BILLING CODE 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XF986

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Low-Energy Geophysical Survey in the Northwest Atlantic Ocean

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

ACTION: Notice; Issuance of an Incidental Harassment Authorization.

SUMMARY: In accordance with the regulations implementing the Marine Mammal Protection Act (MMPA) as amended, notification is hereby given that NMFS has issued an incidental harassment authorization (IHA) to the Scripps Institution of Oceanography (SIO) to take marine mammals incidental to a low-energy marine geophysical survey in the Northwest Atlantic Ocean.

DATES: This Authorization is valid for one year from the date of issuance.

FOR FURTHER INFORMATION CONTACT: Jordan Carduner, Office of Protected Resources, NMFS, (301) 427-8401. 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/national/marine-mammal-protection/incidental-take-authorizations-research-and-other-activities*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq*.) direct 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 and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

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

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

The MMPA states that the term "take" means to harass, hunt, capture, 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).

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (i.e., the issuance of an incidental harassment authorization) with respect to potential impacts on the human environment. This action is consistent with categories of activities identified in Categorical Exclusion B4 (incidental harassment authorizations with no anticipated serious injury or mortality) of the Companion Manual for NOAA Administrative Order 216-6A, which do not individually or cumulatively have the potential for significant impacts on the quality of the human environment and for which we have not identified any extraordinary circumstances that would preclude this categorical exclusion. Accordingly, NMFS has determined that the issuance of the IHA qualifies to be categorically excluded from further NEPA review.

Summary of Request

On November 20, 2017, NMFS received a request from SIO for an IHA to take marine mammals incidental to conducting a low-energy marine geophysical survey in the Northwest Atlantic Ocean. On February 8, 2018, we deemed SIO's application for authorization to be adequate and complete. SIO's request is for take of a small number of 35 species of marine mammals by Level B harassment and Level A harassment. Neither SIO nor NMFS expects mortality to result from this activity, and, therefore, an IHA is appropriate. The planned activity is not expected to exceed one year, hence, we do not expect subsequent MMPA incidental harassment authorizations would be issued for this particular activity.

Description of Specified Activity

Overview

SIO plans to conduct a low-energy marine seismic survey in the Northwest Atlantic Ocean for approximately 25 days during June–July 2018. The survey would occur in International Waters, between ~33.5° and 53.5° N, and 37° and 49° W, at water depths ranging from 1,800 to over 5,000 meters (m) (see Figure 1 in the IHA application) and would entail one source vessel, the R/V *Atlantis*, which would tow a pair of 45 cubic inch (in^3) GI airguns at a depth of 2–4 m with a total discharge volume of approximately 90 in^3 as an energy source along predetermined lines. The receiving system would consist of one hydrophone streamer, either 200 or 600 m in length. The program consists of a site survey in support of a potential future International Ocean Discovery Program project and would examine regional seismic stratigraphy and provide seismic images of changing sediment distributions from deepwater production changes. The Principal Investigators are Drs. M. Lyle (Oregon State University), G. Mountain (Rutgers University), and K. Miller (Rutgers University).

The survey would use two different types of airgun array configurations. The first would entail a pair of 45-in^3 airguns spaced 8 m apart at a water depth of 2–4 m with a 200 m hydrophone streamer and with the vessel traveling at 8 knots (kt). The second would entail a pair of 45-in^3 airguns, but with airguns spaced 2 m apart at a depth of 2–4 m with a 600 m hydrophone streamer and with the vessel traveling at 5 kt to achieve especially high-quality seismic reflection data. Data would be collected within six grids, and also along track lines between the six grid locations (see Figure 1 in the IHA application). A total of 7,911 kilometers (km) of seismic acquisition would occur, including 4,334 km of data collected within the survey grids (2667 km at 8 kt and 1667 km at 5 kt) and an additional 3,577 km of track lines connecting the grids. There could be additional seismic operations in the project area associated with equipment testing, re-acquisition due to equipment malfunction, data degradation during poor

weather, or interruption due to shutdown or track deviation in compliance with IHA requirements.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would also be operated continuously throughout the survey, but not during transits to and from the project area. The MBES (a Kongsberg EM122) operates at 10.5–13 (usually 12) kilohertz (kHz) and is hull-mounted, with the transmitting beamwidth 1 or 2° fore–aft and 150° athwartship. The SBP (a Knudsen 3260) is normally operated to provide information about the near seafloor sedimentary features and the bottom topography that is mapped simultaneously by the MBES. The beam of the SBP is transmitted as a 27º cone, which is directed downward by a 3.5-kHz transducer in the hull of the vessel.

