in the EPA is moot, and no restriction is included in this final rule.

Coastal Restriction: NMFS proposed a GOM-wide restriction within coastal waters inside the 20-m isobath, to be in effect from February through May. For this final rule, NMFS contracted the proposed coastal time-area restriction spatially and expanded it temporally. The restriction has been reduced to cover the same coastal waters (20-m isobath) but between 90° W and the eastern extent of the coastal waters portion of BOEM's updated specified geographic region, while expanding temporally to include the month of January. NMFS received informative public comment on both sides of this issue. Some commenters provided information indicating practicability concerns regarding the proposed restriction, while other commenters supported the importance of the restriction and provided information supporting the temporal expansion of the restriction to include January. As described in the notice of proposed rulemaking, the stock most heavily impacted by the DWH oil spill (of those that may be affected by the specified activities) was the northern coastal stock of bottlenose dolphin. Since publication of the proposed regulations, an additional UME occurred in the area largely overlapping the range of this stock. Therefore, while NMFS appreciates the practicability concerns raised by commenters, we contracted the restriction spatially but did not eliminate the restriction, while expanding it temporally to encompass January through May. The change is described in more detail under Comments and Responses as well as later in this section where the details of the specific closure area is discussed.

Restriction Area Buffer Zones: The proposed regulations included buffer zones specific to each time-area restriction that corresponded with modeled distances to the 160-dB isopleth (*i.e.,* the midpoint of the Level B harassment risk function). These distances were 6 km around the EPA Bryde's whale core habitat area (Area #2), 13 km around the coastal waters restriction (Area #1), and 9 km around the southern EPA area (Area #3). Following BOEM's update to the geographic scope of activity considered through this rule, Areas 2 and 3 are excluded from consideration. Therefore, consideration of buffer zone size around these areas is not relevant. Upon review of public comment, in which commenters raised concerns about practicability among others, and re-evaluation of the nature and extent of mitigation Area #1 as it relates to the necessity of an additional buffer area, NMFS determined it appropriate to not include a buffer for this area. The rationale for the change is described in more detail under Comments and Responses.

Shutdown Requirements

Delphinid Exception: NMFS does not require shutdown or power-down for certain delphinid species. In the notice of proposed rulemaking, we proposed an exception to the general shutdown requirements for certain species of dolphins in relation to airgun surveys, in which the acoustic source would be powered down to the smallest single element of the array. Power-down conditions would be maintained until the animal(s) is observed exiting the exclusion zone or for 15 minutes beyond the last observation of the animal, following which full-power operations may be resumed without ramp-up. NMFS also provided an alternative proposal for consideration by the public, in which no shutdown or power-down would be required upon observation of the same species of dolphins. While we are careful to note that the reasons for and potential effects of dolphin interaction with vessels, including working survey vessels, are not fully understood, 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). NMFS also recognizes that, although dolphins do in fact react to airgun noise in ways that may be considered take (Barkaszi *et al.,* 2012; Barkaszi and Kelly, 2018), there is a lack of notable adverse dolphin reactions to airgun noise despite a large body of observational data. Therefore, the removal of the power-down measure for small delphinids, in favor of the no-shutdown or power-down alternative, 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 or power-down is required for these species.

Distance of Extended Shutdowns: NMFS limits extended distance shutdowns to within 1,500 m. We proposed a number of shutdown requirements on the basis of detections of certain species deemed particularly sensitive (*e.g.,* beaked whales) or of particular circumstances deemed to warrant particular caution (*e.g.,* whales with calves). These were all conditioned upon observation or detection of these species or circumstances at any distance from the vessel. However, NMFS also included as an alternative proposal for public consideration a distance limit of 1,000 m for these extended distance shutdown requirements. We received several comments challenging the value of extended distance shutdown requirements at all and, while NMFS disagrees 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 protected species observers (PSO) 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, NMFS determined that a limit on such extended distance shutdown zones for relevant species or circumstances was appropriate. However, upon consideration of additional information (discussed later in this section), NMFS determined it appropriate to limit extended distance shutdown zones to 1,500 m, rather than 1,000 m.

Sperm Whale Shutdowns: The proposed regulatory text included an extended distance shutdown upon acoustic detection of sperm whales, and this final ITR explicitly expands that requirement to include any detection of sperm whales (*i.e.,* including visual detection) at extended distance (*i.e.,* within 1,500 m). As discussed in Comments and Responses, NMFS received some comments showing that there was a lack of clarity regarding the extended distance shutdowns for acoustic detections of sperm whales. NMFS also received comments indicating that the proposed division (*i.e.,* extended distance shutdown upon acoustic detection of sperm whales but not visual detection) did not make sense given the available information regarding both the status of the GOM sperm whale population and the potential impacts of airgun noise on sperm whale foraging activity. While this measure does not avoid such impacts—the observed impacts on foraging behavior were at even greater distances (Miller *et al.,* 2009)—it may be expected to practicably reduce the occurrence and severity of impacts on foraging behavior.

Shallow Penetration Surveys: NMFS has reduced the standard exclusion zone from 200 m to 100 m, and included an extended distance shutdown requirement that mirrors the requirements for deep penetration surveys but out to a distance of 500 m. The 200-m shutdown distance was proposed on the basis of BOEM's HRG survey protocol (Appendix B of BOEM, 2017). However, practicability concerns were raised by public commenters and 100-m shutdown zones have been effectively applied in the past to afford protection from potential Level A harassment and more severe behavioral responses from these types of activities. Therefore, rather than defer to BOEM's HRG survey protocol, NMFS re-evaluated the same information informing development of the proposed rule, as well as public comment, and determined that the 200-m shutdown distance is not warranted and we reduce the distance accordingly. Regarding the extended distance shutdown in special circumstances, NMFS proposed this mitigation concept in context of deep penetration surveys in the notice of proposed rulemaking. Airgun (and equivalent) surveys are considered to have similar effects on exposed marine mammals, and the sensitive species for which the extended distance shutdown measure was proposed are similarly susceptible to disturbance from shallow penetration surveys, if exposed. Therefore, NMFS expands the extended distance shutdown measure to shallow penetration surveys in addition to deep penetration surveys.

HRG Surveys: NMFS eliminates shutdown requirements for HRG surveys (defined here as surveys using electromechanical sources such as multi-beam echosounders, side-scan sonars, and chirp sub-bottom profilers). The proposed regulations required shutdown for marine mammals within the proposed exclusion zone for surveys operating in water depths greater than 200 m. As discussed above for shallow penetration surveys, this proposal was modeled after BOEM's HRG survey protocol. However, NMFS re-evaluated the available information, as well as public comment, and has determined the requirement to not be warranted. These sources are typically higher-frequency and lower-power, and have highly directional beam patterns. Effects to marine mammals due to use of these sources, if any, are expected to be of very low severity and, therefore, the benefits of the proposed shutdown requirement would be minimal (especially given that animals observed at the surface are necessarily not ensonified by the downward-directed beams from the source at the time they are observed).

Monitoring

Nighttime Ramp-Up: NMFS eliminates the requirement for visual observation during nighttime ramp-up and pre-clearance. Public commenters indicated that this measure is not likely to be effective, and that there are safety concerns associated with PSOs working on deck at night. NMFS concurs with this assessment, as described in detail in Comments and Responses.

PSOs for Node Retrieval: The proposed requirement for third-party PSOs aboard node retrieval vessels is eliminated due to practicability concerns expressed through public comment. NMFS concurs with this assessment, as described in detail in Comments and Responses.

Below, mitigation requirements are described in detail.

Mitigation-Related Monitoring

Monitoring by dedicated, trained marine mammal observers is required in all water depths and, for certain surveys, observers must be independent. Additionally, for some surveys, NMFS requires that some PSOs [16] have prior experience in the role. Independent observers are employed by a third-party observer provider; vessel crew may not serve as PSOs when independent observers are required. 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 (where required). 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, whereas when we use ''PSO'' without a qualifier, the term refers to either visual PSOs or PAM operators (acoustic PSOs).

NMFS does not formally administer any PSO training program or endorse specific providers but will approve PSOs that have successfully completed courses that meet the curriculum and trainer requirements specified herein (see Monitoring and Reporting). NMFS will provide PSO approvals in the 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 indicating successful completion of an acceptable training course. Although PSOs must be approved by NMFS, third-party observer providers and/or companies seeking PSO staffing should expect that observers having satisfactorily completed acceptable training and with the requisite experience (if required) will be quickly approved and, if NMFS does not respond within one week of having received the required information, such PSOs shall be considered to have received de facto approval. 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. Where multiple PSOs are required and/or PAM operators are required, 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. NMFS may grant an exception for the requirement that visual PSOs be limited to a maximum of two consecutive hours on watch followed by a break of at least one hour between watches if requested on the basis of practicability concerns by LOA applicants. If an exception is granted, visual PSOs would instead be limited to a maximum of four consecutive hours on watch followed by a break of at least two hours between watches. Further information regarding PSO requirements may be found in the Monitoring and Reporting section, later in this document.

Deep Penetration Surveys—During deep penetration survey [17] 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 independent 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). PSOs should use NOAA's solar calculator (*www.esrl.noaa.gov/gmd/grad/solcalc/*) to determine sunrise and sunset times at their specific location. NMFS recognizes 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,[18] and serve as the primary point of contact for the operator. However, while it is desirable for all PSOs to be qualified through experience, NMFS is 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.

[16] Note that, although we discuss requirements related only to observation of marine mammals, we use the generic term ''protected species observer.''

[17] Deep penetration surveys are defined as those surveys using airgun arrays with total volume greater than 1,500 in^3.

[18] The coordination of PSO duty schedules and roles may alternatively be performed by a third-party, shore-based Monitoring Coordinator.

With regard to specific observational protocols, NMFS largely follows those described in Appendix B of BOEM's PEIS (BOEM, 2017). 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 receiver or chase vessels, should be relayed to the source vessel(s) and to the PSO team.

All source vessels must use a towed PAM system for potential detection of marine mammals at all times when operating the sound source in waters deeper than 100 m. The term ''towed PAM system'' refers to any combination of hardware and software that uses a towed array for operations. The array can be physically separate from other in-water hardware, or embedded into other equipment, such as seismic streamers. 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 formal standards are currently in place regarding PAM system hardware/software requirements, or regarding PAM operator training.

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 in waters deeper than 100 m; (2) visual monitoring during use of the acoustic source by two PSOs during all daylight hours; (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.

Shallow Penetration Surveys—During shallow penetration surveys,[19] operators must follow the same requirements described above for deep penetration surveys, with one notable exception. The use of PAM is not required.

HRG Surveys—HRG survey protocols differ from the previously described protocols for deep and shallow penetration surveys, and we differentiate between deep-water (greater than 100 m) and shallow-water HRG surveys. Water depth in the GOM provides a reliable indicator of the marine mammal fauna that may be encountered and, therefore, the complexity of likely observations and concern related to potential effects on deep-diving and/or sensitive species.

Deep-water HRG surveys are required to employ a minimum of one independent visual PSO during all daylight operations, in the same manner as was described for deep and shallow penetration surveys. Shallow-water HRG surveys are required to employ a minimum of one visual PSO, which may be a crew member. PSOs employed during shallow-water HRG surveys are only required during a pre-clearance period. PAM is not required for any HRG survey.

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 the potential for certain outcomes such as auditory injury or more severe disruption of behavioral patterns. For deep penetration surveys, 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 (see below for description of extended 1,500-m zone in

[19] Shallow penetration surveys are defined as those using airgun arrays with total volume less than or equal to 1,500 in^3, single airguns, boomers, or equivalent sources.

special circumstances). PSOs should generally focus their observational effort within a 1.5-km zone, to the extent possible, with animals observed at greater distances recorded and mitigation action taken as necessary (see below). For shallow penetration surveys, the PSOs shall establish and monitor a 100-m exclusion zone with additional 100-m buffer (total 200-m zone) during the pre-clearance period and a 100-m exclusion zone during the ramp-up (for small arrays only, versus single airguns) and operational periods (see below for description of extended 500-m zone in special circumstances). PSOs should generally focus their observational effort within a 500-m zone, to the extent possible, with animals observed at greater distances 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 surveys using airgun arrays. 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). Ramp-up is required for all surveys using airgun arrays. While non-airgun acoustic sources are not typically amenable to ''ramping up'' the acoustic output in the way that multi-element airgun arrays are, power to these sources should be increased as feasible in order to effect a ramp-up.

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 may 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 must 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 begins 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.

For deep penetration surveys, 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). For shallow penetration surveys, PSOs must monitor a 200-m zone (or to the distance visible if less than 200 m) for a minimum of 30 minutes prior to ramp-up or start-up (for single airgun or non-airgun surveys). (Note that extended distance shutdowns, discussed below, may be required if certain species or circumstances are detected within greater distances: 1.5 km for deep penetration surveys and 500 m for shallow penetration surveys). 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 by the operator 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 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 delphinids and 30 minutes for all other species). PSOs will monitor the 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

Deep Penetration Surveys—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, NMFS believes 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, NMFS seeks 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 the notice of proposed rulemaking, 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 thresholds related to the accumulation of energy (*i.e.,* cumulative SEL), 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 (cSEL) 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). NMFS recognizes 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 may be impossible to fully avoid, depending on survey location in relation to the areas where these species occur, and should be considered for authorization.

Considering both the dual-metric thresholds described previously (and shown in Table 7) and hearing group-specific marine mammal auditory weighting functions in the context of airgun sources, 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 a source level of 255.2 dB 0-pk SPL for the notional 8,000 in^3 array and spherical spreading propagation, distances for exceedance of group-specific peak injury thresholds are as follows: 65 m (LF), 18 m (MF), and 457 m (HF) (for high-frequency cetaceans, although the notional source parameters indicate a zone less than 500 m, we recognize that actual isopleth distances will vary based on specific array characteristics and site-specific propagation characteristics, and that it is therefore possible that a real-world distance to the injury threshold could exceed 500 m). Assuming a source level of 227.7 dB 0-pk SPL for the notional 90 in^3 single airgun and spherical spreading propagation, these distances would be 3 m (LF) and 19 m (HF) (the source level is lower than the threshold criterion value for mid-frequency cetaceans). These specific modeled source level values were discussed in the notice of proposed rulemaking, and additional information may be found in the modeling report.

Consideration of auditory injury zones based on cSEL criteria is dependent on the animal's generalized hearing range and how it overlaps with the frequencies produced by the sound source of interest in relation to marine mammal auditory weighting functions (NMFS, 2018). As noted above, zones based on the cSEL threshold 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 the notice of proposed rulemaking, NMFS 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' Technical Guidance weighting functions over an airgun array's full acoustic band. Using NMFS' associated User Spreadsheet with hearing group-specific weighted source levels, and inputs assuming a 231.8 dB SEL source level for the notional 8,000 in^3 array, spherical spreading propagation, a source velocity of 4.5 kn, pulse duration of 100 ms, and a 25-m shot interval (shot intervals may vary, with longer shot intervals resulting in smaller calculated zones), distances for group-specific threshold criteria are as follows: 574 m (LF), 0 m (MF), and 1 m (HF). NMFS also assessed the potential for injury based on the accumulation of energy resulting from use of the single airgun and, assuming a source level of 207.8 dB SEL, there would be no realistic zone within which injury would occur.

Therefore, the 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 and in Comments and Responses), 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).

In summary, NMFS' 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) define a distance within which detection probabilities are reasonably high for most species under typical conditions. NMFS' 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 GOM. 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). The shutdown requirement described here would be required for most marine mammals, with certain differences. Small delphinids are excepted from the shutdown requirement, as described in the following section. Certain species are subject to an extended distance shutdown zone, as described in the subsequent section entitled ''Other Shutdown Requirements.''

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). (Here we refer to ''large delphinids'' and ''small delphinids'' as shorthand for generally deep-diving versus surface-dwelling/bow-riding groups, respectively, as the important distinction is their dive behavior rather than their size.) This exception to the shutdown requirement applies solely to specific genera of dolphins—*Steno, Tursiops, Stenella,* and *Lagenodelphis* (see Table 4)—and applies under all circumstances, regardless of what the perception of the animal(s) behavior or intent may be. The proposed regulations included a requirement to conduct a power-down upon detection of these species within the exclusion zone. However, in the preamble to the proposed regulations, NMFS also included an alternative proposal for public review and comment in which no shutdown or power-down would be required. We requested comment on both proposals and other variations of those proposals, including NMFS' interpretation of the data and any other data that support the necessary findings regarding dolphins for no shutdown and no power-down or no shutdown but a power-down. Upon review of the public comments received, as well as the scientific information summarized below, NMFS has determined that the alternative proposal of no shutdown or power-down is appropriate, and satisfies the least practicable adverse impact requirement.

Variations of this measure that include exceptions based on animal behavior—*e.g.,* ''bow-riding'' dolphins, or only ''traveling'' dolphins, meaning that the intersection of the animal and exclusion zone may be due to the animal rather than the vessel—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; Barkaszi and Kelly, 2018) 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.

NMFS cautions 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. Some studies have found 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, NMFS anticipates 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 Surveys—Shutdown protocols for shallow penetration surveys are similar to those described for deep penetration surveys, except that the exclusion zone is defined as a 100-m radial distance around the perimeter of the acoustic source. The dolphin exception described above for deep penetration surveys would apply. As described previously, no shutdowns would be required for HRG surveys.

Extended Shutdown Requirements for Special Circumstances—Shutdown of the acoustic source is also required in the event of certain other detections beyond the standard exclusion zones. In the proposed regulatory text, NMFS conditioned these shutdowns upon detection of the relevant species or circumstances at any distance. However, in the preamble to the proposed regulations, we also included an alternative proposal for public review and comment in which shutdown of the acoustic source would occur in the circumstances listed below, but only within 1 km of the source (for deep penetration surveys). We requested comment on both proposals and other variations of those proposals, including NMFS' interpretation of the data and any other data that support the necessary findings regarding initiating shutdown for certain circumstances at any distance or within 1 km. Following review of public comments and the relevant scientific information, NMFS determined that it is appropriate to limit such shutdown requirements. However, as discussed in the next paragraph, we also determined that the relevant scientific information better supports 1.5 km as a reasonable detection radius (versus 1 km). Placement of a distance limit on these requirements 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 exclusion zone, shutdowns at extended distance should be made on the basis of confirmed detections (visual or acoustic) within the zone.

For deep penetration surveys, NMFS determined an appropriate distance on the basis of available information regarding detection functions for relevant species, but notes 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. The appropriate distance limit may vary for different regions, depending on the species to which it may apply. 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 Bryde's whale and shipboard binocular surveys (*i.e.,* the relevant combination of platform and protocol), a detection function was fit using pooled sightings of Bryde's whales and other mysticete species (Roberts *et al.,* 2015c). The resulting detection function shows a slightly more than 20 percent probability of detecting 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.,* 2015c). 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 mean ESHWs of 1,462 m and 2,258 m for two NOAA vessels on which visual surveys have historically been conducted (Roberts *et al.,* 2015b). Therefore, NMFS set the shutdown radius for special circumstances (described below) at 1.5 km for deep penetration surveys. The shutdown radius for special circumstances is set at 500 m for shallow penetration surveys.

Comments disagreeing with the 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. 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 (*e.g.,* within 1.5 km) include:

• *Upon detection of a Bryde's whale.* On the basis of the findings of NMFS' status review (Rosel *et al.,* 2016), NMFS has listed the GOM Bryde's whale as an endangered species pursuant to the ESA (April 15, 2019; 84 FR 15446). These whales form a small and resident population in the northeastern GOM, with a highly restricted geographic range and a very small population abundance (fewer than 100)—recently determined by a status review team to be ''at or below the near-extinction population level'' (Rosel *et al.,* 2016). The review team stated that, aside from the restricted distribution and small population, the whales face a significant suite of anthropogenic threats, one of which is noise produced by geophysical surveys. NMFS believes it appropriate to eliminate potential effects to individual Bryde's whales to the extent practicable. There may be rare sightings of vagrant baleen whales of other species in the GOM, and the PSO may order a shutdown when observed in the applicable exclusion zone.

• *Upon detection of a sperm whale.* NMFS provided an expanded discussion of the available evidence that supports this measure in the notice of proposed rulemaking. In summary, the sperm whale's primary means of locating prey is echolocation (Miller *et al.,* 2004), and multiple studies have shown that noise can disrupt feeding behavior and/or significantly reduce foraging success for sperm whales at relatively low levels of exposure (*e.g.,* Miller *et al.,* 2009, 2012; Isojunno *et al.,* 2016; Sivle *et al.,* 2012; Cure *et al.,* 2016). Effects on energy intake with no immediate compensation, as is suggested by disruption of foraging behavior without corollary movements to new locations, would be expected to result in bioenergetics consequences to individual whales. Farmer *et al.* (2018a) developed a stochastic life-stage structured bioenergetic model to evaluate the consequences of reduced foraging efficiency in sperm whales, finding that individual resilience to foraging disruptions is primarily a function of size (*i.e.,* reserve capacity) and daily energetic demands, and that the ultimate effects on reproductive success and individual fitness are largely dependent on the duration and frequency of disturbance. The bioenergetic simulations of Farmer *et al.* (2018a) show that frequent disruptions in foraging, as might be expected when large amounts of survey activity overlap with areas of importance for sperm whales, can have potentially severe fitness consequences. In addition, the GOM sperm whale population was heavily impacted by the DWH oil spill. Therefore, in consideration of the potential energetic impacts of survey activity on individual sperm whales and the environmental baseline for the GOM sperm whale population, NMFS determined that meaningful measures must be taken to minimize disruption of foraging behavior. As described earlier in this section, the proposed regulations limited this extended distance shutdown requirement to acoustic detections of sperm whales. However, while stating that NMFS preliminarily did not believe the addition of shutdowns for sperm whales based on visual detections at any distance were warranted, we also requested any information from the public that would be relevant to that determination. NMFS' review of the comments and information provided by the public indicates that expansion of this requirement to include all sperm whale detections, rather than only acoustic detections (as was proposed), is warranted. Please see Comments and Responses for further discussion.

• *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 fitness consequences (*e.g.,* Wursig *et al.,* 1998; Cox *et al.,* 2006). NMFS recognizes 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 the Estimated Take section), there are high levels of predicted exposures for beaked whales in particular. Because it is likely that only a small proportion of beaked whales and *Kogia* spp. potentially affected by the proposed surveys would actually be detected, it is important to avoid potential impacts when practicable. Additionally for *Kogia* spp.—the one species of high-frequency cetacean likely to be encountered—auditory injury zones relative to peak pressure thresholds are significantly greater than for other cetaceans—approximately 500 m from the acoustic source, depending on the specific real world array characteristics (NMFS, 2018).

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).

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 observation (including acoustic observation, where required) and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred (when required). NMFS defines ''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.

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 would not be authorized. 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

Discussion of various time-area restrictions was provided in the notice of proposed rulemaking. NMFS proposed two time-area restrictions located within the area covered by the current GOMESA moratorium. As discussed previously, BOEM subsequently updated the scope of the specified activity that was the subject of the petition for the ITR, removing the area subject to the current GOMESA moratorium from consideration through this rule. Therefore, consideration of those two proposed restrictions (Areas 2–3 in Figure 4 below), and any alternatives, is no longer relevant. Figure 4 depicts the time-area restrictions, absent consideration of BOEM's removal of the GOMESA moratorium area. Areas 2 and 3 are entirely within that area, and the eastern extent of Area 1 is functionally reduced through the removal of the GOMESA moratorium area.

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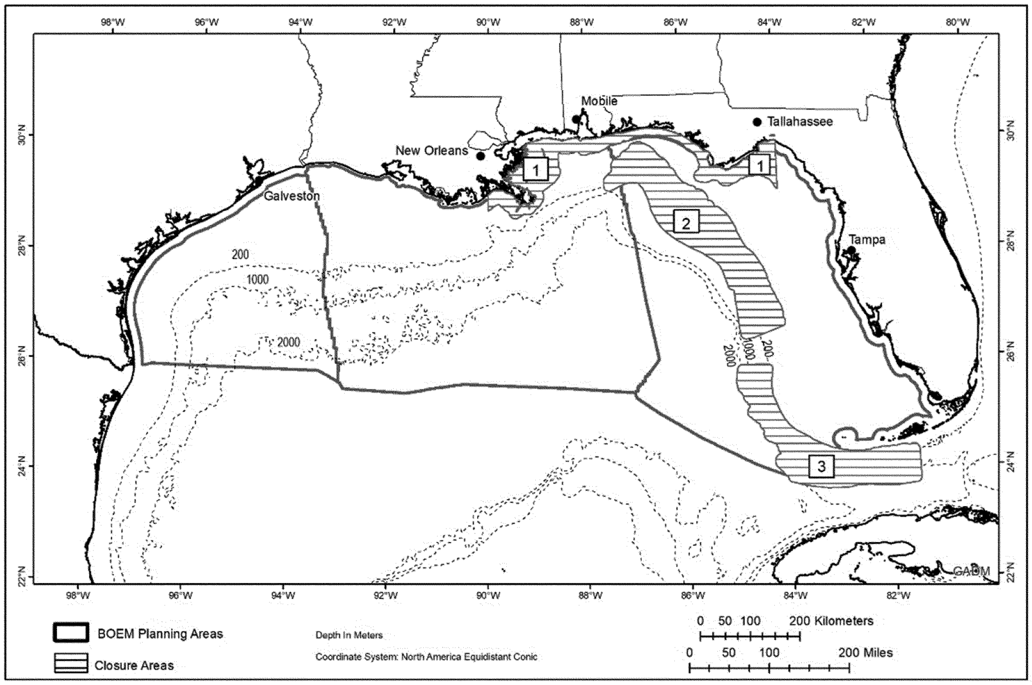

Figure 4. Time-area Restrictions as Originally Proposed. Areas 2 and 3 are not within the area covered by the final rule, which was updated and reduced.

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Coastal Restriction—No airgun surveys may occur from 90–84° W (as truncated through removal of the GOMESA moratorium area) and shoreward of a line indicated by the 20-m isobath, during the months of January through May (Area 1; Figure 4). Waters shoreward of the 20-m isobath, where coastal dolphin stocks occur, represent the areas of greatest abundance for bottlenose dolphins (Roberts *et al.,* 2016). As discussed above, and in greater detail in Comments and Responses, this requirement was modified from the proposed regulations by contracting the area spatially while expanding the restriction temporally by one month, in order to more practicably minimize potential impacts on the potentially affected stock most heavily impacted by the DWH oil spill (*i.e.,* the northern coastal stock of bottlenose dolphins).

The restriction is intended specifically to avoid additional stressors to the northern coastal stock of bottlenose dolphins during the time period believed to be of greatest importance as a reproductive period. As described previously, NOAA estimates that potentially 82 percent of northern coastal dolphins were exposed to DWH oil, resulting in an array of long-term health impacts (including reproductive failure) and possible population reductions of 50 percent for the stock (DWH MMIQT, 2015). The same analysis estimated that these population-level impacts could require 39 years to recovery, in the absence of other additional stressors. More recently, the stock has been subject to another declared UME; further discussion of this UME is provided under Description of Marine Mammals in the Area of the Specified Activity.

The January–May timeframe is intended to best encompass the most important reproductive period for bottlenose dolphins in these coastal waters, when additional stress is most likely to have serious impacts on pregnancy and/or survival of neonates. Expert interpretation of the long-term data for neonate strandings is that February–April are the primary months that animals are born in the northern GOM, and that fewer but similar numbers are born in January and May. This refers to long-term averages and in any particular year the peak reproductive period can shift earlier or later.

Bryde's Whale—The ''Bryde's whale core habitat area'' considered in the notice of proposed rulemaking was designated as between the 100- and 400-m isobaths, from 87.5° W to 27.5° N (Area 2; Figure 4). As summarized at the beginning of this section, and discussed in greater detail in Comments and Responses, the proposed regulatory text included a seasonal restriction within the same area. The preamble to the proposed regulations also included alternative proposals for public review and comment. This area is entirely located in the GOMESA moratorium area, which is now removed from consideration through this rule.

As described previously, NOAA's status review team determined the status of the GOM Bryde's whale to be precarious (Rosel *et al.,* 2016). These findings formed, in part, the basis for the analysis presented in the preamble to the proposed regulations and subsequently supported NMFS' listing of the GOM Bryde's whale as an endangered species pursuant to the ESA (84 FR 15446; April 15, 2019). These whales form a small and resident population in the northeastern GOM, with a highly restricted geographic range and a very small population abundance—determined by the status review team to be ''at or below the near-extinction population level'' (Rosel *et al.,* 2016). Aside from the restricted distribution and small population, the whales face a significant suite of anthropogenic threats, one of which is noise produced by airgun surveys.

While various population abundance estimates are available (*e.g.,* Waring *et al.,* 2016; Roberts *et al.,* 2016; Dias and Garrison, 2016), the population abundance was almost certainly less than 100 prior to the DWH oil spill. NOAA estimated that, as a result of that event, 48 percent of the population may have been exposed to DWH oil, with 17 percent killed and 22 percent of females experiencing reproductive failure. The best estimate for maximum population reduction was 22 percent, with an estimated 69 years to recovery (to the precarious status prior to the DWH oil spill) (DWH MMIQT, 2015). It is considered likely that Bryde's whale habitat previously extended to shelf and slope areas of the western and central GOM similar to where they are found now in the eastern GOM, and that anthropogenic activity—largely energy exploration and production—concentrated in those areas could have resulted in habitat abandonment (Reeves *et al.,* 2011; Rosel and Wilcox, 2014). Further, the population exhibits very low levels of genetic diversity and significant genetic mitochondrial DNA divergence from other Bryde's whales worldwide (Rosel and Wilcox, 2014).

The small population size, restricted range, and low genetic diversity alone place these whales at significant risk of extinction (IWC, 2017), which has been exacerbated by the effects of the DWH oil spill. Additionally, Bryde's whale dive and foraging behavior places them at heightened risk of being struck by vessels and/or entangled in fishing gear (Soldevilla *et al.,* 2017). NMFS considered a restriction in this core habitat area to protect Bryde's whales because of their hearing sensitivity in the lower frequency range (which makes them generally more susceptible to incurring effects from airgun noise than other taxa in the GOM); the potential impacts to important behavioral functions such as feeding, breeding, and raising young; their dangerously low population size; and other issues discussed previously. The absence of survey activity in the area would be expected to protect Bryde's whales and their habitat through the alleviation or minimization of a range of airgun effects, both acute and chronic, that could otherwise accrue to impact the reproduction or survival of individuals in the core habitat area. The absence of survey activity in the area would not only largely avoid Level B harassment of Bryde's whales, but also very importantly minimize other acoustic effects such as masking and loss of communication space. Based on Roberts *et al.,* 2016, this core habitat area is expected to encompass approximately 92 percent of Bryde's whales in the Gulf of Mexico. The update of the scope of the rule eliminates this core area and the corresponding impacts of concern from consideration in the analysis.

Although this area is no longer relevant under the updated geographic scope of the specified activity and this rule, the discussion above is still important to provide a picture of the species' distribution in the GOM and NMFS' work to identify appropriate mitigation in this rulemaking. Because NMFS acknowledges that some whales may be present at locations other than within this core habitat area, we considered additional information in order to evaluate whether a different closure area may be warranted. For example, a NOAA survey reported observation of a Bryde's whale in the western GOM in 2017 (NMFS, 2018). There had not previously been a verified sighting of a Bryde's whale in the western GOM and, given the importance of this observation, additional survey effort was conducted in an attempt to increase effort in the area. However, no additional sightings were recorded. Overall, Bryde's whales observations have been consistently located within the eastern GOM core habitat area, with few whales sighted elsewhere despite a large amount of dedicated cetacean survey effort that covered both continental shelf and oceanic waters. Whales have been sighted in the core habitat area in all seasons, and all indications are that the whales inhabit this area year-round as a resident population. A tagged whale remained within the area for 38 days, the entire time the tag was active. Therefore, while it is possible that Bryde's whales occur outside the core habitat area, or that whales from the eastern GOM occasionally travel outside the area, the few existing observations outside the eastern GOM do not affect NMFS' determination that the area considered in the proposed rule represents core habitat, or identify any additional important habitat that may appropriately be subject to a restriction on survey activity.

Entanglement Avoidance

The use of ocean-bottom nodes (OBN) or similar equipment requiring the use of tethers or connecting lines poses an entanglement risk. In order to avoid incidents of entanglement, NMFS requires the same measures included for the same purpose in permits issued by BOEM. These measures apply to operators conducting OBN surveys (or surveys using similar equipment), and include: (1) Use negatively buoyant coated wire-core tether cable (*e.g.,* ¾'' polyurethane-coated cable with ½'' wire core); (2) retrieve all lines immediately following completion of the survey; and (3) attach acoustic pingers directly to the coated tether cable. Acoustic releases should not be used. No unnecessary release lines or lanyards may be used and nylon rope may not be used for any component of the system. Pingers must be attached directly to the nodal tether cable via shackle, with cables retrieved via grapnel. If a lanyard is required it must be as short as possible and made as stiff as possible, *e.g.,* by placing inside a hose sleeve. The notice of proposed rulemaking also included a proposed requirement to require operators to employ a third-party PSO aboard the node retrieval vessel in order to document any unexpected marine mammal entanglement. In consideration of the information provided by public commenters, NMFS has determined that this measure is unnecessary and eliminates it from the final ITR. Use of a third-party PSO in this capacity would not help to avoid entanglement events, and operators would be required to report any such events to BSEE. Therefore, the requirement provides little benefit while imposing costs on operators.

Vessel Strike Avoidance

These measures apply to all vessels associated with any survey activity (*e.g.,* source vessels, streamer vessels, chase vessels, supply vessels). However, NMFS notes 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 must slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (distances stated below). Visual observers monitoring the vessel strike avoidance zone may be third-party observers (*i.e.,* PSOs) or crew members, but crew members responsible for these duties must be provided sufficient training to (1) distinguish protected species from other phenomena and (2) broadly to identify a marine mammal as a baleen whale, sperm whale, or other marine mammal;

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

3. All vessels must maintain a minimum separation distance of 500 m from baleen whales;

4. All vessels must maintain a minimum separation distance of 100 m from sperm whales;

5. All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all other marine mammals, with an understanding that at times this may not be possible (*e.g.,* for animals that approach the vessel); and

6. When marine mammals are sighted while a vessel is underway, the vessel shall 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 must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This does not apply to any vessel towing gear or any vessel that is navigationally constrained.

NMFS has 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 LOA for an activity, Section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of the authorized taking. NMFS' 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.

Section 101(a)(5)(A) allows that incidental taking may be authorized only if the total of such taking contemplated over the course of five years will have a negligible impact on affected species or stocks (a finding based on impacts to annual rates of recruitment and survival) and, further, section 101(a)(5)(B) requires that authorizations issued pursuant to 101(a)(5)(A) be withdrawn or suspended if the total taking is having, or may have, more than a negligible impact (or such information may inform decisions on requests for LOAs under the specific regulations). Therefore, the necessary requirements pertaining to monitoring and reporting must address the total annual impacts to marine mammal species or stocks. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

These requirements are described below under ''Data Collection'' and ''LOA Reporting.'' Additional comprehensive reporting, across LOA-holders on an annual basis, is also required and is described below under ''Comprehensive Reporting.''

More specifically, 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 To Monitoring and Reporting From the Notice of Proposed Rulemaking

Here we summarize substantive changes to monitoring and reporting requirements from the notice of proposed rulemaking. All changes were made on the basis of review of public comments received and/or review of new information.

- Although NMFS recognizes the importance of producing the most accurate estimates of actual take possible, we agree that the specific approach described in the proposed rule for correcting observations to produce estimates of actual takes is novel in that it has not been previously required of applicants conducting similar activities and, therefore, its appropriateness for application to observations conducted from working source vessels (versus research vessels) is unknown. As suggested through public comment, NMFS will continue to evaluate the best method for producing accurate estimates of actual take, based on marine mammal detections, through the adaptive management process, including consideration of the Marine Mammal Commission-recommended method included in the proposed regulations.
- NMFS has revised requirements relating to reporting of injured or dead marine mammals and has added newly crafted requirements relating to actions that should be taken in response to notification of live stranding events in

certain circumstances, in order to reflect current best practice.

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 indicating successful completion of an acceptable PSO training course; submitted resumes should not include superfluous information. In order for a PSO training course to be deemed acceptable by NMFS (in consultation with BOEM/BSEE), the agencies must, at minimum, review 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. Absent a waiver (discussed below), 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; 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.

In addition, it is recommended that PSOs meet the following requirements:

• 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 (vision 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; and

• 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.

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 formally administer any PSO training program or endorse specific providers but will approve PSOs that have successfully completed courses that meet the curriculum and trainer requirements specified herein and, therefore, are deemed acceptable. To be deemed acceptable, training should adhere 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.

For all deep penetration surveys, the vessel operator must provide bigeye binoculars of appropriate quality (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) 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. Other required equipment, which should be made available to PSOs by the third-party observer provider, includes reticle binoculars of appropriate quality (*e.g.,* 7 x 50), GPS, digital camera with a telephoto lens (the camera or lens should also have an image stabilization system) that is at least 300 mm or equivalent on a full-frame single-lens reflex, 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

Use of towed PAM is required for deep penetration surveys. Monitoring of a towed PAM system is required at all times for these surveys, from 30 minutes prior to ramp-up, throughout all use of the acoustic source, and for 60 minutes following cessation of survey activity. Towed PAM systems should consist of hardware (*e.g.,* hydrophone array, recorder, cables) and software (*e.g.,* data processing program and algorithm). Some type of automated detection software must be used. Acoustic 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, detection of signals due to vessel and flow noise, low accuracy in localization) and there are no formal guidelines currently in place regarding specifications for hardware, software, or operator training requirements.

NMFS' 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 shall 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. In terms of calibrating the rest of the system, the signal route to the data recorder and monitoring software shall be calibrated so that the binary amplitude data written to hard disk can be converted into units of acoustic pressure. The configuration of 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. GPS data acquisition is recommended for all PAM operations. If the PAM plan (see below) claims an ability to localize, every localization estimate obtained from a PAM system must be accompanied by some estimate of uncertainty and ambiguity.

In the absence of formal standards addressing any of these three facets of PAM technology, all applicants must provide a PAM plan including description of the hardware and software proposed for use prior to proceeding with any survey where PAM is required. Following the survey, a validation document must be submitted as part of required reporting (see below). The purpose of the PAM plan is to demonstrate that the PAM system being proposed for use is adequate for addressing the mitigation goals. The plan shall include methodology and documentation requirements for all stages of the project. 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. Where relevant, the plan should address the potential for PAM deployment on a receiver vessel or other associated vessel separate from the acoustic source.

Species clusters—The plan shall list the species of concern during the upcoming operation. While some species may be listed individually for special attention, in many circumstances it is expected that for the purposes of a PAM operation multiple species can be grouped together in a ''cluster'' that shares similar acoustic and behavioral characteristics (*e.g.,* sperm whale, beaked whales). The plan must specify a target minimum detection (and possibly localization) range for each species cluster used in the document. Different ranges can be defined for different operational conditions. The PAM system may exceed this detection range, but shall always be capable of achieving this minimum detection range.

Hardware and software specifications—The plan shall have a section dedicated to demonstrating that the PAM hardware is sensitive enough to detect signals from the species clusters of concern at the target minimum detection ranges specified. The plan should include a hardware specification table and hardware performance diagram. The diagram will show the sensitivity and bandwidth of the combined array hardware and recording system, as well as the received levels required for a given species cluster to be detectable at the target minimum detection range. The overall goal of the diagram is to visually demonstrate that the planned PAM array/recording system would have the capability of detecting various species clusters at required target ranges, provided that background noise levels are not an issue.

Operational conditions—The validation document should demonstrate whether the PAM system has been compromised by excessive background noise, whether that noise is electronic interference, flow, platform, or environmental noise. Therefore, the plan shall define a set of ''operational conditions'' under which detection statistics (background noise profiles) will be categorized during the project. Operational conditions consist of three categories: Platform activity and status, mitigation (activity) status, and environmental status.

Operating procedures—The plan shall describe the level of effort that is reasonably expected to occur for the monitoring requirements. For every species cluster, the plan should detail which part of the PAM display would be used for detecting that cluster. For example, if a scrolling spectrogram display is being used for a species cluster, then the spectrogram's fast Fourier transform sample size, frequency bandwidth, and their refresh rate shall be specified. Similar details would be provided for other software tools, such as click detectors and other automated detectors and classifiers. The plan shall also provide a screenshot of the expected monitor display.

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 must report all cetacean detections. While not required prior to development of formal standards for PAM use, NMFS recommends that vessel self-noise assessments be 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 electronic data forms. 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. NMFS requires that, at a minimum, the following information be reported:

- Vessel names (source vessel and other vessels associated with survey), vessel size and type, maximum speed capability of vessel, port of origin, and call signs;
- PSO names and affiliations;
- Dates of departures and returns to port with port name;
- Dates and participants of PSO briefings;
- 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 and vessel location at beginning and end of visual PSO duty shifts;
- Vessel location at 30 second intervals (if software capability allows) or 5 minute intervals (if location must be manually recorded);
- 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 Beaufort scale and any other relevant weather conditions including cloud cover, fog, sun glare, night, and overall visibility to the horizon;
- Vessel location when environmental conditions change significantly;
- Factors that may have contributed 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 an array, tow depth of an acoustic source, and any other notes of significance (*i.e.,* pre-clearance, 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 and PSO location (including height above water) at time of sighting;
  - 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 method of estimating distance) and its heading relative to vessel at initial sighting;
  - Identification of the animal (*e.g.,* genus/species, lowest possible taxonomic level, or unidentified) and PSO confidence in identification; 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); 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.