Table 1. Specifications of the R/V Atlantis Airgun Array.

Number of airguns	2
Gun positions used	Two inline airguns 2- or 8-m apart
Tow depth of energy source	2-4 m
Dominant frequency components	0–188 Hz
Air discharge volume	Approximately 90 in^3
Shot interval	9.72 seconds (2 m airgun separation survey) and 12.15 seconds (8 m airgun separation survey)

A detailed description of SIO's planned survey is provided in the *Federal Register* notice for the proposed IHA (83 FR 18644; April 27, 2018). Since that time, no changes have been made to SIO's planned survey activities. Therefore, a detailed description is not provided here. Please refer to that *Federal Register* notice for the description of the specific activity. Mitigation, monitoring, and reporting measures are described in detail later in this document (please see "Mitigation" and "Monitoring and Reporting").

Comments and Responses

NMFS published a notice of proposed IHA in the *Federal Register* on April 27, 2018 (83 FR 18644). During the 30-day public comment period, NMFS received a comment letter from the Marine Mammal Commission (Commission). NMFS has posted the comments online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-research-and-other-activities*. NMFS addresses any comments specific to SIO's application related to the statutory and regulatory requirements or findings that NMFS must make under the MMPA in order to issue an Authorization. The following is a summary of the public comments and NMFS' responses.

Comment 1: The Commission expressed concerns regarding SIO's method to estimate the extent of the Level A and Level B harassment zones and the numbers of marine mammal takes. The Commission stated that the model is not the best available science because it assumes spherical spreading, a constant sound speed, and no bottom interactions for surveys in deep water, and that the model provides results to a water depth of 2,000 m while SIO's planned survey would occur in waters from 1,800 to more than 5,000 m in depth. In light of their concerns, the Commission recommended that NMFS require SIO, in collaboration with Lamont-Doherty Earth Observatory of Columbia University (LDEO) (which performed the modeling of Level A and Level B harassment zones) to re-estimate the Level A and Level B harassment zones and associated takes of marine mammals using (1) operational (including number/type/spacing of airguns, tow depth, source level/operating pressure, operational volume) and site-specific environmental (including sound speed profiles, bathymetry, and sediment characteristics at a minimum) parameters; (2) a comprehensive source model (*i.e.*, Gundalf Optimizer or AASM) and (3) an appropriate sound propagation model for the proposed IHA.

Specifically, the Commission states that LDEO should be using the ray-tracing sound propagation model BELLHOP, rather than the MATLAB code currently used.

NMFS Response: NMFS acknowledges the Commission's concerns about LDEO's current modeling approach for estimating Level A and Level B harassment zones and takes. SIO's application (LGL, 2018) and the *Federal Register* notice of the proposed IHA (83 FR 18644; April 27, 2018) describe the applicant's approach to modeling Level A and Level B harassment zones. The model LDEO currently uses does not allow for the consideration of environmental and site-specific parameters as requested by the Commission.

SIO's application (LGL, 2018) describes their approach to modeling Level A and Level B harassment zones. In summary, LDEO acquired field measurements for several array configurations at shallow, intermediate, and deep-water depths during acoustic verification studies conducted in the northern Gulf of Mexico in 2007 and 2008 (Tolstoy *et al*., 2009). Based on the empirical data from those studies, LDEO developed a sound propagation modeling approach that predicts received sound levels as a function of distance from a particular airgun array configuration in deep water. For this survey, LDEO modeled Level A and Level B harassment zones based on the empirically-derived measurements from the Gulf of Mexico calibration survey (Appendix H of NSF-USGS 2011). LDEO used the deep-water radii obtained from model results down to a maximum water depth of 2,000 m (Figure 2 and 3 in Appendix H of NSF-USGS 2011).