LOA Reporting

PSO effort, survey details, and sightings data should be recorded continuously during surveys. Reports must include all information described above under ''Data Collection,'' including amount and location of line-kms surveyed and all marine mammal observations with closest approach distance. Reports must be submitted to NMFS within 90 days of survey completion or following expiration of an issued LOA. In the event that an LOA is issued for a period exceeding one year, annual reports must be submitted during the period of validity. The draft report must be accompanied by a certification from lead PSOs as to the accuracy of the report. A final report must be submitted within 30 days following resolution of any comments on the draft report.

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 LOA-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 (if PAM was required), which should include necessary noise validation diagrams (NVD) and demonstrate whether background noise levels on the PAM deployment limited achievement of the planned detection goals. A separate diagram shall be produced for every background noise percentile chosen for analysis. Background noise percentiles, rather than a simple average of the data, are required because the highly non-stationary characteristics of many background noise profiles cannot be described by a simple mean. For example, data collected during a seismic survey will have short periods of time containing high-intensity pulses and longer periods of time dominated by lower levels of reverberation. Taking a simple mean of these noise data would imply background noise levels substantially higher than what may actually have been present between seismic pulses. A validation report would typically contain between three to five diagrams, depending on the number of percentiles analyzed. At a minimum, the validation report should contain three diagrams that include the 50th percentile (median), 5th percentile, and 95th percentile. The 25th percentile and 75th percentile may also be included. In each percentile diagram, a separate background noise curve shall be drawn for each defined operational condition. In general, the NVD should be generated from the data stream that is used for detecting the presence of marine mammal signals. For example, if beamforming or some other form of array gain has been applied before invoking signal detection, then the NVD should be generated using the beamformed data, and not omnidirectional data. The complete set of NVDs, one for each percentile of interest, combined with a table that lists the fraction of time the activity was in each operational state, provides a means of reviewing the background noise-limitations encountered by the PAM system during various operational conditions. Actual marine mammal detections should be plotted on this diagram for a reasonableness check on the expected received levels. Overall, the validation document should reiterate all the goals and parameters stated in the planning document and verify that goals were/were not met, why, changes, etc. Also, the validation document should state whether the planning was suited to the needs of the survey and met the required mitigation standards.

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, it may be appropriate to make observational data corrections with respect to assumed species-specific detection probability as evaluated through consideration of environmental factors (*e.g., f*(0)). Appropriate methods will be considered through the adaptive management process.

The report must include a post-survey estimate of the instances of take of each species utilizing the line miles of survey actually conducted and the same methods used to initially predict the estimated take in the LOA application. Depending on the length and dates of the survey, LOA-holders may be required to segment take estimates into specific years to support the administration of the rule.

Comprehensive Reporting

Individual LOA-holders will be responsible for collecting and submitting monitoring data to NMFS, as described above. In addition, on an annual basis, LOA-holders will also collectively be responsible for compilation and analysis of those data for inclusion in subsequent annual synthesis reports. Individual LOA-holders may collaborate to produce this report or may elect to have their trade associations support the production of such a report. These reports would summarize the data presented in the individual LOA-holder reports, provide analysis of these synthesized results, discuss the implementation of required mitigation, and present any recommendations. This comprehensive annual report would be the basis of an annual adaptive management process (described below in Adaptive Management). The following topics will be described in comprehensive reporting:

• Summary of geophysical survey activity by survey type, geographic zone (*i.e.,* the seven zones described in the modeling report), month, and acoustic source status (*e.g.,* inactive, ramp-up, full-power, power-down);

• Summary of monitoring effort (on-effort hours and/or distance) by acoustic source status, location, and visibility conditions (for both visual and acoustic monitoring);

• Summary of mitigation measures implemented (*e.g.,* delayed ramp-ups, shutdowns, course alterations for vessel strike avoidance) by survey type and location;

- Sighting rates of marine mammals during periods with and without acoustic source activities and other variables that could affect detectability of marine mammals, such as:
  - Initial sighting distances of marine mammals relative to source status;
  - Closest point of approach of marine mammals relative to source status;
  - Observed behaviors and types of movements of marine mammals relative to source status;
  - Distribution/presence of marine mammals around the survey vessel relative to source status; and
  - Analysis of the effects of various factors influencing the detectability of marine mammals (*e.g.,* wind speed, sea state, swell height, presence of glare or fog).
- Estimates of total take across all activities for which take is authorized based on actual survey effort and original estimation method;
- Summary and conclusions from monitoring in previous year; and
- Recommendations for adaptive management.

Each annual comprehensive report should cover one full year of monitoring effort and must be submitted for review each year. Each report should analyze survey and monitoring effort described in reports submitted by individual LOA-holders during a given one-year period, beginning from the date of effectiveness of these regulations. Each annual comprehensive report must be submitted for review 90 days following conclusion of the annual reporting period.

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 LOA-holder shall report the incident to the Office of Protected Resources (OPR), NMFS and to the regional stranding network 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 LOA-holder shall report the incident to OPR, NMFS and to the regional stranding network 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

For deep penetration surveys, 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 LOA-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 LOA-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 LOA-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 LOA-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 LOA-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; or,
- Necropsies with findings of pathologies that are unusual for the species or area.

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 Analysis 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' 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 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).

For each potential activity-related stressor, NMFS considers 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, was addressed under Mitigation and in the Potential Effects of the Specified Activity on Marine Mammals section of this notice and the notice of proposed rulemaking and are not discussed further, as there are minimal risks expected from these potential stressors.

The ''specified activity'' for these regulations is a broad program of geophysical survey activity that could occur at any time of year in U.S. waters of the GOM, within the specified geographical region as updated by BOEM (*i.e.,* excluding the GOMESA leasing moratorium area). In recognition of the broad scale of this activity in terms of geographic and temporal scales, we use a new analytical methodology—first described by Ellison *et al.* (2015) and proposed for use and discussed in detail in the notice of proposed rulemaking—through which an explicit, systematic risk assessment framework is applied to evaluate potential effects of aggregated discrete acoustic exposure events (*i.e.,* proposed geophysical survey activities) on marine mammals. This risk assessment framework is one component of the overall negligible impact analysis. Development of the approach was supported collaboratively by BOEM and NMFS, which together provided guidance to an expert working group (EWG) in terms of application to relevant regulatory processes. The risk assessment framework (or EWG framework) is described by Southall *et al.* (2017), which is available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-oil-and-gas.* That document is a companion to this analysis, and is referred to hereafter as the ''EWG report.'' The risk assessment framework is also described below. It was developed and implemented by the EWG in relation to the specified activity described in the proposed rule, provided for public review in association with the notice of proposed rulemaking (Southall *et al.,* 2017), and subsequently refined in response to public comment and in consideration of the updated scope of the activity. We incorporate the framework and its results into this analysis.

The EWG framework described below comprehensively considers the aggregate impacts to marine mammal populations from the activities addressed in this rule in the context of both (1) the severity of the impacts and (2) the vulnerability of the affected species. However, it does not consider the effects of the mitigation required through these regulations in identifying risk ratings for the affected species. In addition, while the EWG framework comprehensively considers the spatial and temporal overlay of the activities and the marine mammals in the GOM, as well as the number of takes predicted by the described modeling (both in the proposed rule, and as updated in this final rule), there are details about the nature of any ''take'' anticipated to result from these activities that were not considered directly in the EWG framework analysis that warrant explicit consideration in the negligible impact determination. Last, the EWG framework analysis addresses impacts to guilds in some cases where there is not specific information to further support species-specific findings. Accordingly, following the description of the EWG framework below, NMFS highlights a few factors regarding the nature of the predicted ''takes'' and then brings together the results of implementation of the EWG framework, these additional factors, and the anticipated effects of the mitigation to summarize the negligible impact analysis for each of the affected species or stocks.

EWG Risk Assessment

The acoustic exposure modeling (Zeddies *et al.,* 2015, 2017a) provided marine mammal noise exposure estimates based on BOEM-provided projections of future survey effort and best available modeling of sound propagation, animal distribution, and animal movement. This provided a conservative but reasonable best estimate of potential acute noise exposure events that may result from the described suite of activities, and formed the basis for the analysis in the proposed rule. BOEM subsequently updated the scope of its activity, which reduced the amount of activity overall through removal of projected activity in the eastern GOM (see Table 1 and Figure 2). Acoustic exposure estimates were updated by BOEM accordingly (based on the same modeling presented in the proposed rule) and these revised estimates form the basis for this updated analysis.

The primary goal of this new analytical effort was to develop a systematic risk assessment framework that would use the modeling results to put into biologically-relevant context the level of potential risk of injury and/or disturbance to marine mammals. The risk assessment framework considers both the aggregation of acute effects and the broad temporal and spatial scales over which chronic effects may occur. Previously, Wood *et al.* (2012) conducted an analysis of a proposed airgun survey, in which the authors derived a qualitative risk assessment method of considering the biological significance of exposures predicted to be consistent with the onset of physical injury and behavioral disturbance. Subsequently, Ellison *et al.* (2015) described development of a more systematic and (in some cases) quantitative basis for a risk assessment approach to assess the biological significance and potential population consequences of predicted noise exposures. The approach for this final rule, which incorporates the revised acoustic exposure modeling results as an input, includes certain modifications to and departures from the conceptual approach described by Ellison *et al.* (2015). These are described in greater detail in the EWG report.

Generally, this approach is a relativistic risk assessment that provides an interpretation of the exposure estimates within the context of key biological and population parameters (*e.g.,* population size, life history factors, compensatory ability of the species, animal behavioral state, aversion), as well as other biological, environmental, and anthropogenic factors. This analysis as updated since BOEM revised the scope of its action was performed on a species-specific basis within each modeling zone (Figure 3) for a high-effort scenario (represented by Year 1 of BOEM's revised effort projections) and a moderate-effort scenario (represented by Year 4 of BOEM's revised effort projections). (For most species, the maximum annual take occurs under the Year 1 scenario. The two exceptions are the bottlenose dolphin and Atlantic spotted dolphin, for which the maximum annual take occurs under the Year 4 scenario.) The end result provides an indication of the biological significance of these exposure numbers for each affected marine mammal stock (*i.e.,* yielding the severity of impact and vulnerability of stock/population information), and forecasts the likelihood of any such impact. This result is expressed as relative impact ratings of overall risk that couple potential severity of effect on a stock and likely vulnerability of the population to the consequences of those effects, given biologically relevant information (*e.g.,* compensatory ability).

Spectral, temporal, and spatial overlaps between survey activities and animal distribution are the primary factors that drive the type, magnitude, and severity of potential effects on marine mammals, and these considerations are integrated into both the severity and vulnerability assessments. In discussion with BOEM and NMFS, the EWG developed a strategic approach to balance the weight of these considerations between the two assessments, specifying and clarifying where and how the interactions between potential disturbance and species within these dimensions are evaluated. Overall ratings are then considered in conjunction with the required mitigation (and any additional relevant contextual information) to ultimately inform our determinations. Elements of this approach are subjective and relative within the context of this program of projected actions and, overall, the analysis necessarily requires the application of professional judgment.

Severity of Effect

Level A Harassment—In order to evaluate the potential severity of the expected potential takes by Level A harassment (accounting for aversion) (Table 9) on the species or stock, the EWG framework uses a potential biological removal (PBR)-equivalent metric. As described previously, PBR is 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. To be clear, NMFS does not expect any of the potential occurrences of injury (*i.e.,* permanent threshold shift (PTS)) that may be authorized under this rule to result in mortality of marine mammals, nor should Level A harassment be considered a ''removal'' in the context of PBR when used to inform a negligible impact determination. PTS is not appropriately considered equivalent to serious injury. However, PBR can serve as a gross indicator of the status of the species and a good surrogate for population vulnerability/health and, accordingly, PBR or a related metric can be used appropriately to inform a separate analysis to evaluate the potential relative severity to the population of a permanent impact such as PTS on a given number of individuals. This analysis is used to assess relative risks to populations as a result of PTS; NMFS does not expect that Level A harassment could directly result in mortality and our use of the PBR metric in this context should not be interpreted as such.

However, exposure estimates generated using habitat-based density models (Roberts *et al.,* 2016) cannot appropriately be directly related to the PBR values found in NMFS' SARs. Therefore, a modified PBR value was derived on the basis of the typical pattern for NMFS' PBR values, where the value varies between approximately 0.6–0.9 percent of the minimum population abundance depending upon population confidence limits (higher with increasing confidence). For endangered species, PBR values are typically ⅕ of the values for non-endangered species due to assumption of a lower recovery factor—endangered species are typically assigned recovery factors of 0.1, while species of unknown status relative to the optimum sustainable population level (*i.e.,* most species) are typically assigned factors of 0.5. This basic relationship of population size relative to PBR was used to define the following relative risk levels due to Level A harassment.

- Very high—Level A harassment greater than 1.5 or 0.3 percent (the latter figure is used for endangered species) of zone-specific estimated population abundance.
- High—0.75–1.5 or 0.15–0.3 percent of zone-specific population.
- Moderate—0.375–0.75 or 0.075–0.15 percent of zone-specific population.
- Low—0.075–0.375 or 0.015–0.075 percent of zone-specific population.
- Very low—less than 0.075 or less than 0.015 percent of zone-specific population.

Relative severity scores by zone (Figure 3) and species were determined for high and moderate annual effort scenarios. As described previously, we do not believe that Level A harassment is likely to actually occur for mid-frequency cetaceans and therefore do not predict (nor will we authorize) any take by Level A harassment for these species (*i.e.,* most species in the GOM).

Bryde's whales (a low-frequency cetacean species) are expected to be present primarily in Zones 1 and 4 (though may be present to a lesser extent in Zones 2 and 5). BOEM's update to the geographic scope of its action removed the entirety of Zone 1 and the majority of Zone 4 from consideration in this rule. Altogether, no incidents of Level A harassment are predicted for Bryde's whales.

Kogia spp. (high-frequency cetacean species) are primarily present in Zones 4–7. We assess the relative severity resulting from injury for *Kogia* spp. to be ''very high'' in Zones 5–7 under both evaluated activity scenarios. In Zone 4, relative severity is ''high'' under the moderate effort scenario, and no activity is projected in Zone 4 under the high effort scenario.

In summary, we assess that there is no risk of Level A harassment for any mid-frequency cetacean species. Overall severity associated with take by Level A harassment is expected to be very high for *Kogia* spp. and very low for Bryde's whales, as no incidents of Level A harassment are predicted for the stock.

We note that regardless of the relative risk assessed in this framework, because of the anticipated received levels and duration of sound exposure expected for any marine mammals exposed above Level A harassment criteria, no individuals of any species or stock are expected to receive more than a relatively minor degree of PTS, which would not be expected to meaningfully increase the likelihood or severity of any potential population-level effects. See "Loss of Hearing Sensitivity," below, for additional discussion.

Level B Harassment—As described above in Estimated Take, a significant model assumption was that populations of animals were reset for each 24-hr period. Exposure estimates for the 24-hr period were then aggregated across all assumed survey days as completely independent events, assuming populations turn over completely within each large zone on a daily basis. In order to evaluate modeled daily exposures and determine more realistic exposure probabilities for individuals across multiple days, we used information on species-typical movement behavior to determine a species-typical offset of modeled daily exposures, using the exploratory analysis discussed under Estimated Take (*i.e.,* Test Scenario 1). In this test scenario, modeled results were compared for a 30-day period versus the aggregation of 24-hr population reset intervals. When conducting computationally-intensive modeling over the full assumed 30-day survey period (versus aggregating the smaller 24-hr periods for 30 days), results showed about 10–45 percent of the total number of takes calculated using a 24-hr reset of the population, with differences relating to species-typical movement and residency patterns. Given that many of the evaluated survey activities occur for 30-day or longer periods, particularly some of the larger surveys for which the majority of the modeled exposures occur, using such a scaling process is appropriate in order to evaluate the likely severity of the predicted exposures and to estimate take for the purposes of LOA applications and predicting the number of individual marine mammals taken during the course of a single survey (although, as noted previously, for surveys significantly longer than 30 days, the take numbers with this scaling applied would still be expected to overestimate the number of individuals, given the greater degree of repeat exposures that would be expected the longer the survey goes on). This output was used in a severity assessment. This approach is also discussed in more detail in the EWG report.

Similar to the evaluation of severity for Level A harassment, the scaled Level B harassment takes were rated through a population-dependent binning system. For each species, scaled takes were divided by the zone-specific predicted abundance, and these proportions were used to evaluate the relative severity of modeled exposures based on the distribution of values across species to evaluate risk associated with behavioral disruption across species—a simple, logical means of evaluating relative risk across species and areas. Relative risk ratings using percent of area population size were defined as follows:

- Very high—Adjusted Level B harassment takes greater than 800 percent of zone-specific population;
- High—Adjusted Level B harassment takes 401–800 percent of zone-specific population;
- Moderate—Adjusted Level B harassment takes 201–400 percent of zone-specific population;
- Low—Adjusted Level B harassment takes 100–200 percent of zone-specific population; and
- Very low—Adjusted Level B harassment takes less than 100 percent of zone-specific population.

Vulnerability of Affected Population

Vulnerability rating seeks to evaluate the relative risk of a predicted effect given species-typical and population-specific parameters (*e.g.,* species-specific life history, population factors) and other relevant interacting factors (*e.g.,* human or other environmental stressors). The assessment includes consideration of four categories within two overarching risk factors (species-specific biological and environmental risk factors). These values were selected to capture key aspects of the importance of spatial (geographic), spectral (frequency content of noise in relation to species-typical hearing and sound communications), and temporal relationships between sound and receivers. Explicit numerical criteria for identifying scores were specified where possible, but in some cases qualitative judgments based on a reasonable interpretation of given aspects of the proposed activity and how it relates to the species in question and the environment within the specified area were required. Factors considered in the vulnerability assessment were detailed in Southall *et al.* (2017) and are reproduced here (Table 11). Note that the effects of the Deepwater Horizon oil spill are accounted for through the non-noise chronic anthropogenic risk factor identified below, while the effects to acoustic habitat and on individual animal behavior via masking (summarized in Potential Effects of the Specified Activity on Marine Mammals and Their Habitat and described in detail in that section of the notice of proposed rulemaking) are accounted for through the masking and chronic anthropogenic noise risk factors. Species-specific vulnerability scoring according to this scheme is shown in Table 12. Zone-specific vulnerability ratings corresponding with the scores given in Table 12 below are provided in Tables 8–10 of the EWG report.

TABLE 11—VULNERABILITY ASSESSMENT FACTORS

	Score
Masking: Degree of spectral overlap between biologically important acoustic signals and predominant noise source of proposed activity (max: 7 out of 30):	
Communication masking: Predominant noise energy directly/partially overlaps [1] species-specific signals utilized for communication.	+3/+1
Foraging masking: Predominant noise energy directly/partially overlaps[1] species-specific signals utilized in foraging (including echolocation and other foraging coordination signals).	+2/+1
Navigation/Orientation signal masking: Predominant noise energy directly/partially overlaps[1] signals likely utilized in spatial orientation to which species is well capable of hearing.	+2/+1
Species population: Stock status, trend, and size (max: 7 out of 30):	
Population status: Endangered (ESA) and/or depleted (MMPA) (Y/N)	+3/0
Trend rating: Decreasing/unknown or data deficient/stable (*i.e.,* within 5 percent)/increasing (last three SARs for which new population estimates were updated).	+2/+1/0/−1
Population size: Small (less than 2,500)	+2
Species habitat use and compensatory abilities: Degree to which activity within a specified area [2] overlaps with species habitat and distribution (max: 7 out of 30):	
Habitat use: Survey area contains greater than 30/15–30/5–15/less than 5 percent of total region-wide estimated population (during defined survey period).	+4/+2/+1/0

TABLE 11—VULNERABILITY ASSESSMENT FACTORS—Continued

	Score
Temporal sensitivity: Survey overlaps temporally with well-defined species-specific biologically-important period (*e.g.,* calving).	Up to +3
Other (chronic) noise and non-noise stressors: Magnitude of other potential sources of disturbance or other stressors that may influence a species response to additional noise and disturbance of the proposed activity (max: 9 out of 30):	
Chronic anthropogenic noise: Species subject to high/moderate degree of current or known future (overlapping activity) chronic anthropogenic noise.	+2/+1
Chronic anthropogenic risk factors (non-noise): Species subject to high/moderate degree of current or known future risk from other chronic, non-noise anthropogenic activities (*e.g.,* fisheries interactions, ship strike).	Up to +4/+2
Chronic biological risk factors (non-noise): Known presence of disease, parasites, prey limitation, or high predation pressure.	Up to +3

[1] Direct or partial overlap means that the predominant spectral content of received noise exposure from activity specific sources is expected to occur at identical frequencies as signals of interest, or that secondary (lower-level) spectral content of received noise exposure from activity specific sources is expected to occur at identical frequencies as signals of interest.

[2] This is the area over which an activity is evaluated and a local population is determined, in this case the seven modeling zones.

TABLE 12—VULNERABILITY ASSESSMENT SCORING [1]

Species	Communication	Foraging	Navigation	Status	Trend	Size	Habitat	Time	Chronic noise	Chronic other	Biological risk	Total score range
Bryde's whale	3	2	2	3	2	2	0–4	0–1	1–2	0–3	0	16–23
Sperm whale	1	1	2	3	2	2	0–4	0–1	1–2	0–3	0	14–18
Kogia spp.	0	0	1	0	2	2	0–4	0–1	1–2	0–3	0	8–13
Beaked whale	0	0	1	0	1	0	0–4	0–1	1–2	0–3	1	6–13
Rough-toothed dolphin	0	0	1	0	2	0	1–4	0–1	1–2	0–3	0	6–10
Bottlenose dolphin	1	0	1	0	−1	0	0–4	0–1	1–2	0–3	0	2–10
Clymene dolphin	0	0	1	0	2	0	0–4	0–1	1–2	0–3	0	6–10
Atlantic spotted dolphin	1	0	1	0	1	0	0–4	0–1	1–2	0–3	2	6–14
Pantropical spotted dolphin	0	0	1	0	2	0	0–4	0–1	1–2	0–3	0	6–10
Spinner dolphin	0	0	1	0	0	0	0–4	0–1	1–2	0–3	0	3–9
Striped dolphin	0	0	1	0	2	0	0–4	0–1	1–2	0–3	0	6–10
Fraser's dolphin	0	0	1	0	1	2	0–4	0–1	1–2	0–3	0	7–11
Risso's dolphin	0	0	1	0	−1	0	0–4	0–1	1–2	0–3	1	4–9
Melon-headed whale	0	0	1	0	2	0	0–4	0–1	1–2	0–3	0	6–10
Pygmy killer whale	0	0	1	0	2	2	0–4	0–1	1–2	0–3	0	8–12
False killer whale	0	0	1	0	−1	0	0–4	0–1	1–2	0–3	0	3–7
Killer whale	1	0	1	0	2	2	0–4	0–1	1–2	0–3	0	9–12
Short-finned pilot whale	1	0	1	0	0	2	0–4	0–1	1–2	0–3	1	7–13

[1] Factors with a single value presented are those that remain constant across zones; other factors vary based on zone and a range of values is presented.

TABLE 13—VULNERABILITY RATING SCHEME

Total score	Risk probability (% of total)	Vulnerability rating
24–30	80–100	Very high.
18–23	60–79	High.
12–17	40–59	Moderate.
6–11	20–39	Low.
0–5	0–19	Very low.

Risk

In the final step of the framework, severity and vulnerability ratings are integrated to provide relative impact ratings of overall risk. Severity and vulnerability assessments each produce a numerical rating (1–5) corresponding with the qualitative rating (*i.e.,* very low, low, moderate, high, very high). A matrix is then used to integrate these two scores to provide an overall risk assessment. The matrix is shown in Table 2 of Southall *et al.* (2017).

The likely severity of effect was assessed as the percentage of total population affected based on scaled modeled Level B harassment takes relative to zone population size. There is no risk due to the effects of survey activity when there is no survey activity in a given zone for a given effort scenario. However, a stock's inherent zone-specific vulnerability score drives the risk rating in those zones (Zone 1 under any activity scenario and Zone 4 under the high effort scenario), and risk ratings for all zones are considered together in generating scenario-specific GOM-wide risk ratings for each species. Also, zones predicted to contain abundance of less than 0.05 percent of the GOM-wide population for a species were considered to have *de minimis* risk and are not included in derivation of the stock-specific GOM-wide rating.

Table 14 provides relative impact ratings by zone, and Table 15 provides GOM-wide relative impact ratings, for overall risk associated with predicted takes by Level B harassment, for representative high and moderate effort scenarios.

TABLE 14—OVERALL EVALUATED RISK BY ZONE AND ACTIVITY SCENARIO

Species	Zone 1[1]		Zone 2		Zone 3		Zone 4[1]		Zone 5		Zone 6		Zone 7	
	H	M	H	M	H	M	H	M	H	M	H	M	H	M
Bryde's whale	L	L	L	L	n/a	n/a	L	L	L	L	n/a	n/a	n/a	n/a
Sperm whale	n/a	n/a	n/a	n/a	n/a	n/a	L	L	VH	VH	M	L	L	L
Kogia spp.	VL	VL	n/a	n/a	n/a	n/a	L	L	H	M	L	VL	VL	VL
Beaked whale	n/a	n/a	n/a	n/a	n/a	n/a	VL	VL	VH	VH	H	M	M	L
Rough-toothed dolphin	VL	VL	L	M	VL	VL	VL	VL	H	M	M	L	VL	VL
Bottlenose dolphin	VL	VL	H	H	VL	VL	VL	VL	VL	VL	n/a	n/a	n/a	n/a
Clymene dolphin	n/a	n/a	n/a	n/a	n/a	n/a	VL	VL	H	M	M	L	VL	VL
Atlantic spotted dolphin	L	L	H	VH	VL	VL	VL	VL	M	L	n/a	n/a	n/a	n/a
Pantropical spotted dolphin	VL	VL	n/a	n/a	n/a	n/a	VL	VL	H	M	L	VL	L	L
Spinner dolphin	VL	VL	n/a	n/a	n/a	n/a	VL	VL	H	M	n/a	n/a	VL	VL
Striped dolphin	n/a	n/a	n/a	n/a	n/a	n/a	VL	VL	H	M	L	VL	L	VL
Fraser's dolphin	VL	VL	VL	VL	VL	VL	VL	VL	M	L	L	VL	VL	VL
Risso's dolphin	VL	VL	n/a	n/a	n/a	n/a	VL	VL	H	M	M	VL	VL	VL
Melon-headed whale	VL	VL	n/a	n/a	n/a	n/a	VL	VL	H	M	M	VL	VL	VL
Pygmy killer whale	VL	VL	n/a	n/a	n/a	n/a	VL	VL	M	L	L	VL	VL	VL
False killer whale	VL	VL	VL	VL	VL	VL	VL	VL	H	M	L	VL	VL	VL
Killer whale	VL	VL	VL	VL	VL	VL	VL	VL	L	L	VL	VL	L	L
Short-finned pilot whale	n/a	n/a	n/a	n/a	n/a	n/a	VL	VL	M	M	M	VL	VL	VL

H = Year 1 (representative high effort scenario); M = Year 4 (representative moderate effort scenario).
n/a = less than 0.05% of GOM-wide population predicted in zone.
VL = very low; L = low; M = moderate; H = high; VH = very high.
[1] No activity would occur in Zone 1, and no activity is projected in Zone 4 under the high effort scenario.

TABLE 15—OVERALL EVALUATED RISK BY ACTIVITY SCENARIO, GOM-WIDE

Species	High effort scenario (Year 1)	Moderate effort scenario (Year 4)
Bryde's whale	Low	Low.
Sperm whale	Moderate[1]	Low.
Kogia spp.	Low	Very low.
Beaked whales	High[1]	Moderate.[1]
Rough-toothed dolphin	Very low	Very low.
Bottlenose dolphin (shelf/coastal)	Very low	Very low.
Bottlenose dolphin (oceanic)	Very low	Very low.
Clymene dolphin	Low	Low.[1]
Atlantic spotted dolphin	Low	Low.
Pantropical spotted dolphin	Low	Very low.
Spinner dolphin	Very low	Very low.
Striped dolphin	Low	Very low.
Fraser's dolphin	Very low	Very low.
Risso's dolphin	Very low	Very low.
Melon-headed whale	Very low	Very low.
Pygmy killer whale	Very low	Very low.
False killer whale	Very low	Very low.
Killer whale	Very low	Very low.
Short-finned pilot whale	Low	Low.[1]

[1] For these ratings, the median value across zones for the scenario fell between two ratings, and the higher rating is presented.

In order to characterize the relative risk for each species across their entire range in the GOM, the EWG analysis used the median of the seven zone-specific risk ratings for each activity scenario (high and moderate effort), not counting those in which less than 0.05 percent of the GOM-wide abundance occurred, to describe a GOM-wide risk rating for each of the representative activity scenarios (Table 15).

Overall, the results of the risk assessment show that (as expected), risk is highly correlated with effort and density. Areas where little or no survey activity is predicted to occur or areas within which few or no animals of a particular species are believed to occur have very low or no potential risk of negatively affecting marine mammals, as seen across activity scenarios in Zones 1, 3, and 4. Areas with consistently high levels of effort (Zones 2, 5, 6, and 7) are generally predicted to have higher overall evaluated risk across all species. However, fewer species of animals are expected to be present in Zone 2, where we primarily expect shelf species such as bottlenose and Atlantic spotted dolphins. In Zone 7, animals are expected to be subject to less other chronic noise and non-noise stressors, which is reflected in the vulnerability scoring for that zone. Therefore, despite consistently high levels of projected effort, overall rankings for that zone are lower than for Zones 5 and 6.

Zones 2 and 5 were the only zones with ''very high'' levels of risk due to behavioral disturbance, identified for two species of particular concern in Zone 5 (beaked and sperm whales) and for Atlantic spotted dolphins in Zone 2 (moderate effort scenario only). As particularly sensitive species, beaked whales and sperm whales consistently receive relatively high severity scores. For sperm whales, this sensitivity is manifest through typically higher vulnerability scoring, whereas the assumed sensitivity of beaked whales to noise exposure is expressed through the application of behavioral harassment criteria (Table 6) and, therefore, relatively high assumed take numbers. Bottlenose dolphins and Atlantic spotted dolphin are generally the only species expected to commonly occur in relatively shallow waters of the continental shelf (Zones 1–3) and relatively high risk is assessed for these species in Zone 2, across activity scenarios. Relatively moderate levels of risk were also identified for other species in some contexts, and these are generally explained by the interaction of specific factors related to survey effort concentration and areas of heightened geographic distribution or specific factors related to population trends or zone-related differences in vulnerability. Overall, following BOEM's update to the geographic scope of activity (with the entirety of Zone 1, most of Zone 4, and one-third of Zone 7 removed from consideration here; see Table 1) the greatest relative risk across species is generally seen in Zones 5 and 6.

When considered across both representative activity scenarios (Table 15), only beaked whales are considered to have relatively high risk (under the high effort scenario only). Relatively moderate risk is assessed for beaked whales under the moderate effort scenario. Relatively moderate risk is also assessed for sperm whales under the high effort scenario. The rest of the species have no more than low to very low risk under either scenario. Shelf/coastal and oceanic bottlenose dolphin stocks, rough-toothed dolphins, spinner dolphins, Fraser's dolphins, Risso's dolphins, melon-headed whales, pygmy killer whales, false killer whales, and killer whales are assessed as having no greater than very low relative risk under any scenario.

Although the scores generated by the EWG framework and further aggregated across zones (as described above) are species-specific, additional stock-specific information can be gleaned through the zone-specific nature of the analysis. For example, with some bottlenose dolphin stocks, the zones align with stock range edges. The oceanic stock of bottlenose dolphins occurs within Zones 4–7, while coastal and shelf stocks occur within Zones 1–3 (sufficient information is not available to attribute takes on a stock-specific basis in Zones 1–3). These species-specific risk ratings are broadly applied in NMFS' negligible impact analysis to all of the multiple stocks that are analyzed in this rule (Table 4). However, NMFS is also considering additional stock-specific information in our analysis, where appropriate, as indicated in our Description of Marine Mammals in the Area of the Specified Activity, Potential Effects of the Specified Activity on Marine Mammals and Their Habitat, and Mitigation sections (*e.g.,* coastal bottlenose dolphins were heavily impacted by the DWH oil spill, and we have therefore required a time/area restriction to reduce impacts).

Duration of Level B Harassment Exposures

In order to more fully place the predicted amount of take into meaningful context, it is useful to understand the duration of exposure at or above a given level of received sound, as well as the likely number of repeated exposures across days. While a momentary exposure above the criteria for Level B harassment counts as an instance of take, that accounting does not make any distinction between fleeting exposures and more severe encounters in which an animal may be exposed to that received level of sound for a longer period of time. Yet this information is meaningful to an understanding of the likely severity of the exposure, which is relevant to the negligible impact evaluation and not directly incorporated into the risk assessment framework described above. For example, for bottlenose dolphins exposed to noise from 3D WAZ surveys in Zone 6, the modeling report shows that approximately 72 takes (Level B harassment) would be expected to occur in a 24-hr period. However, each animat modeled has a record or time history of received levels of sound over the course of the modeled 24-hr period. The 50th percentile of the cumulative distribution function indicates that the time spent exposed to levels of sound above 160 dB rms SPL (*i.e.,* the 50 percent midpoint for Level B harassment) would be only 1.8 minutes—a minimal amount of exposure carrying little potential for significant disruption of behavioral activity. We provide summary information regarding the total average time in a 24-hr period that an animal would spend with received levels above 160 dB and between 140 and 160 dB in Table 16.

Additionally, as we discussed in the Estimated Take section of the notice of proposed rulemaking for Test Scenario 1 (and summarized above), by comparing exposure estimates generated by multiplying 24-hr exposure estimates by the total number of survey days versus modeling for a full 30-day survey duration for six representative species, we were able to refine the exposure estimates to better reflect the number of individuals exposed above threshold within a single survey. Using this same comparison and scalar ratios described above, we are able to predict an average number of days each of the representative species modeled in the test scenario were exposed above the Level B harassment thresholds within a single survey. As with the duration of exposures discussed above, the number of repeated exposures is important to an understanding of the severity of effects. For example, the ratio for beaked whales indicates that the 30-day modeling showed that approximately 10 percent as many individual beaked whales (compared to the results produced by multiplying average 24-hr exposure results by the 30-day survey duration) could be expected to be exposed above harassment thresholds. However, the approach of scaling up the 24-hour exposure estimates appropriately reflects the instances of exposure above threshold (which cannot be more than 1 in 24 hours), so the inverse of the scalar ratio suggests the average number of days in the 30-day modeling period that beaked whales are exposed above threshold is approximately ten. It is important to remember that this is an average and that it is likely some individuals would be exposed on fewer days and some on more. Table 16 reflects the average days exposed above threshold for the indicated species having applied the scalar ratios described previously.

TABLE 16—TIME IN MINUTES (PER DAY) SPENT ABOVE THRESHOLDS (50TH PERCENTILE) AND AVERAGE NUMBER OF DAYS INDIVIDUALS TAKEN DURING 30-DAY SURVEY

Species	Survey type and time (min/day) above 160 dB rms (50% take)				Survey type and time (min/day) above 140 dB rms (10% take)				Average number of days "taken" during 30-day survey
	2D	3D NAZ	3D WAZ	Coil	2D	3D NAZ	3D WAZ	Coil	
Bryde's whale	7.6	18.2	6.8	21.4	61.7	163.5	55.4	401.1	5.3
Sperm whale	5.2	10.3	4.0	20.7	12.0	31.8	10.7	25.2	2.4

TABLE 16—TIME IN MINUTES (PER DAY) SPENT ABOVE THRESHOLDS (50TH PERCENTILE) AND AVERAGE NUMBER OF DAYS INDIVIDUALS TAKEN DURING 30-DAY SURVEY—Continued

Species	Survey type and time (min/day) above 160 dB rms (50% take)				Survey type and time (min/day) above 140 dB rms (10% take)				Average number of days "taken" during 30-day survey
	2D	3D NAZ	3D WAZ	Coil	2D	3D NAZ	3D WAZ	Coil	
Kogia spp.	3.2	7.9	2.8	15.3	7.6	19.0	6.7	13.9	3.1
Beaked whale [1]	6.0	12.4	4.4	24.0	16.2	39.7	14.1	31.1	9.9
Rough-toothed dolphin	3.0	6.3	2.5	11.4	11.2	27.6	10.2	20.9	3.5
Bottlenose dolphin	4.5	11.7	4.0	16.8	22.0	54.6	19.7	53.2	3.5
Clymene dolphin	1.8	3.9	1.6	8.7	8.0	21.1	7.2	20.4	3.5
Atlantic spotted dolphin	7.0	16.0	6.5	25.7	23.4	58.1	20.9	49.3	3.5
Pantropical spotted dolphin	1.8	4.1	1.6	8.7	8.1	21.0	7.1	22.2	3.5
Spinner dolphin	3.2	8.5	2.7	16.4	12.4	31.0	10.8	22.8	3.5
Striped dolphin	1.8	4.0	1.6	8.5	8.0	21.0	7.2	21.3	3.5
Fraser's dolphin	2.8	6.4	2.4	13.8	9.4	24.2	8.4	24.0	3.5
Risso's dolphin	3.4	8.4	2.9	15.3	13.8	37.7	12.2	31.5	3.5
Melon-headed whale	2.6	5.9	2.2	13.1	9.3	24.2	8.3	24.0	3.4
Pygmy killer whale	1.8	3.6	1.4	7.1	7.3	18.5	6.6	17.3	3.4
False killer whale	2.4	4.9	1.9	9.3	8.8	22.0	8.0	17.8	3.4
Killer whale	2.7	6.1	3.3	12.0	16.8	46.1	14.9	73.6	3.4
Short-finned pilot whale	3.3	8.1	2.9	17.5	10.9	27.4	9.8	20.8	3.4

[1] Beaked whales are evaluated according to a different scale where 90% of the population exposed above 140 dB rms is considered taken and 50% of the population exposed above 120 dB rms is considered taken.

Loss of Hearing Sensitivity

In general, NMFS expects that noise-induced hearing loss, whether temporary (temporary threshold shift, equivalent to Level B harassment) or permanent (PTS, the only form of Level A harassment that may result from this action), is only possible as a result of airgun survey activity for low-frequency and high-frequency cetaceans. The best available scientific information indicates that low-frequency cetacean species (*i.e.,* mysticete whales, including the Bryde's whale) have heightened sensitivity to frequencies in the range output by airguns, as shown by their auditory weighting function, whereas high-frequency cetacean species (including *Kogia* spp.) have heightened sensitivity to noise in general (as shown by their lower threshold for the onset of PTS) (NMFS, 2018). However, no instances of Level A harassment are predicted to occur for Bryde's whales, and Level A harassment of Bryde's whales will not be authorized under this rule.

Level A harassment is predicted to occur for *Kogia* spp. (as indicated in Table 9 and evaluated in the "Level A harassment" subsection above). However, the degree of injury (hearing impairment) is expected to be mild. If permanent hearing impairment occurs, it is most likely that the affected animal would lose a few dB in its hearing sensitivity, which in most cases would not be expected to affect its ability to survive and reproduce. Hearing impairment that occurs for these individual animals would be limited to at or slightly above the dominant frequency of the noise sources. In particular, the predicted PTS resulting from airgun exposure is not likely to affect their echolocation performance or communication, as *Kogia* spp. likely produce acoustic signals at frequencies above 100 kHz (Merkens *et al.,* 2018), well above the frequency range of airgun noise. Further, modeled exceedance of Level A harassment criteria typically resulted from being near an individual source once, rather than accumulating energy from multiple sources. Overall, the modeling indicated that exceeding the SEL threshold is a rare event, and having four vessels close to each other (350 m between tracks) did not cause appreciable accumulation of energy at the ranges relevant for injury exposures. Accumulation of energy from independent surveys is expected to be negligible. This is relevant for *Kogia* spp. because based on their expected sensitivity, we expect that aversion may play a stronger role in avoiding exposures above the peak pressure PTS threshold than we have accounted for.

For both Bryde's whales and *Kogia* spp., some subset of the individual marine mammals predicted to be taken by Level B harassment may incur some TTS in addition to being behaviorally harassed. For Bryde's whales, TTS is more likely to occur at frequencies important for communication. However, any TTS incurred would be expected to be of a relatively small degree and short duration. This is due to the low likelihood of sound source approaches of the proximity or duration necessary to cause more severe TTS, given the fact that both sound source and marine mammals are continuously moving, the anticipated effectiveness of shutdowns, and general avoidance by marine mammals of louder sources.

For these reasons, and in conjunction with the required mitigation, NMFS does not believe that Level A harassment (here, PTS) or Level B harassment in the form of TTS will play a meaningful role in the overall degree of impact experienced by marine mammal populations as a result of the projected survey activity. Further, the impacts of any TTS incurred are addressed along with behavioral disruption through the broader analysis of Level B harassment.

Impacts to Habitat

Potential impacts to marine mammal habitat, including to marine mammal prey, were discussed in detail in the notice of proposed rulemaking and summarized herein (see Potential Effects of the Specified Activities on Marine Mammals and Their Habitat as well as responses to comments concerning these issues).

Regarding impacts to prey species such as fish and invertebrates, NMFS' review of the available information leads to a conclusion that the most likely impact of survey activity would be temporary avoidance of an area, with a rapid return to pre-survey distribution and behavior, and minimal impacts to recruitment or survival anticipated. Therefore, 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 prey species are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Regarding potential impacts to acoustic habitat, NMFS previously summarized a detailed analysis of potential cumulative and chronic effects to marine mammals (found in the CCE report available online at *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico*). That analysis focused on potential effects to sperm whales (which also provides a conservative proxy regarding potential effects to other mid- and high-frequency cetacean species) and to Bryde's whales. Regarding sperm whales, the analysis shows that the survey activities do not significantly contribute to the soundscape in the frequency band relevant for their lower-frequency slow-clicks, and that there will be no significant change in communication space for sperm whales. Similar conclusions may be assumed for other mid- and high-frequency cetacean species.

Implications for acoustic masking and reduced communication space resulting from noise produced by airgun surveys in the GOM are expected to be particularly heightened for animals that actively produce low-frequency sounds or whose hearing is attuned to lower frequencies (*i.e.,* Bryde's whales). The strength of the communication space approach used here is that it evaluates potential contractions in the availability of a signal of documented importance to a population of animals of key management interest in the region. In this case, losses of communication space for Bryde's whales were estimated to be higher in eastern and central GOM canyons and shelf break areas. In contrast, relative maintenance of listening area and communication space was seen within the Bryde's whale core habitat area in the eastern GOM. The result was heavily influenced by the projected lack of survey activity in that region, which underscores the importance of maintaining this important habitat for the Bryde's whale. Following BOEM's update to the scope of activity considered herein, no survey activity will occur under this rule within Bryde's whale core habitat, or within the broader eastern GOM. In areas where larger amounts of survey activity were projected, significant loss of low-frequency listening area and communication space for Bryde's whale calls was estimated. However, these are areas where Bryde's whales are unlikely to occur (*i.e.,* deeper waters of the central and western GOM).

Species and Stock-Specific Negligible Impact Analysis Summaries

In this section, we consider the relative impact ratings described above in conjunction with the required mitigation and other relevant contextual information in order to produce a final assessment of impact to the stock or species, *i.e.,* the negligible impact determinations. The effects of the DWH oil spill are accounted for through the vulnerability scoring (Table 12). NMFS developed mitigation requirements for consideration in the proposed rule, including time-area restrictions, designed specifically to provide benefit to certain populations for which a relatively high amount of risk is predicted in relation to exposure to survey noise. The required time-area restrictions, described in detail in Proposed Mitigation in the notice of proposed rulemaking and depicted in Figure 4, were designed specifically to provide benefit to the bottlenose dolphin, Bryde's whale, and beaked and sperm whales, with additional benefits to *Kogia* spp., which are often found in higher densities in the same locations of greater abundance for beaked and sperm whales. Two of the three time-area restrictions in the proposed rule—the Bryde's whale core habitat area and the Dry Tortugas area (Areas #2 and 3; Figure 4)—are eliminated from consideration as a result of BOEM's update to the geographic scope of action, as these two areas are entirely within the portion of the GOM removed from consideration. The bottlenose dolphin area, as revised herein (see Mitigation), is included in this final rule.

Although the Bryde's whale core habitat and Dry Tortugas areas are not the subject of restrictions on survey activity, as the updated scope of activity considered here does not include those two areas, the beneficial effect for animals in those areas, and the stocks of which they are a part, remains the same. No survey activity in those areas can be considered for LOAs issued under this rule. In addition, we expect the lack of survey activity in those areas to provide some subsidiary benefit to additional species that may be present, as indicated in the sections below and reflected in the updated take estimates.

The absence of survey activity in those two areas benefits both the primary species for which they were designed and species that may benefit secondarily by likely reducing the portion of a stock likely exposed to survey noise and avoiding impacts to certain species in areas of importance for them. These areas are discussed more specifically in the context of the species and stocks they were designed to protect in the Proposed Mitigation section of the notice of proposed rulemaking, and are summarized in the sections below.

Bryde's Whale

First, we note that the estimated (and allowable) take of Bryde's whales has been reduced as compared to the proposed rule as a result of the change in scope. Specifically, both the maximum annual take and the average annual take decreased by approximately 98 percent. The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for Bryde's whales are low, regardless of activity scenario. We note that, although the evaluated severity of take for Bryde's whales is very low in all zones where take could occur, vulnerability for the species is assessed as high in all zones where the species occurs. When integrated through the risk framework as described above, overall risk for the species is therefore assessed as low for both the high and moderate effort scenarios. Evaluated risk is lower than what was considered in the proposed rule, where analysis of the prior take estimates resulted in a risk rating of moderate for both scenarios.

We further consider the likely severity of any predicted behavioral disruption of Bryde's whales in the context of the likely duration of exposure above Level B harassment thresholds. Specifically, the average modeled time per day spent at received levels above 160 dB rms (where 50 percent of the exposed population is considered taken) ranges from 6.8–21.4 minutes for deep penetration survey types. The average time spent exposed to received levels between 140 and 160 dB rms (where 10 percent of the exposed population is considered taken) ranges from 55–164 minutes for 2D, 3D NAZ, and 3D WAZ surveys, and 401 minutes for coil surveys (which comprise approximately 10 percent of the total activity days).

Importantly, no survey activity will occur within the Bryde's whale core habitat area pursuant to this rule. The absence of survey activity in the area is expected to benefit Bryde's whales and their habitat by minimizing a range of potential effects of airgun noise, both acute and chronic, that could otherwise accrue to impact the reproduction or survival of individuals in this area. Absence of survey activity in this area will minimize disturbance of the species in the place most important to them for critical behaviors such as foraging and socialization. Based on Roberts *et al.* (2016), the area encompasses approximately 92 percent of the predicted abundance of Bryde's whales in the GOM. Intensive survey effort in the region has not resulted in any confirmed Bryde's whale sightings outside this core habitat area (aside from a single anomalous sighting in the western GOM). Although some sound from airguns may still propagate into the Bryde's whale core habitat area from surveys that may occur outside of the area (in certain locations where separation distance between the core habitat area and the area considered for survey activity through this rule is less; see Figure 2), exposure of Bryde's whales to sound levels that may be expected to result in Level B harassment will be eliminated or reduced for animals within the Bryde's whale core area. The absence of survey activity in this area and significant reduction in associated exposure of Bryde's whales to seismic airgun noise is expected to eliminate the likelihood of auditory injury of Bryde's whales. Finally, the absence of survey activity in the eastern GOM will reduce chronic exposure of Bryde's whales to higher levels of anthropogenic sound and the associated effects including masking, disruption of acoustic habitat, long-term changes in behavior such as vocalization, and stress.

As described in the preceding ''Loss of Hearing Sensitivity'' section, we have analyzed the likely impacts of potential temporary hearing impairment and do not expect that they would result in impacts on reproduction or survival of any individuals. The extended shutdown zone for Bryde's whales (1,500 m)—to be implemented in the unlikely event that a Bryde's whale is encountered outside of the core habitat area—is expected to further minimize the severity of any hearing impairment incurred as well as reducing the likelihood of more severe behavioral responses. Similarly, application of this extended distance shutdown requirement when calves are present will minimize the potential for and degree of disturbance during this sensitive life stage.

No mortality of Bryde's whales is anticipated or authorized. It is possible that Bryde's whale individuals in this stock, if encountered in areas not typically considered to be Bryde's whale habitat, will be impacted briefly on one or more days during a year of activity by one type of survey or another and some subset of those exposures above thresholds may be of comparatively long duration within a day. However, the significant and critical protection afforded through the absence of survey activity in the core habitat area and the associated reduction in estimated take ensures that the impacts of the expected takes from these activities are not likely to adversely affect the GOM stock of Bryde's whales through impacts on annual rates of recruitment or survival.

Sperm Whale

First, we note that the estimated (and allowable) take of sperm whales has been reduced as compared to the proposed rule as a result of the change in scope. Specifically, the maximum annual take decreased by approximately 62 percent and the average annual take decreased by approximately 58 percent. The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for sperm whales were between moderate and low (equivalent to a 2.5 on a 5-point scale, with a 3 equating to ''moderate'') (for the high effort scenario) or low (for the moderate effort scenario). Evaluated risk is reduced from the proposed rule, where the high effort scenario resulted in a very high risk rating and the moderate effort scenario resulted in a high risk rating. We further consider the likely severity of any predicted behavioral disruption of sperm whales in the context of the likely duration of exposure above Level B harassment thresholds. Specifically, the average modeled time per day spent at received levels above 160 dB rms (where 50 percent of the exposed population is considered taken) ranges from 4–10.3 minutes for 2D, 3D NAZ, and 3D WAZ surveys and up to 20.7 minutes for coil surveys (which comprise less than 10 percent of the total projected activity days) and the average time spent between 140 and 160 dB rms (where 10 percent of the exposed population is considered taken) is 12–31.8 minutes.

Odontocetes echolocate to find prey, and while there are many different strategies for hunting, one common pattern, especially for deeper-diving species, is to conduct multiple repeated deep dives within a feeding bout, and multiple bouts within a day, to find and catch prey. While exposures of the short durations noted above could potentially interrupt a dive or cause an individual to relocate to feed, such a short-duration interruption would typically be unlikely to have significant impacts on an individual's energy budget. However, the moderate risk rating for the high effort scenario reflects the higher number of total days across which these singularly more minor impacts may occur, as well as other factors, and points to the need for the consideration of additional reduction of impacts where possible. In years when less effort occurs, as represented by the moderate effort scenario, risk will be less.

Importantly, no survey activity is expected within the Dry Tortugas Mitigation Area, which was analyzed and proposed for implementation in the proposed rule. The area provides preferred habitat for comparatively high densities of sperm whales and is thought to be used as a calving area. The absence of survey activity in the area is expected to alleviate some of the previous impacts of concern to sperm whales (as well as beaked whales and *Kogia* spp.) and their habitat by minimizing a range of potential effects of airgun noise, both acute and chronic, that could otherwise accrue to impact the reproduction or survival of individuals in this area. Absence of survey activity in this area will minimize disturbance of the species in a place of importance for critical behaviors such as foraging and socialization and, overall, helps to reduce evaluated risk to the stock as a whole.

Additionally, we note that the extended distance shutdown zone for sperm whales (1,500 m) is expected to further reduce the likelihood and minimize the severity of more severe behavioral responses. Similarly, application of this extended distance shutdown requirement when calves are present will minimize the potential for and degree of disturbance during this sensitive life stage.

No mortality or Level A harassment of sperm whales is anticipated or authorized. While it is likely that the majority of the individual sperm whales will be impacted briefly on one or more days during a year of activity by one type of survey or another, based on the nature of the individual exposures (shorter duration) and takes, as well as the aggregated scale of the impacts across the GOM in consideration of the mitigation discussed here, the impacts of the expected takes from these activities are not likely to adversely affect the GOM stock of sperm whales through adverse impacts on annual rates of recruitment or survival.

Beaked Whales

In consideration of the similarities in the nature and scale of impacts, we consider the GOM stocks of Cuvier's, Gervais', and Blainville's beaked whales together in this section. First, we note that the estimated (and allowable) take of beaked whales has been reduced as compared to the proposed rule as a result of the change in scope. Specifically, the maximum annual take decreased by approximately 19 percent and the average annual take decreased by approximately 15 percent. The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for beaked whales were between high and moderate (equivalent to a 3.5 on a 5-point scale, with a 4 equating to ''high'') for the high effort scenario and between moderate and low (equivalent to a 2.5 on a 5-point scale, with a 3 equating to ''moderate'') for the moderate effort scenario. Evaluated risk is reduced from the proposed rule, where the high effort scenario resulted in a very high risk rating and the moderate effort scenario resulted in a high risk rating. We further consider the likely severity of any predicted behavioral disruption of beaked whales in the context of the likely duration of exposure above Level B harassment thresholds. Beaked whales are considered more behaviorally sensitive to sound than most other species, and therefore we utilize different thresholds to predict behavioral disturbance. However, this means that beaked whales are evaluated as ''taken'' upon exposure to received sound levels as low as 120 dB (where 50 percent of the exposed beaked whale population is considered taken). These received levels are typically reached at extreme distance from the acoustic source (*i.e.,* greater than 50 km from the source). Behavioral responses to noise are significantly correlated with distance from the source (*e.g.,* Gomez *et al.,* 2016); and potential responses to these relatively low received levels at such great distances, while conservatively evaluated here as take under the MMPA, are unlikely to result in any response of such a severity as to carry any cost to the animal. (Additionally, in certain circumstances, noise from the surveys at these distances may be indistinguishable from other low-frequency background noise). Therefore, as for other species, we consider only the average modeled time per day spent at received levels above 140 dB rms (where 90 percent of the exposed beaked whale populations are considered taken) and 160 dB rms (where, potentially, all exposed beaked whales are taken). The average time spent in a state of exposure above 160 dB rms is only 6–12.4 minutes for 2D, 3D NAZ, and 3D WAZ surveys and 24 minutes for coil surveys. The average time spent in a state of exposure above 140 dB rms is 14.1 minutes for 3D WAZ surveys, 16.2 minutes for 2D surveys, 31.1 minutes for coil surveys, and 39.7 minutes for 3D NAZ surveys.

Odontocetes echolocate to find prey, and while there are many different strategies for hunting, one common pattern, especially for deeper-diving species, is to conduct multiple repeated deep dives within a feeding bout, and multiple bouts within a day, to find and catch prey. As we noted, while some of the exposures of the durations noted above could interrupt a dive or cause an individual to relocate to feed because of the lower thresholds combined with the way exposures are distributed across received levels, a higher proportion of the total takes (as compared to other taxa) are at the lower end of the received levels at which take would be expected to occur and at great distance from the acoustic source, where responses (if any) should be assumed to be minor. All else being equal, exposures to lower received levels and, separately, at greater distances might be expected to result in less severe responses, even given longer durations (*e.g.,* DeRuiter *et al.,* 2013). Considered individually or infrequently, these sorts of feeding interruptions would be unlikely to have significant impacts on an individual's energy budget, especially given the likely availability of adequate alternate feeding areas relatively nearby. However, the high risk rating for the high effort scenario reflects the higher number of total days across which these singularly more minor impacts may occur, as well as other factors, and points to the need for the consideration of additional reduction of impacts where possible. In years when less effort occurs, as represented by the moderate effort scenario, risk will be less.

Importantly, no survey activity is expected within the Dry Tortugas Mitigation Area, which was analyzed and proposed for implementation in the proposed rule. The area provides preferred habitat for comparatively high densities of beaked whales. The absence of survey activity in this important area is expected to alleviate some of the previous impacts of concern to beaked whales (as well as sperm whales and *Kogia* spp.) and their habitat by minimizing a range of potential effects of airgun noise, both acute and chronic, that could otherwise accrue to impact the reproduction or survival of individuals in this area. Absence of survey activity in this area will minimize disturbance of the species in a place of importance for critical behaviors such as foraging and socialization and, overall, helps to reduce evaluated risk to the stocks as a whole.

Additionally, we note that the extended distance shutdown zone for beaked whales (1,500 m) is expected to further reduce the likelihood of, and minimize the severity of, more severe behavioral responses.

Despite the nature and duration of the exposures anticipated, which at a smaller scale might not be expected to meaningfully impact individual fitness, given the high to moderate EWG risk rating and the relatively high number of predicted beaked whale takes (increasing the likelihood of some subset of individuals accruing a fair number of repeated takes over sequential days—albeit assuming takes at low received levels and at distances from the source where responses, if any, should be expected to be minor), it is more likely that a small number of individuals could be interrupted during foraging in a manner and amount such that impacts to the energy budgets of females (from either losing feeding opportunities or expending energy to find alternative feeding options) could cause them to forego reproduction for a year. Energetic impacts to males are generally meaningless to population rates unless they cause death, and extreme energy deficits (beyond what could be considered reasonably likely to result from these activities) are required to cause the death of an adult marine mammal. As noted previously, however, foregone reproduction (especially for one year, which is the maximum predicted because the relatively small number anticipated in any one year makes the probability that any individual would be impacted in this way twice in five years very low) has far less of an impact on population rates than mortality. And a small number of instances of foregone reproduction would not be expected to adversely affect these stocks through effects on annual rates of recruitment or survival.

It is worth noting that in similar situations, *i.e.,* where individual beaked whales may be exposed to noise above harassment thresholds regularly, populations appear to be stable based on multiple studies and lines of evidence (*e.g.,* Falcone and Schorr, 2014; DiMarzio *et al.,* 2018). In research done at the Navy's fixed tracking range in the Bahamas, animals were observed to leave the immediate area of an anti-submarine warfare training exercise but return within a few days after the event ended (Claridge and Durban, 2009; McCarthy *et al.,* 2011; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011). It is important to note that in these contexts, beaked whales were exposed to noise stimuli to which they are significantly more acoustically sensitive (*i.e.,* mid-frequency active sonar versus low-frequency airgun noise).

Of note, due to their pelagic distribution, typical high availability bias due to deep-diving behavior and cryptic nature when at the surface, beaked whales are rarely sighted during at-sea surveys and difficult to distinguish between species when visually observed in the field. Accordingly, abundance estimates in NMFS SARs are recorded for *Mesoplodon* spp. Available sightings data, including often unresolved sightings of beaked whales, must be combined in order to develop habitat-based density models for beaked whales, as were used to inform our acoustic exposure modeling effort. Therefore, density and take estimates in this rule are similarly lumped for the three species of beaked whales, and there is no additional information by which NMFS could appropriately apportion impacts other than equally/proportionally across the three species.

No mortality or Level A harassment of any of these three species of beaked whales is anticipated or authorized. It is likely that the majority of the individual beaked whales will be impacted on one or more days during a year of activity by one type of survey or another. It is possible that some small number of female beaked whales may experience a year of foregone reproduction. However, based on the nature of the majority of the individual exposures and the overall scale of the aggregate impacts and risk rating in consideration of the mitigation discussed here, and noting the continued presence of beaked whales in the GOM given the many years of high activity levels and the evidence that beaked whales maintain stable or increasing populations in other areas with high levels of acoustic activity, the impacts of the expected takes from these activities are not likely to adversely affect the GOM stocks of Cuvier's, Gervais', or Blainville's beaked whales through adverse impacts on annual rates of recruitment or survival.

Kogia spp.

First, we note that the estimated (and allowable) take of *Kogia* spp. has been reduced as compared to the proposed rule as a result of the change in scope. Specifically, the maximum annual take by Level B harassment decreased by approximately 46 percent and the average annual take decreased by approximately 43 percent. (These reductions are 49 and 46 percent, respectively, for Level A harassment.) The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for *Kogia* spp. were low (for the high effort scenario) and very low (for the moderate effort scenario). Evaluated risk is reduced from the proposed rule, where the high effort scenario resulted in a moderate risk rating and the moderate effort scenario resulted in a low risk rating. We further consider the likely severity of any predicted behavioral disruption of *Kogia* spp. in the context of the likely duration of exposure above Level B harassment thresholds. Specifically, the average modeled time per day spent at received levels above 160 dB rms (where 50 percent of the exposed population is considered taken) ranges from 2.8–7.9 minutes for 2D, 3D NAZ, and 3D WAZ surveys and up to 15.3 minutes for coil surveys (which comprise less than 10 percent of the total projected activity days), and the average time spent between 140 and 160 dB rms (where 10 percent of the exposed population is considered taken) is 6.7–19 minutes.

Odontocetes echolocate to find prey, and while there are many different strategies for hunting, one common pattern, especially for deeper diving species, is to conduct multiple repeated deep dives within a feeding bout, and multiple bouts within a day, to find and catch prey. While exposures of the short durations noted above could potentially interrupt a dive or cause an individual to relocate to feed, such a short-duration interruption would be unlikely to have significant impacts on an individual's energy budget and, further, for these species and this open-ocean area, there are no specific known reasons (*i.e.,* these species range GOM-wide beyond the continental slope and there are no known biologically important areas) to expect that there would not be adequate alternate feeding areas relatively nearby, especially considering the anticipated absence of survey activity in the eastern GOM.

As described above, no survey activity is expected within the Dry Tortugas Mitigation Area, which was analyzed and proposed for implementation in the proposed rule. The absence of survey activity in the area is expected to afford additional reduction of impacts to *Kogia* spp., in addition to sperm and beaked whales, given their relatively high density in that area. Importantly, the absence of survey activity in the area will reduce disturbance of these species in places of importance to them for critical behaviors such as foraging and socialization and, overall, help to reduce evaluated risk to the stocks as a whole.

NMFS has analyzed the likely impacts of potential hearing impairment, including the estimated upper bounds of permanent threshold shift (Level A harassment) that could be authorized under the rule, and do not expect that they would result in impacts on reproduction or survival of any individuals. As described in the previous section, the degree of injury for individuals would be expected to be mild, and the predicted PTS resulting from airgun exposure is not likely to affect echolocation performance or communication for *Kogia* spp. Additionally, the extended distance shutdown zone for *Kogia* spp. (1,500 m) is expected to further minimize the severity of any hearing impairment incurred and also to further reduce the likelihood of, and minimize the severity of, more severe behavioral responses.

Of note, due to their pelagic distribution, small size, and cryptic behavior, pygmy sperm whales and dwarf sperm whales are rarely sighted during at-sea surveys and difficult to distinguish between when visually observed in the field. Accordingly, abundance estimates in NMFS SARs are recorded for *Kogia* spp. only, density and take estimates in this rule are similarly lumped for the two species, and there is no additional information by which NMFS could appropriately apportion impacts other than equally/proportionally across the two species.

No mortality of *Kogia* spp. is anticipated or authorized. While it is likely that the majority of the individuals of these two species will be impacted briefly on one or more days during a year of activity by one type of survey or another, based on the nature of the individual exposures and takes, as well as the aggregated scale of the impacts across the GOM, and in consideration of the mitigation discussed here, the impacts of the expected takes from these activities are not likely to adversely impact the GOM stocks of dwarf or pygmy sperm whales through adverse impacts on annual rates of recruitment or survival.

Bottlenose Dolphins

The change in scope did not result in any appreciable change to estimated (and allowable) take of bottlenose dolphins compared to the proposed rule. Specifically, the maximum annual take increased slightly (by approximately 2 percent), while the average annual take decreased slightly (by approximately 1 percent). The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for both oceanic bottlenose dolphins and coastal/shelf bottlenose dolphins are very low for both scenarios. In the proposed rule, risk was evaluated for bottlenose dolphins GOM-wide (here we have refined the risk evaluation to differentiate between oceanic and coastal/shelf stocks). Evaluated risk is reduced from the proposed rule, where the high effort scenario resulted in a low risk rating and the moderate effort scenario resulted in a moderate risk rating. We further considered the likely severity of any predicted behavioral disruption of bottlenose dolphins in the context of the likely duration of exposure above Level B harassment thresholds. Specifically, the average modeled time per day spent at received levels above 160 dB rms (where 50 percent of the exposed population is considered taken) ranges from 4–11.7 minutes for 2D, 3D NAZ, and 3D WAZ surveys and up to 16.8 minutes for coil surveys (which comprise less than 10 percent of the total projected activity days) and the average time spent between 140 and 160 dB rms is 19.7–54.6 minutes. While exposures of the short durations noted above could potentially interrupt a dive or cause an individual to relocate to feed, among other impacts, such a short-duration interruption would be unlikely to have significant impacts on an individual's energy budget or otherwise impact reproduction or survival.

As described earlier in this preamble, the northern coastal stock of bottlenose dolphin was particularly severely impacted by the DWH oil spill, and was additionally affected by a recent UME. Importantly, as described in Mitigation, NMFS is requiring a seasonal time-area restriction on airgun survey activity within the coastal waters where this stock is likely to be found. The closure area is expected to protect coastal bottlenose dolphins and their habitat through the alleviation or minimization of a range of potential effects of airgun noise, both acute and chronic, that could otherwise accrue to impact the reproduction or survival of individuals in this area. The timing of the restriction provides protection during the times of year thought to be most important for bottlenose dolphin calving and nursing of young. Although some sound from airguns may still propagate into the area from surveys that may occur outside of the area, exposure of bottlenose dolphins to sound levels that would result in Level B harassment will be alleviated or reduced for animals within the closure area. Any exposure to noise that may increase stress levels and exacerbate health problems in bottlenose dolphins still recovering from the effects of the DWH spill will be minimized during this important reproductive period. This important mitigation results in a reduction in the scale of aggregate effects (which, among other things, suggests the comparative number of days across which individual bottlenose dolphins might be taken within a year) and associated risk assessment.

Of note, bottlenose dolphins cannot be identified to stock when visually observed in the field. Abundance estimates in NMFS SARs are based strictly on the location where animals are observed, and available sightings data must be combined in order to develop habitat-based density models for bottlenose dolphins, as were used to inform our acoustic exposure modeling effort. Therefore, density and take estimates in this rule are provided for bottlenose dolphins as a GOM-wide species. However, based on NMFS' stock delineations, we can reasonably assume that dolphins occurring within Zones 4–7 would be from the oceanic stock, while dolphins occurring within Zones 1–3 would be from the shelf stock and/or coastal stocks. Therefore, for the oceanic stock, we are able to draw stock-specific conclusions in this analysis. For coastal/shelf stocks, there is no additional information by which NMFS could appropriately apportion impacts other than equally/proportionally across the stocks, with the exception of predicting reduced impacts to the northern coastal stock as described above. We note that, as a result of BOEM's update to the scope of activity, the eastern coastal stock will not experience any impacts and is accordingly no longer considered in this rule.

No mortality or Level A harassment of bottlenose dolphins is anticipated or authorized. While it is likely that the majority of individual dolphins may be impacted briefly on one or more days during a year of activity by one type of survey or another, based on the nature of the individual exposures (shorter duration) and takes, as well as the aggregated scale of the impacts across the GOM in consideration of the mitigation discussed here, the impacts of the expected takes from these activities are not likely to adversely affect any affected GOM stock of bottlenose dolphins through adverse impacts on annual rates of recruitment or survival.

All Other Stocks

In consideration of the similarities in the nature and scale of impacts, we consider the GOM stocks of the following species together in this section: Rough-toothed dolphin, Clymene dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, striped dolphin, spinner dolphin, Fraser's dolphin, Risso's dolphin, melon-headed whale, pygmy killer whale, false killer whale, killer whale, and short-finned pilot whale. Estimated (and allowable) take of these stocks (including both the maximum annual take and the average annual take) has been reduced as compared to the proposed rule as a result of the change in scope (with the exception of the Atlantic spotted dolphin). For the Atlantic spotted dolphin, the change in scope resulted in increases compared to the proposed rule. Specifically, the maximum annual take increased by approximately 9 percent, while the average annual take increased by approximately 4 percent. These slight increases do not impact our analysis for the stock.

The EWG analysis, which evaluated the relative significance of the aggregated impacts of the survey activities across seven GOM zones in the context of the vulnerability of each species, concluded that the GOM-wide risk ratings for high and moderate effort scenarios ranged from very low to low for these species. For all stocks, there was a trend of decreased or static risk ratings compared to the proposed rule, where the GOM-wide risk ratings for high and moderate effort scenarios ranged from low to moderate.

We further considered the likely severity of any predicted behavioral disruption of the individuals of these species in the context of the likely duration of exposure above Level B harassment thresholds. Specifically, the average modeled time per day spent at received levels above 160 dB rms (where 50 percent of the exposed population is considered taken) ranges from 1.4–11.7 minutes for 2D, 3D NAZ, and 3D WAZ surveys and up to 25.7 minutes for coil surveys (which comprise less than 10 percent of the total projected activity days). The average time per day spent between 140 and 160 dB rms for individuals that are taken is from 8–58.1 minutes, with the one exception of killer whales exposed to noise from coil surveys, which average 73.6 minutes (though we note that the overall risk rating for the species is very low).

Odontocetes echolocate to find prey, and there are many different strategies for hunting. One common pattern for deeper-diving species is to conduct multiple repeated deep dives within a feeding bout, and multiple bouts within a day, to find and catch prey. While exposures of the shorter durations noted above could potentially interrupt a dive or cause an individual to relocate to feed, such a short-duration interruption would be unlikely to have significant impacts on an individual's energy budget and, further, for these species and this open-ocean area, there are no specific known reasons (*i.e.,* these species range GOM-wide beyond the continental slope and there are no known biologically important areas) to expect that there would not be adequate alternate feeding areas relatively nearby, especially considering the anticipated absence of survey activity in the eastern GOM. For those species that are more shallow feeding species, it is unlikely that the noise exposure considered herein would result in minimal significant disruption of foraging behavior and, therefore, the concomitant energetic effects would similarly be minimal.

Of note, the Atlantic spotted dolphin would benefit (via lessening of both number and severity of takes) from the coastal waters time-area restriction developed to benefit bottlenose dolphins and several additional species experience notably reduced effects from the absence of survey activity in important eastern GOM habitat. Specifically, multiple shelf-break associated and pelagic species (such as Risso's dolphin, melon-headed whales, and rough-toothed dolphins) experience a reduction estimated take from the absence of survey activity in both the Bryde's whale core habitat and Dry Tortugas Areas. Maximum annual and average annual take decreased for these species compared with the proposed rule by 20 and 14 percent, 19 and 15 percent, and 19 and 18 percent, respectively. Numerous other species would be expected to be present in varying numbers at various times.

No mortality or Level A harassment of these species is anticipated or authorized. It is likely that the majority of the individuals of these 13 species will be impacted briefly on one or more days during a year of activity by one type of survey or another. Based on the nature of the individual exposures and takes, as well as the very low to low aggregated scale of the impacts across the GOM and considering the mitigation discussed here, the impacts of the expected takes from these activities are not likely to adversely impact the GOM stocks of any of these 13 GOM stocks of these species through adverse impacts on annual rates of recruitment or survival.

Determination

Based on the analysis contained herein of the likely effects of the specified activities on marine mammals and their habitat, and taking into consideration the implementation of the monitoring and mitigation measures, NMFS finds that the total marine mammal take from the specified activities will have a negligible impact on all affected marine mammal species and stocks.

Small Numbers

The sections below provide an explanation of how NMFS interprets and applies the small numbers standard and remain substantively unchanged from the discussion provided in the notice of proposed rulemaking. Additional discussion appears in Comments and Responses to address specific comments, questions, or recommendations received from the public.

What are small numbers?

The term ''small numbers'' appears in section 101(a)(5)(A) of the MMPA as follows:

(5)(A)(i) Upon request therefor by citizens of the United States who engage in a specified activity (other than commercial fishing) within a specified geographical region, the Secretary shall allow, during periods of not more than five consecutive years each, the incidental, but not intentional, taking by citizens while engaging in that activity within that region of *small numbers* of marine mammals of a species or population stock if the Secretary, after notice (in the **Federal Register** and in newspapers of general circulation, and through appropriate electronic media, in the coastal areas that may be affected by such activity) and opportunity for public comment—

(I) finds that the total of such taking during each five-year (or less) period concerned will have a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses [. . .] and

(II) prescribes regulations setting forth—

(aa) permissible methods of taking pursuant to such activity, and other 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, and on the availability of such species or stock for subsistence uses; and

(bb) requirements pertaining to the monitoring and reporting of such taking.

(Emphasis added.)

In addition to section 101(a)(5)(A), the MMPA as amended in 1994 includes a similar provision in section 101(a)(5)(D), which provides for the issuance of incidental take authorizations for small numbers of marine mammals without the need for regulations, effective for up to one year, where the taking is limited to harassment:

(5)(D)(i) Upon request therefor by citizens of the United States who engage in a specified activity (other than commercial fishing) within a specific geographic region, the Secretary shall authorize, for periods of not more than 1 year, subject to such conditions as the Secretary may specify, the incidental, but not intentional, taking by harassment of *small numbers* of marine mammals of a species or population stock by such citizens while engaging in that activity within that region if the Secretary finds that such harassment during each period concerned—

(I) will have a negligible impact on such species or stock, and

(II) will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses[.]

(Emphasis added.)

The MMPA does not define ''small numbers.'' NMFS' 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,* 695 F.3d 893 (9th Cir. 2012).

However, NMFS has not historically indicated what the agency believes to be the upper limit of small numbers.

To maintain an interpretation of small numbers as a proportion of a species or stock that does not conflate with negligible impact, NMFS uses a simple approach that establishes equal bins corresponding to small, medium, and large proportions of the population abundance. NMFS then compares the number of individuals estimated and authorized to be taken against the best available abundance estimate for that species or stock.

It can be challenging to predict the numbers of individual marine mammals that will be taken by an activity. Many models calculate instances of take but are unable to account for repeated exposures of individual marine mammals, though the instances of take necessarily represent the upper bound of the number of individuals. In some of those cases, such as for this rule (see Estimated Take), we are able to generate a more refined estimate of the numbers of individuals predicted to be taken utilizing a combination of quantitative tools and qualitative information. When an acceptable estimate of the individual marine mammals taken is available,[20] the small numbers determination is based directly upon whether 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 most appropriate 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, as infrequent or 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 also 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.

Is the small numbers standard evaluated based on total take under incidental take regulations or within the context of an individual letter of authorization?

Neither the MMPA nor NMFS' implementing regulations address whether the small numbers determination should be based upon the total annual taking for (1) all activities occurring under specific incidental take regulation or (2) to individual LOAs issued thereunder. The MMPA does not define small numbers or explain how to apply the term in either paragraph (A) or (D) of section 101(a)(5), including how to apply the term in a way that allows for consistency between those two very similar provisions in the statute. Whether to apply the small numbers finding to each individual LOA under regulations that cover multiple concurrent LOA holders is a matter of first impression for NMFS.

Specifically, section 101(a)(5)(A)(i)(I) explicitly states that the negligible impact determination for a specified activity must take into account the total taking over the five-year period, but the small numbers language is not tied explicitly to the same language. Rather, the small numbers provision appears in section 101(a)(5)(A)(i) as a limitation on what the Secretary may allow. The regulatory vehicle for authorizing (*i.e.,* ''allowing'') the take of marine mammals is the LOA.

Given NMFS' discretion in light of the ambiguities in the statute regarding how to apply the small numbers standard, we have determined that the small numbers finding should be applied to the annual take authorized per individual LOA, rather than to the total annual taking for all activities potentially occurring under the incidental take regulations. This per-LOA approach harmonizes section 101(a)(5)(A) with the per-IHA application in section 101(a)(5)(D) of the MMPA.[21] This per-LOA approach is not only permissible but also preferable to the total annual taking approach because NMFS' per-LOA approach to small numbers in section 101(a)(5)(A) affords greater regulatory flexibility to utilize section 101(a)(5)(A) when there are benefits to doing so for the resource (marine mammals), the public, prospective applicants, and administrative efficiency:

• From a resource protection standpoint, it is better to conduct a comprehensive negligible impact analysis that considers all of the activities covered under the rule (versus considering them independently pursuant to individual IHAs) and ensures that the total combined taking from those activities will have a negligible impact on the affected marine mammal species or stocks and no unmitigable adverse impact on subsistence uses. Furthermore, mitigation and monitoring are more effective when considered across all activity and years covered under regulations.

• From an agency resource standpoint, it ultimately will save significant time and effort to cover multi-year activities under a rule instead of multiple incidental harassment authorizations (IHAs). While regulations require more analysis up front, additional public comment and internal review, and additional time to promulgate compared to a single IHA, they are effective for up to five years (for non-military readiness activities) and can cover multiple actors within a year. The process of issuing individual LOAs under incidental take regulations utilizes the analysis, public comment, and review that was conducted for the regulations, and takes significantly less time than it takes to issue independent IHAs.

• From an applicant standpoint, incidental take regulations offer more regulatory certainty than IHAs (five years versus one year) and significant cost savings, both in time and environmental compliance analysis and documentation. This is especially true for situations like here, where multiple applicants will be applying for individual LOAs under regulations. In the case of this rule, the certainty afforded by the promulgation of a regulatory framework (*e.g.,* by using previously established take estimates, mitigation and monitoring

[20] We note that although NMFS' implementing regulations require applications for incidental take to include an estimate of the marine mammals to be taken, there is nothing in section 101(a)(5)(A) (or (D)) 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.*)

[21] As the court observed in *Native Village of Chickaloon* v. *NMFS,* 947 F. Supp. 2d 1031, 1049 n.123 (D. Alaska 2013) ''the same statutory standards apply'' to incidental take authorization under both provisions.

requirements, and procedures for requesting and obtaining an LOA) is a significant benefit for prospective applicants.

NMFS' evaluation of past IHAs suggests that bundling together the activities covered by two or three IHAs that might be ideal subjects for a combined incidental take regulation (*e.g.,* for ongoing maintenance construction activities, or seismic surveys in the Arctic by different entities) may exceed the taking of small numbers of a species if NMFS were to apply the small numbers standard across all taking contemplated by the regulation in a year. In other words, if the small numbers standard is applied to the total annual taking under a rule, NMFS may not be able to make the necessary small numbers finding, which would preclude the use of section 101(a)(5)(A) for multiple activities, thereby eliminating the opportunity to derive the resource and streamlining benefits outlined above. Also, application of the small numbers standard across the total annual taking covered by an incidental take regulation, inasmuch as prospective applicants can see that the total annual take may exceed one-third of species or stock abundance, would create an incentive for applicants to pursue individual IHAs (again, precluding the ability to gain the benefits outlined above).

Our conclusion is that NMFS can appropriately elect to make a ''small numbers'' finding based on the estimated annual take in individual LOAs issued under the rule. This approach does not affect the negligible impact analysis for a rule, which is the biologically relevant inquiry and based on the total annual estimated taking for all activities the regulations will govern. Making the small numbers finding based on the estimated annual take in individual LOAs allows NMFS to take advantage of the associated administrative and environmental benefits of utilizing section 101(a)(5)(A) that would be precluded in many cases if small numbers were required to be applied to the total annual taking under the regulations. NMFS finds this method of making a small numbers determination to be a permissible interpretation of the relevant MMPA provisions.

Although this application of small numbers may be argued as being less protective of marine mammals, NMFS disagrees. As noted previously, the small numbers standard has less biological significance as compared to the substantive and contextually-specific analysis necessary to support the negligible impact determination. The negligible impact determination is still controlling, and the maximum total annual taking that may be authorized across all LOAs under an incidental take regulation still could not exceed the overall amount analyzed for the negligible impact determination. Thus, under this option, the negligible impact analysis for the rulemaking still would have to be conducted for the time period explicitly specified in the statute (*i.e.,* up to five years), but the small numbers analysis would attach to the instrument itself that authorizes the taking, *i.e.,* the LOA.

How will small numbers be evaluated under this GOM rule?

In this rule, up-to-date species information is available, and sophisticated models have been used to estimate take in a manner that will allow for quantitative comparison of the take of individuals versus the best available abundance estimates for the species or stocks. Specifically, while the modeling effort utilized in the rule enumerates the estimated instances of takes that will occur across days as the result of the operation of certain survey types in certain areas, the modeling report also includes the evaluation of a test scenario that allows for a reasonable modification of those generalized take estimates to better estimate the number of individuals that will be taken within one survey. LOA applicants using modeling results from the rule to inform their applications will be able to reasonably estimate the number of marine mammal individuals taken by their activities. LOA applications that do not use the modeling provided in the rule to estimate take for their activities will need to be reviewed, and applicants will be required to ensure that their estimates adequately inform the small numbers finding. If applicants use the modeling provided by this rule to estimate take, additional review will not be deemed necessary (unless other conditions necessitating review exist, as described in the Letters of Authorization section). If applicants do not use the modeling provided by the rule, however, NMFS may publish a notice in the **Federal Register** soliciting public comment, if the model or inputs differ substantively from those that have been reviewed by NMFS and the public previously, if the model or inputs differ substantively from those that have been reviewed by NMFS and the public previously. The estimated take of marine mammals for each species will then be compared against the best available scientific information on species or stock abundance estimate as determined by NMFS, and estimates that do not exceed one-third of that estimate will be considered small numbers.

Adaptive Management

The regulations governing the take of marine mammals incidental to geophysical survey activities contain an adaptive management component. The comprehensive reporting requirements associated with this rule (see the Monitoring and Reporting section) are designed to provide NMFS with monitoring data from the previous year to allow consideration of whether any changes are appropriate. The use of adaptive management allows NMFS to consider new information from different sources to determine (with input from the LOA-holders regarding practicability) on a regular (*e.g.,* annual or biennial) basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammal species or stocks or their habitat and if the measures are practicable. The adaptive management process and associated reporting requirements would serve as the basis for evaluating performance and compliance.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: (1) Results from monitoring reports, as required by MMPA authorizations; (2) results from general marine mammal and sound research; and (3) any information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized through these regulations and subsequent LOAs or that the specified activity may be having more than a negligible impact on affected stocks.

Under this rule, NMFS plans to implement an annual adaptive management process including BOEM, BSEE, industry operators (including geophysical companies as well as exploration and production companies), and others as appropriate. Industry operators may elect to be represented in this process by their respective trade associations. NMFS, BOEM, and BSEE (*i.e.,* the regulatory agencies) and industry operators who have conducted or contracted for survey operations in the GOM in the prior year (or their representatives) will provide an agreed-upon description of roles and responsibilities, as well as points of contact, in advance of each year's adaptive management process. The foundation of the adaptive management process will be the annual comprehensive reports produced by LOA-holders (or their representatives), as well as the results of any relevant research activities, including research supported voluntarily by the oil and gas industry and research supported by the Federal government. Please see the Monitoring Contribution Through Other Research section in the notice of proposed rulemaking for a description of representative past research efforts. The outcome of the annual adaptive management process would be an assessment of effects to marine mammal populations in the GOM relative to NMFS' determinations under the MMPA and ESA, recommendations related to mitigation, monitoring, and reporting, and recommendations for future research (whether supported by industry or the regulatory agencies).

Data collection and reporting by individual LOA-holders will occur on an ongoing basis, per the terms of issued LOAs. In a given annual cycle, the comprehensive annual report will summarize and synthesize all LOA-specific reports received, with report development (supported through collaboration of individual LOA-holders or by their representatives) occurring for 90 days following the end of a given one-year period. Review and revision of the report, followed by a joint meeting of the parties, will occur within 90 days following receipt of the annual report. Any agreed-upon modifications will occur through the process for modifications and/or adaptive management described in the regulatory text following this preamble.

Monitoring Contribution Through Other Research

NMFS' MMPA implementing regulations require that applicants for incidental take authorizations describe the suggested means of coordinating research opportunities, plans, and activities relating to reducing incidental taking and evaluating its effects (50 CFR 216.104(a)(14)). Such coordination can serve as an effective supplement to the monitoring and reporting required pursuant to issued LOAs and/or incidental take regulations. NMFS expects that relevant research efforts will inform the annual adaptive management process described above, and that levels and types of research efforts will change from year to year in response to identified needs and evolutions in knowledge, emerging trends in the economy and available funding, and available scientific and technological resources. In the notice of proposed rulemaking, NMFS described examples of relevant research efforts (83 FR 29300–29301). We do not repeat that information here, but refer the reader to that notice for more information. The described efforts may not be predictive of any future levels and types of research efforts. Research occurring in locations other than the GOM may be relevant to understanding the effects of geophysical surveys on marine mammals or marine mammal populations or the effectiveness of mitigation. NMFS also refers the reader to the industry Joint Industry Program (JIP) website (*www.soundandmarinelife.org*), which hosts a database of available products funded partially or fully through the JIP, and to BOEM's Environmental Studies Program (ESP), which develops, funds, and manages scientific research to inform policy decisions regarding outer continental shelf resource development (*www.boem.gov/studies).*

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, NMFS has determined that the total taking of affected species or stocks will not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

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 such species under NMFS' jurisdiction 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 this final rule, and any subsequent LOAs, is subject to the requirements of Section 7 of the ESA. Therefore, NMFS' 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 the rule and subsequent LOAs on July 19, 2018. The formal consultation concluded and a final Biological Opinion (BiOp) was issued on March 13, 2020. The BiOp concluded that the Permits and Conservation Division's proposed action is not likely to jeopardize the continued existence of sperm whales or the GOM Bryde's whale.

National Environmental Policy Act

In 2017, 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 GOM OCS, pursuant to requirements of NEPA. These activities include geophysical surveys in support of hydrocarbon exploration, as are described in the MMPA petition before NMFS. The PEIS is available online at: *www.boem.gov/Gulf-of-Mexico-Geological-and-Geophysical-Activities-Programmatic-EIS/.* 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 to streamline decision-making. 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' comments and suggestions in the NEPA process. In the notice of proposed rulemaking, NMFS stated its intention to adopt BOEM's analysis in order to assess the impacts to the human environment of issuance of the subject ITR, 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 the ITR and subsequent LOAs. Following review of public comments received, NMFS confirmed that it would be appropriate to adopt BOEM's analysis in order to support assessment of the impacts to the human environment of issuance of the subject ITR and subsequent LOAs. Therefore NMFS prepared a Record of Decision for the following purposes: (1) To adopt the Final PEIS to support NMFS' analysis associated with issuance of incidental take authorizations pursuant to section 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 NMFS' decision to review and potentially issue incidental take authorizations under the MMPA on a case-by-case basis, if appropriate.

Letters of Authorization

Under these incidental take regulations, industry operators may apply for and obtain LOAs, as described in NMFS' MMPA implementing regulations (50 CFR 216.106). LOAs may be issued for any time period that does not exceed the effective duration of the final rule, provided the description of the activity in the request includes a sufficient degree of specificity with which to evaluate whether the activity falls within the scope of the rule. Because the specified activity described herein does not provide actual specifics of the timing, location, and survey design for activities that would be the subject of issued LOAs, such requests must include, at minimum, the information described at 50 CFR 216.104(a)(1) and (2), and should include an affirmation of intent to adhere to the mitigation, monitoring, and reporting requirements described in the regulations. The level of effort proposed by an operator would be used to develop an LOA-specific take estimate based on the results of Zeddies *et al.* (2015, 2017a).

The proposed rule indicated that LOA applications with take estimates based on modeling other than that specifically included in the modeling report used to support the EIS and the proposed rule (Zeddies *et al.,* 2015, 2017a) would be published for public comment prior to the issuance of an LOA. However, upon further consideration of the ''*Gulf of Mexico Acoustic Exposure Model Variable Analysis*'' (Zeddies *et al.,* 2017b; ''Acoustic Exposure Model Variable Analysis'') provided by IAGC and API to NMFS prior to the publication of the proposed rule and made available to the public with the proposed rule and the Associations' public comments, which extensively referenced the Acoustic Exposure Model Variable Analysis, the final rule more flexibly provides that if applicants do not use the modeling provided by the rule, NMFS may publish a notice in the **Federal Register** soliciting public comment, if the model or inputs differ substantively from those that have been reviewed by NMFS and the public previously. Specifically, the Acoustic Exposure Model Variable Analysis includes the results (*i.e.,* take estimates) of a supplemental analysis of the same modeling effort used in Zeddies *et al.* (2015, 2017a) to support the proposed rule, but evaluating the effects on the modeling results of different variables. One analyzed variable of particular utility was the use of a smaller airgun array that could serve as a reasonable representative for some of the smaller arrays that are commonly used in the GOM. This specific applicable example, in which the model and inputs of this Acoustic Exposure Model Variable Analysis have been reviewed by NMFS and the public previously (both in that they mirror Zeddies *et al.* (2015, 2017a) and in that NMFS also explicitly made the Acoustic Exposure Model Variable Analysis available to the public during the comment period), illustrates the need to provide flexibility and make efficient use of previous public and agency review. NMFS has, therefore, determined it appropriate to allow that additional public review is not needed unless the model or inputs differ substantively from those that have been reviewed by NMFS and the public previously. Further, we explicitly note the utility of the modeling and results presented in the Acoustic Exposure Model Variable Analysis report for representing smaller airgun arrays that are commonly used in the GOM and affirm that further public comment on that report should not be necessary prior to the use of its results to support the issuance of LOAs.

Technologies continue to evolve to meet the technical, environmental, and economic challenges of oil and gas development. The use of ''new and unusual technologies'' (NUT), *i.e.,* technologies other than those described herein, will be evaluated on a case-by-case basis and may require public review. Some seemingly new technologies proposed for use by operators are often extended applications of existing technologies and interface with the environment in essentially the same way as well-known or conventional technologies. For such evaluations, NMFS will follow the existing process used by BOEM, by using the following considerations:

- Has the technology or hardware been used previously or extensively in the U.S. GOM under operating conditions similar to those anticipated for the activities proposed by the operator? If so, the technology would not be considered a NUT;
- Does the technology function in a manner that potentially causes different impacts to the environment than similar equipment or procedures did in the past? If so, the technology would be considered a NUT;
- Does the technology have a significantly different interface with the environment than similar equipment or procedures did in the past? If so, the technology would be considered a NUT; and
- Does the technology include operating characteristics that are outside established performance parameters? If so, the technology would be considered a NUT.

NMFS will consult with BOEM as well as with NMFS' ESA Interagency Cooperation Division regarding the level of review necessary for issuance of an LOA in which a NUT is proposed for use.

Classification

Pursuant to the procedures established to implement Executive Order 12866, the Office of Management and Budget (OMB) has determined that this rule is economically significant. Accordingly, a regulatory impact analysis (RIA) was prepared and made available for review by the public. Following review of public comments, a final RIA has been prepared and is available online at: *www.fisheries.noaa.gov/action/incidental-take-authorization-oil-and-gas-industry-geophysical-survey-activity-gulf-mexico.* Appendix B of the RIA provides a final regulatory flexibility analysis (FRFA, discussed below), while Appendix C addresses other compliance requirements.

The RIA evaluates the potential costs and benefits of these incidental take regulations against two baselines, a baseline corresponding with regulatory conditions in place since 2013 pursuant to a settlement agreement, as amended through stipulated agreement, involving a stay of litigation (*NRDC et al.* v. *Bernhardt et al.,* Civil Action No. 2:10 cv–01882 (E.D. La.)), and a baseline corresponding to conditions prior to the 2013 settlement agreement. Under the settlement agreement that is in effect, industry trade groups representing operators agreed to include certain mitigation requirements for geophysical surveys in the GOM.

OMB Circular A–4 provides that agencies may present multiple baselines where this would provide additional useful information to the public on the projected effects of the regulation. NMFS presented both baselines for public information and comment, consistent with the Circular A–4 provision allowing agencies to present multiple baselines. No information or comments regarding the economic baselines were received.

These regulations require new mitigation measures relative to the settlement baseline and, thus, new costs for survey operators. However, the rule also alleviates the burden of implementing minimum separation distance requirements for deep penetration airgun surveys, as required under the settlement agreement. The rule also results in certain indirect (but non-monetized) costs. However, the RIA analysis demonstrates that these costs are not likely to be significant. Moreover, as described in the RIA, total costs related to compliance for survey activities are small compared with expenditures on other aspects of oil and gas industry operations, and direct compliance costs of the regulatory requirements are unlikely to result in materially reduced oil and gas activities in the GOM.

The rule also results in certain non-monetized benefits. The protection of marine mammals afforded by this rule (pursuant to the requirements of the MMPA) benefits the regional economic value of marine mammals via tourism and recreation to some extent, as mitigation measures applied to geophysical survey activities in the GOM region are expected to benefit the marine mammal populations that support this economic activity in the GOM. In addition, some degree of benefits can be expected to accrue solely via ecological benefits to marine mammals and other wildlife as a result of the regulatory requirements. The published literature (described in the RIA) is clear that healthy populations of marine mammals and other co-existing species benefit regional economies and provide social welfare benefits to people. However, the literature does not provide a basis for quantitatively valuing the cost of anticipated incremental changes in environmental disturbance and marine mammal harassment associated with the rule.

Notably, the rule also affords significant benefit to the regulated industry by providing regulatory certainty through an efficient framework within which to achieve compliance with the MMPA. In particular, cost savings may be generated by the reduced administrative effort required to obtain an LOA under the framework established by a rule compared to what would be required to obtain an incidental harassment authorization (IHA) under section 101(a)(5)(D). Absent the rule, to attain equivalent compliance with the MMPA, survey operators in the GOM would need to apply for an IHA. Although not monetized in the RIA, NMFS' analysis indicates that the upfront work associated with the rule (*e.g.,* analyses, modeling, process for obtaining LOA) likely saves significant time and money for operators. A conservative cost savings calculation, based on estimates of the costs for IHA applications relative to LOA application costs and an assumption of the number of likely authorizations based on total annual survey days and survey estimates included in the RIA, ranges from $500,000 to $1.5 million annually. In terms of timing, NMFS recommends that IHA applicants contact the agency six to nine months in advance of the planned activity, whereas NMFS anticipates a timeframe of three months or less (depending upon the content of the request and the activities covered) for LOA applications under this rule.

Details regarding cost estimation are available in the RIA. A qualitative evaluation of indirect costs related to the regulations is also provided in the RIA. Note that these costs would be diffused across all operators receiving LOAs.

NMFS prepared a FRFA, as required by Section 603 of the Regulatory Flexibility Act (RFA), for this rule. The FRFA describes the economic effects this rule will have on small entities. A description of this action, why it is being considered, the objectives of the action, and the legal basis for the action are contained in the preamble of this rule. A copy of the full analysis is available as an appendix to the RIA. The MMPA provides the statutory basis for this rule. No duplicative, overlapping, or conflicting Federal rules have been identified. A detailed summary of the initial regulatory flexibility analysis was provided at the proposed rule stage. No comments or information regarding this analysis were received.

This final rule is expected to directly regulate businesses that conduct geophysical surveys in the GOM with the potential to incidentally take marine mammals. Some of these businesses may be defined as small entities. The FRFA is summarized below.

The FRFA focuses on identifying small businesses that would bear the incremental survey costs associated with the rule. These may include entities undertaking, commissioning, or purchasing surveys. In order to estimate the number of small entities to which the rule will apply, permit applications between 2006 and 2015 were analyzed to understand what industries were involved in permit applications for geophysical surveys in the Gulf of Mexico and to identify U.S.-based permit applicants that would be classified as small according to Small Business Administration definitions and the most recent revenue or employment data available. In total, 34 U.S.-based small businesses applied for geophysical survey permits in the Gulf of Mexico between 2006 and 2015. By assuming that the same proportion of international, large, and small companies will undertake the surveys over the next five years as occurred during 2006 to 2015, the likely number of future surveys that will include small entity applicants may be estimated. Accordingly, NMFS estimates that small entities would apply for approximately 32 to 53 surveys over the next five years, or approximately six to 11 surveys annually. Historically, there was a ratio of approximately 2.2 surveys applied for per small entity. Using this ratio, NMFS estimates that approximately 15 to 24 small companies will likely apply for permits over the next five years, or approximately 3 to 5 small companies each year. The future distribution of small survey companies by industry is not known, but the historical pattern of surveys suggests that companies involved in oil and gas extraction (NAICS 2111) and support activities for oil and gas (213112) will account for the majority of the survey applications by small companies.

A review of the reported annual revenues for the 34 small entities that applied for survey permits between 2006 and 2015 reveals a wide range, with the lowest revenues reported to be $0.04 million and the highest revenues reported to be $1.9 billion. Average revenues for the small entities who applied for permits were $232 million, with median revenues of $12.26 million. We note, however, that the revenues and numbers of employees reported for many of these small companies appeared to be erroneous, in multiple instances reporting annual revenues significantly less than the costs of conducting even the lowest cost surveys. As a result, these revenue estimates are likely to be inaccurate or, alternatively, permit applicants must pass survey costs on to the companies that purchase or commission the seismic data. Given that the oil and gas extraction companies are generally the entities purchasing the survey data, we expect that it is most likely that survey costs are ultimately borne by NAICS 2111 (oil and gas extraction), either as the permittees for the survey permit or because the other, smaller businesses pass these costs along in the data purchase price.

In summary, the FRFA finds the following: First, in the majority of cases (88 percent), survey permit applicants are large businesses. Second, when the permit applicants are small businesses, the majority of the time (63 percent) they are oil and gas extractors (NAICS 2111). Third, together, these permits (for large businesses and small businesses with high annual revenues for which rule costs are a small fraction) account for 96 percent of the survey permits. Fourth, while small entities in other industries occasionally apply for permits (four percent historically), these businesses are quite small, with average annual revenues in the millions or even less. Given their size, it is unlikely that these permit applicants bear survey costs; otherwise it would be reflected in their annual revenues (*i.e.,* their revenues on average would reflect that they recover their costs). Accordingly, NMFS expects it is most likely that survey costs are passed on to oil and gas extraction companies who commission the surveys or purchase the data. And fifth, overall, up to five small businesses (NAICS 2111) per year may experience increased costs of between 0.1 and 0.7 percent of average annual revenues.

The draft version of the RIA and the Initial Regulatory Flexibility Analysis considered effects of a more stringent alternative than the proposed rule. The more stringent alternative included additional shutdown requirements and area closures for surveys, generating costs up to 20 percent greater than the proposed rule. NMFS did not elect to proceed with these elements of the more stringent alternative in the final rule, which reduces the potential for impacts to small businesses. NMFS determined that the final rule achieves the statutory objectives with a lower regulatory burden. As described above, a relatively small portion of total survey activities are undertaken by small entities and the FRFA determines that it is unlikely that small entities will bear the compliance costs described in the RIA.

This final rule revises the information collection request (ICR) requirement associated with OMB Control Number 0648–0151 to allow for the expected increase in applicants/respondents due to this final action. This revision is subject to review and approval by OMB under the Paperwork Reduction Act (PRA) and has been submitted to OMB. NMFS published a 30-day **Federal Register** notice (85 FR 60765; September 28, 2020) that provided for an additional comment period. Details on the new information collection requirements can be found in the RIA Appendix C.2. NMFS anticipates that 95 to 151 geophysical surveys will take place annually on average over the five years of the regulations in the GOM that would be subject to potential information collection requirements. Due to this final rule, NMFS estimates at least 95 new LOA applications annually. Because the existing OMB Control Number 0648–0151 expires less than a year (June 30, 2021) after this final rule publishes, there will be less than a year for respondents to carry out work under these regulations before this OMB Control Number expires. Thus, NMFS estimates no more than one-quarter of respondents (24) will complete work to the point of developing an annual report prior to when 0648–0151 must be renewed.

We invite the general public and other Federal agencies to comment on proposed and continuing information collections, which helps us assess the impact of our information collection requirements and minimize the public's reporting burden. Written comments and recommendations for this information collection should be submitted at the following website: *www.reginfo.gov/public/do/PRAMain.* Find this particular information collection by using the search function and entering either the title of the collection or the OMB Control Number 0648–0151.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

List of Subjects in 50 CFR Part 217

Exports, Fish, Imports, Indians, Labeling, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation.

Dated: December 7, 2020.

Samuel D. Rauch III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 217 is amended as follows:

PART 217—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

■ 1. The authority citation for part 217 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

■ 2. Add Subpart S, consisting of §§ 217.180 through 217.189, to read as follows:

Subpart S—Taking Marine Mammals Incidental to Geophysical Survey Activities in the Gulf of Mexico

Sec.

217.180 Specified activity and specified geographical region.
217.181 Effective dates.
217.182 Permissible methods of taking.
217.183 Prohibitions.
217.184 Mitigation requirements.
217.185 Requirements for monitoring and reporting.
217.186 Letters of Authorization.
217.187 Renewals and modifications of Letters of Authorization.
217.188 [Reserved]
217.189 [Reserved]

Subpart S—Taking Marine Mammals Incidental to Geophysical Survey Activities in the Gulf of Mexico

§ 217.180 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to oil and gas industry operators (LOA-holders), and those persons authorized to conduct activities on their behalf, for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occurs incidental to geophysical survey activities.

(b) The taking of marine mammals by oil and gas industry operators may be authorized in a Letter of Authorization (LOA) only if it occurs within U.S. waters in the Gulf of Mexico, outside the area subject to a Congressional leasing moratorium under the Gulf of Mexico Energy Security Act (GOMESA) (Pub L. 109–432, § 104) as of the effective date of these regulations.

§ 217.181 Effective dates.

Regulations in this subpart are effective from April 19, 2021 through April 19, 2026.

§ 217.182 Permissible methods of taking.

Under LOAs issued pursuant to §§ 216.106 of this chapter and 217.186, LOA-holders may incidentally, but not intentionally, take marine mammals within the area described in § 217.180(b) by Level A and Level B harassment associated with geophysical survey activities, provided the activity is in compliance with all terms, conditions, and requirements of the regulations in this subpart and the appropriate LOA.

§ 217.183 Prohibitions.

Notwithstanding takings contemplated in §§ 217.180 and 217.182, and authorized by a LOA issued under §§ 216.106 of this chapter and 217.186, no person in connection with the activities described in § 217.180 may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or a LOA issued under §§ 216.106 of this chapter and 217.186;

(b) Take any marine mammal not specified in such LOAs;

(c) Take any marine mammal specified in such LOAs in any manner other than as specified; or

(d) Take a marine mammal specified in such LOAs if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal.

§ 217.184 Mitigation requirements.

When conducting the activities identified in § 217.180, the mitigation measures contained in any LOA issued under §§ 216.106 of this chapter and 217.186 must be implemented. These mitigation measures shall include but are not limited to:

(a) *General conditions.* (1) A copy of any issued LOA must be in the possession of the LOA-holder, vessel operator, other relevant personnel, the lead protected species observer (PSO), and any other relevant designees operating under the authority of the LOA.

(2) The LOA-holder must instruct relevant vessel personnel with regard to the authority of the protected species monitoring team (PSO team), and must ensure that relevant vessel personnel and PSO team participate in a joint onboard briefing, led by the vessel operator and lead PSO, prior to beginning work to ensure that responsibilities, communication procedures, protected species monitoring protocols, operational procedures, and LOA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations before work involving those personnel commences.

(3) 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 must be avoided. For surveys using airgun arrays as the acoustic source, notified operational capacity (*i.e.,* total array volume) (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 communicated to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(4) PSOs must be used as specified in this paragraph (a)(4).

(i) LOA-holders must use independent, dedicated, qualified PSOs, meaning that the PSOs must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards), and must be qualified pursuant to § 217.185(a) (except as specified at § 217.184(d)(2)(iii–iv)). Acoustic PSOs are required to complete specialized training for operating passive acoustic monitoring (PAM) systems and are encouraged to have familiarity with the vessel on which they will be working. PSOs may act as both acoustic and visual observers (but not simultaneously), so long as they demonstrate that their training and experience are sufficient to perform each task.

(ii) The LOA-holder must submit PSO resumes for NMFS review and approval prior to commencement of the survey (except as specified at § 217.184(d)(2)(iii)). Resumes should include dates of training and any prior NMFS approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS is allowed one week to approve PSOs from the time that the necessary information is received by NMFS, after which PSOs meeting the minimum requirements will automatically be considered approved.

(iii) At least one visual PSO and two acoustic PSOs (when required) aboard each acoustic source vessel must have a minimum of 90 days at-sea experience working in those roles, respectively, with no more than eighteen months elapsed since the conclusion of the at-sea experience (except as specified at § 217.184(d)(2)(iii)). One visual PSO with such experience must be designated as the lead for the entire PSO team. The lead must coordinate duty schedules and roles for the PSO team and serve as the primary point of contact for the vessel operator. (Note that the responsibility of coordinating duty schedules and roles may instead be assigned to a shore-based, third-party monitoring coordinator.) To the maximum extent practicable, the lead PSO must devise the duty schedule such that experienced PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience.

(b) *Deep penetration surveys.* (1) Deep penetration surveys are defined as surveys using airgun arrays with total volume greater than 1,500 in^3.

(2) Visual monitoring must be conducted as specified in this paragraph (b)(2).

(i) During survey operations (*i.e.,* any day on which use of the acoustic source is planned to occur, and 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).

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs must coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and must conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs must immediately communicate all observations of marine mammals to the on-duty acoustic PSO, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Any observations of marine mammals by crew members aboard any vessel associated with the survey must be relayed to the PSO team.

(vi) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs must conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(vii) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. NMFS may grant an exception for LOA applications that demonstrate such a ''two hours on/one hour off'' duty cycle is not practicable, in which case visual PSOs will be subject to a maximum of four consecutive hours on watch followed by a break of at least two hours between watches. Combined observational duties (visual and acoustic but not at the same time) must not exceed 12 hours per 24-hour period for any individual PSO.

(3) Acoustic monitoring must be conducted as specified in this paragraph (b)(3).

(i) All source vessels must use a towed PAM system at all times when operating in waters deeper than 100 m, which must be monitored by a minimum of one acoustic PSO beginning at least 30 minutes prior to ramp-up, at all times during use of the acoustic source, and until one hour after use of the acoustic source ceases. ''PAM system'' refers to calibrated hydrophone arrays with full system redundancy to detect, identify, and estimate distance and bearing to vocalizing cetaceans, 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. The PAM system must have at least one calibrated hydrophone (per each deployed hydrophone type and/or set) sufficient for determining whether background noise levels on the towed PAM system are sufficiently low to meet performance expectations. Applicants must provide a PAM plan including description of the hardware and software proposed for use prior to proceeding with any survey where PAM is required.

(ii) Acoustic PSOs must immediately communicate all detections of marine mammals 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.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches, and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (visual and acoustic but not at the same time) must not exceed 12 hours per 24-hour period for any individual PSO.

(iv) Survey activity may continue for 30 minutes when the PAM system malfunctions or is damaged, 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 during daylight hours only under the following conditions:

(A) Sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding delphinids) detected solely by PAM in the applicable exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began occurring without an active PAM system; and

(D) 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.

(4) PSOs must establish and monitor applicable exclusion and buffer zones. These zones must be based upon the radial distance from the edges 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 (*i.e.,* anytime the acoustic source is active, including ramp-up), occurrence of marine mammals within the relevant buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown of the acoustic source.

(i) Two exclusion zones are defined, depending on the species and context. A standard exclusion zone encompassing the area at and below the sea surface out to a radius of 500 meters from the edges of the airgun array (0–500 m) is defined. For special circumstances (defined at § 217.184(b)(9)(v)), the exclusion zone encompasses an extended distance of 1,500 meters (0–1,500 m).

(ii) During pre-start clearance monitoring (*i.e.,* before ramp-up begins), the buffer zone acts as an extension of the exclusion zone in that observations of marine mammals within the buffer zone would also preclude airgun operations from beginning (*i.e.,* ramp-up). For all marine mammals (except where superseded by the extended 1,500-m exclusion zone), the buffer zone encompasses the area at and below the sea surface from the edge of the 0–500 meter exclusion zone out to a radius of 1,000 meters from the edges of the airgun array (500–1,000 m). The buffer zone is not applicable when the exclusion zone is greater than 500 meters, *i.e.,* the observational focal zone is not increased beyond 1,500 meters.

(5) A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total active array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. A 30-minute pre-start clearance observation period must occur prior to the start of ramp-up. The LOA-holder must adhere to the following pre-start clearance and ramp-up requirements:

(i) 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 not be less than 60 minutes prior to the planned ramp-up.

(ii) Ramp-ups must be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(iii) 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.

(iv) Ramp-up must not be initiated if any marine mammal is within the applicable exclusion or buffer zone. If a marine mammal is observed within the exclusion zone or the buffer zone during the 30-minute pre-start clearance period, ramp-up must not begin until the animal(s) has been observed exiting the zones or until an additional time period has elapsed with no further sightings (15 minutes for small delphinids and 30 minutes for all other species).

(v) Ramp-up must begin by activating a single airgun of the smallest volume in the array and shall continue 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 must not be less than 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed.

(vi) Ramp-up must cease and the source shut down upon observation of marine mammals within the applicable exclusion zone. Once ramp-up has begun, observations of marine mammals within the buffer zone do not require shutdown.

(vii) Ramp-up may occur at times of poor visibility, including nighttime, if appropriate acoustic monitoring has occurred with no detections of a marine mammal other than delphinids in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at night where operational planning cannot reasonably avoid such circumstances.

(viii) If the acoustic source is shut down for brief periods (*i.e.,* less than 30 minutes) for reasons other than implementation of prescribed mitigation (*e.g.,* mechanical difficulty), it may be activated again without ramp-up if PSOs have maintained constant visual and/or acoustic observation and no visual or acoustic detections of any marine mammal have occurred within the applicable exclusion zone. For any longer shutdown, pre-start clearance observation 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-start clearance watch is not required.

(ix) Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require ramp-up but does require the pre-start clearance observation period.

(6) Shutdowns must be implemented as specified in this paragraph (b)(6).

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source pursuant to the requirements of this subpart.

(ii) 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.

(iii) When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs.

(iv) When the airgun array is active (*i.e.,* anytime one or more airguns is active, including during ramp-up) and (1) a marine mammal appears within or enters the applicable exclusion zone and/or (2) a marine mammal (excluding delphinids) is detected acoustically and localized within the applicable exclusion zone, the acoustic source must be shut down. When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation.

(v) The extended 1,500-m exclusion zone must be applied upon detection (visual or acoustic) of a baleen whale, sperm whale, beaked whale, or *Kogia* spp. within the zone.

(vi) Shutdown requirements are waived for dolphins of the following genera: *Tursiops, Stenella, Steno,* and *Lagenodelphis.* If a delphinid is visually detected within the exclusion zone, no shutdown is required unless the PSO confirms the individual to be of a genus other than those listed above, in which case a shutdown is required. Acoustic detection of delphinids does not require shutdown.

(vii) If there is uncertainty regarding identification or localization, PSOs may use best professional judgment in making the decision to call for a shutdown.

(viii) Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) has been observed exiting the applicable exclusion zone or following a 30-minute clearance period with no further detection of the marine mammal(s).

(c) *Shallow penetration surveys.* (1) Shallow penetration surveys are defined as surveys using airgun arrays with total volume equal to or less than 1,500 in^3, single airguns, boomers, or equivalent sources.

(2) LOA-holders conducting shallow penetration surveys must follow the requirements defined for deep penetration surveys at § 217.184(b), with the following exceptions:

(i) Acoustic monitoring is not required for shallow penetration surveys.

(ii) Ramp-up for small airgun arrays must follow the procedure described above for large airgun arrays, but may occur over an abbreviated period of time. Ramp-up is not required for surveys using only a single airgun. For non-airgun sources, power should be increased as feasible to effect a ramp-up.

(iii) Two exclusion zones are defined, depending on the species and context. A standard exclusion zone encompassing the area at and below the sea surface out to a radius of 100 meters from the edges of the airgun array (if used) or from the acoustic source (0–100 m) is defined. For special circumstances (§ 217.184(b)(6)(v)), the exclusion zone encompasses an extended distance of 500 meters (0–500 m).

(iv) The buffer zone encompasses the area at and below the sea surface from the edge of the 0–100 meter exclusion zone out to a radius of 200 meters from the edges of the airgun array (if used) or from the acoustic source (100–200 meters). The buffer zone is not applicable when the exclusion zone is greater than 100 meters.

(d) *High-resolution geophysical (HRG) surveys.* (1) HRG surveys are defined as surveys using an electromechanical source that operates at frequencies less than 180 kHz, other than those defined at § 217.184(c)(1) (*e.g.,* side-scan sonar, multibeam echosounder, or chirp sub-bottom profiler).

(2) LOA-holders conducting HRG surveys must follow the requirements defined for shallow penetration surveys at § 217.184(c), with the following exceptions:

(i) No shutdowns are required for HRG surveys. Pre-start clearance watch is required as defined at § 217.184(c), *i.e.,* for a period of 30 minutes and over a 200-m radius from the acoustic source.

(ii) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of one trained and experienced independent PSO 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) when operating in waters deeper than 100 m.

(iii) When operating in waters shallower than 100 m, LOA-holders must employ one trained visual PSO, who may be a crew member, only for purposes of conducting pre-start clearance monitoring. If PSOs are crew members, *i.e.,* are not independent PSOs, the PSOs are not subject to NMFS' approval. In these circumstances, LOA requests must describe the training that will be provided to crew members filling the role of PSO.

(iv) PSOs are not required during survey operations in which the active acoustic source(s) are deployed on an autonomous underwater vehicle.

(e) *Time-area closure.* From January 1 through May 31, no use of airguns may occur shoreward of the 20-m isobath and between 90–84° W.

(f) *Entanglement avoidance.* To avoid the risk of entanglement, LOA-holders conducting surveys using ocean-bottom nodes or similar gear must:

(1) Use negatively buoyant coated wire-core tether cable;

(2) Retrieve all lines immediately following completion of the survey; and

(3) Attach acoustic pingers directly to the coated tether cable; acoustic releases should not be used.

(g) *Vessel strike avoidance.* LOA-holders must adhere to the following requirements:

(1) Vessel operators and crews must maintain a vigilant watch for all marine mammals and must slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel, which shall be defined according to the parameters stated in this subsection. Visual observers monitoring the vessel strike avoidance zone may be third-party observers (*i.e.,* PSOs) 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 as a baleen whale, sperm whale, or other marine mammal;

(2) Vessel speeds must be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of marine mammals are observed near a vessel;

(3) All vessels must maintain a minimum separation distance of 500 m from baleen whales;

(4) All vessels must maintain a minimum separation distance of 100 m from sperm whales;

(5) All vessels must, to the maximum extent practicable, 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

(6) When marine mammals are sighted while a vessel is underway, the vessel must 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 must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This does not apply to any vessel towing gear or any vessel that is navigationally constrained.

(7) 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.

§ 217.185 Requirements for monitoring and reporting.

(a) *PSO qualifications.* (1) PSOs must successfully complete relevant, acceptable training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(2) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must be submitted to NMFS and shall include written justification. Requests will be granted or denied (with justification) by NMFS within one week of receipt of submitted information. Alternate experience that may be considered includes, but is not limited to:

(i) Secondary education and/or experience comparable to PSO duties;

(ii) Previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or

(iii) Previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(b) *Equipment.* LOA-holders are required to:

(i) Provide PSOs with bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality solely for PSO use. These must 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.

(ii) For each vessel required to use a PAM system, provide a PAM system that has been verified and tested by an experienced acoustic PSO who will be using it during the trip for which monitoring is required;

(iii) Work with the selected third-party observer provider to ensure PSOs have all equipment (including backup equipment) needed to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals. (Equipment specified in A. through G. below may be provided by an individual PSO, the third-party observer provider, or the LOA-holder, but the LOA-holder is responsible for ensuring PSOs have the proper equipment required to perform the duties specified herein.) Such equipment, at a minimum, must include:

(A) Reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (at least one per PSO, plus backups);

(B) Global Positioning Unit (GPS) (plus backup);

(C) Digital camera with a telephoto lens (the camera or lens should also have an image stabilization system) that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR) (plus backup);

(D) Compass (plus backup);

(E) Radios for communication among vessel crew and PSOs (at least one per PSO, plus backups); and

(F) Any other tools necessary to adequately perform necessary PSO tasks.

(c) *Data collection.* PSOs must use standardized electronic data forms. PSOs must record detailed information about any implementation of mitigation requirements, including the distance of marine mammals 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 or activation of the acoustic source. If required mitigation was not implemented, PSOs must record a description of the circumstances. At a minimum, the following information should be recorded:

(1) Vessel names (source vessel and other vessels associated with survey), vessel size and type, maximum speed capability of vessel, port of origin, and call signs;

(2) PSO names and affiliations;

(3) Dates of departures and returns to port with port name;

(4) Dates of and participants in PSO briefings;

(5) Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;

(6) Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;

(7) Vessel location at 30-second intervals (if software capability allows) or 5-minute intervals (if location must be manually recorded);

(8) Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;

(9) Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions changed significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon;

(10) Vessel location when environmental conditions change significantly;

(11) Factors that may have contributed to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.,* vessel traffic, equipment malfunctions);

(12) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in an array, tow depth of an acoustic source, and any other notes of significance (*i.e.,* pre-start clearance, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.); and

(13) Upon visual observation of a marine mammal, the following information:

(i) Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(ii) PSO who sighted the animal and PSO location (including height above water) at time of sighting;

(iii) Time of sighting;

(iv) Vessel coordinates at time of sighting;

(v) Water depth;

(vi) Direction of vessel's travel (compass direction);

(vii) Speed of the vessel(s) from which the observation was made;

(viii) Direction of animal's travel relative to the vessel;

(ix) Pace of the animal;

(x) Estimated distance to the animal (and method of estimating distance) and its heading relative to vessel at initial sighting;

(xi) Identification of the animal (*e.g.,* genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

(xii) Estimated number of animals (high/low/best);

(xiii) Estimated number of animals by cohort (adults, juveniles, group composition, etc.);

(xiv) 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);

(xv) Detailed behavior observations (*e.g.,* number of blows/breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior), including an assessment of behavioral responses to survey activity;

(xvi) Animal's closest point of approach (CPA) and/or closest distance from any element of the acoustic source;

(xvii) Platform activity at time of sighting (*e.g.,* deploying, recovering, testing, shooting, data acquisition, other); and

(xviii) Description of any actions implemented in response to the sighting (*e.g.,* delays, shutdown, ramp-up) and time and location of the action.

(12) Upon acoustic detection of a marine mammal using a PAM system, the following information:

(i) An acoustic encounter identification number, and whether the detection was linked with a visual sighting;

(ii) Date and time when first and last heard;

(iii) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal); and

(iv) 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.

(d) *Reporting.* (1) Annual reporting must be submitted as specified in this paragraph.

(i) LOA-holders must submit a summary report to NMFS on all activities and monitoring results within 90 days of the completion of the survey or expiration of the LOA, whichever comes sooner, and must include all information described above under § 217.185(c). If an issued LOA is valid for greater than one year, the summary report must be submitted on an annual basis.

(ii) The report must describe activities conducted and sightings of marine mammals, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities, and information regarding locations where the acoustic source was used). In addition to the report, all raw observational data must be made available to NMFS.

(iii) For operations requiring the use of PAM, the report must 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. Copies of any vessel self-noise assessment reports must be included with the report.

(iv) The LOA-holder must provide geo-referenced time-stamped vessel tracklines for all time periods in which airguns (full array or single) were operating. Tracklines must include points recording any change in airgun status (*e.g.,* when the airguns began operating, when they were turned off). GIS files must be provided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates must be referenced to the WGS84 geographic coordinate system.

(v) The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring.

(vi) A final report must be submitted within 30 days following resolution of any comments on the draft report.

(2) Comprehensive reporting must be submitted as specified in this paragraph. LOA-holders must contribute to the compilation and analysis of data for inclusion in an annual synthesis report addressing all data collected and reported through annual reporting in each calendar year. The synthesis period shall include all annual reports deemed to be final by NMFS in a given one-year reporting period. The report must be submitted to NMFS within 90 days following the end of a given one-year reporting period.

(e) *Reporting of injured or dead marine mammals.* (1) In the event that personnel involved in the survey activities discover an injured or dead marine mammal, the LOA-holder must report the incident to the Office of Protected Resources (OPR), NMFS and to the Southeast Regional Stranding Network as soon as feasible. The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(ii) Species identification (if known) or description of the animal(s) involved;

(iii) Condition of the animal(s) (including carcass condition if the animal is dead);

(iv) Observed behaviors of the animal(s), if alive;

(v) If available, photographs or video footage of the animal(s); and

(vi) General circumstances under which the animal was discovered.

(2) In the event of a ship strike of a marine mammal by any vessel involved in the survey activities, the LOA-holder must report the incident to OPR, NMFS and to the Southeast Regional Stranding Network as soon as feasible. The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the incident;

(ii) Species identification (if known) or description of the animal(s) involved;

(iii) Vessel's speed during and leading up to the incident;

(iv) Vessel's course/heading and what operations were being conducted (if applicable);

(v) Status of all sound sources in use;

(vi) 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;

(vii) Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

(viii) Estimated size and length of animal that was struck;

(ix) Description of the behavior of the marine mammal immediately preceding and following the strike;

(x) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

(xi) 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

(xii) To the extent practicable, photographs or video footage of the animal(s).

(3) For deep penetration surveys, 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 LOA-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:

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

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

(iii) If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the LOA-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.

(4) 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, and an investigation into the stranding is being pursued, NMFS will submit a written request to the LOA-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. 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.

(i) 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

(ii) 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.

§ 217.186 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, prospective LOA-holders must apply for and obtain an LOA.

(b) An LOA, unless suspended or revoked, may be effective for a period not to exceed the expiration date of these regulations.

(c) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, the LOA-holder must apply for and obtain a modification of the LOA as described in § 217.187.

(d) The LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact (*i.e.,* mitigation) on the species or stock and its habitat; and

(3) Requirements for monitoring and reporting.

(e) Issuance of the LOA shall be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under these regulations and a determination that the amount of take authorized under the LOA is of no more than small numbers.

(f) For LOA issuance, where either (1) the conclusions put forth in an application (*e.g.,* take estimates) are based on analytical methods that differ substantively from those used in the development of the rule, or (2) the proposed activity or anticipated impacts vary substantively in scope or nature from those analyzed for the rule, NMFS may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis of the differences, and solicit public comment before making a decision regarding issuance of the LOA.

(g) Notice of issuance or denial of an LOA shall be published in the **Federal Register** within thirty days of a determination.

§ 217.187 Renewals and modifications of Letters of Authorization (LOA).

(a) An LOA issued under § 216.106 of this chapter and § 217.186 for the activity identified in § 217.180 shall be modified upon request by the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section); and

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For LOA modification requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that result in more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis of the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under § 216.106 of this chapter and § 217.186 for the activity identified in § 217.180 may be modified by NMFS under the following circumstances:

(1) NMFS may modify (including adding or removing measures) the existing mitigation, monitoring, or reporting measures (after consulting with the LOA-holder regarding the practicability of the modifications) if doing so is practicable and creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations;

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA:

(A) Results from monitoring from previous years;

(B) Results from other marine mammal and/or sound research or studies; and

(C) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent LOAs.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of proposed LOA in the **Federal Register** and solicit public comment.

(2) If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in an LOA issued pursuant to § 216.106 of this chapter and § 217.186, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within thirty days of the action.

§§ 217.188–217.189 [Reserved]

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