In 2015, LDEO explored the question of whether the Gulf of Mexico calibration data described above adequately informs the model to predict exclusion isopleths in other areas by conducting a retrospective sound power analysis of one of the lines acquired during L-DEO's seismic survey offshore New Jersey in 2014 (Crone, 2015). NMFS presented a comparison of the

predicted radii (*i.e.*, modeled exclusion zones) with radii based on in situ measurements (*i.e.*, the upper bound [95th percentile] of the cross-line prediction) in a previous notice of issued Authorization for LDEO (see 80 FR 27635, May 14, 2015, Table 1). Briefly, the analysis presented in Crone (2015), specific to the survey site offshore New Jersey, confirmed that in-situ, site specific measurements and estimates of 160 decibel (dB) and 180 dB isopleths collected by the hydrophone streamer of the *R/V Marcus Langseth* in shallow water were smaller than the modeled (*i.e.*, predicted) zones for two seismic surveys conducted offshore New Jersey in shallow water in 2014 and 2015. In that particular case, Crone's (2015) results showed that LDEO's modeled 180 dB and 160 dB zones were approximately 28 percent and 33 percent smaller, respectively, than the in-situ, site-specific measurements, thus confirming that LDEO's model was conservative in that case.

The following is a summary of two additional analyses of in-situ data that support LDEO's use of the modeled Level A and Level B harassment zones in this particular case. In 2010, LDEO assessed the accuracy of their modeling approach by comparing the sound levels of the field measurements acquired in the Gulf of Mexico study to their model predictions (Diebold *et al*., 2010). They reported that the observed sound levels from the field measurements fell almost entirely below the predicted mitigation radii curve for deep water (*i.e.*, greater than 1,000 m; 3280.8 ft) (Diebold *et al*., 2010). In 2012, LDEO used a similar process to model distances to isopleths corresponding to Level A and Level B harassment thresholds for a shallow-water seismic survey in the northeast Pacific Ocean offshore Washington State. LDEO conducted the shallow-water survey using a 6,600 in^3 airgun configuration aboard the *R/V Marcus Langseth* and recorded the received sound levels on both the shelf and slope using the *Langseth's* 8 km hydrophone streamer. Crone *et al*. (2014) analyzed those received sound levels from the 2012

survey and confirmed that in-situ, site specific measurements and estimates of the 160 dB and 180 dB isopleths collected by the *Langseth's* hydrophone streamer in shallow water were two to three times smaller than LDEO's modeling approach had predicted. While the results confirmed the role of bathymetry in sound propagation, Crone *et al*. (2014) were also able to confirm that the empirical measurements from the Gulf of Mexico calibration survey (the same measurements used to inform LDEO's modeling approach for the planned surveys in the northwest Atlantic Ocean) overestimated the size of the exclusion and buffer zones for the shallow-water 2012 survey off Washington State and were thus precautionary, in that particular case.

NMFS continues to work with LDEO to address the issue of incorporating site-specific information for future authorizations for seismic surveys. However, LDEO's current modeling approach (supported by the three data points discussed previously) represents the best available information for NMFS to reach determinations for this IHA. As described earlier, the comparisons of LDEO's model results and the field data collected at multiple locations (*i.e*., the Gulf of Mexico, offshore Washington State, and offshore New Jersey) illustrate a degree of conservativeness built into LDEO's model for deep water, which NMFS expects to offset some of the limitations of the model to capture the variability resulting from site-specific factors. Based upon the best available information (*i.e*., the three data points, two of which are peer-reviewed, discussed in this response), NMFS finds that the Level A and Level B harassment zone calculations are appropriate for use in this particular IHA.

LDEO has conveyed to NMFS that additional modeling efforts to refine the process and conduct comparative analysis may be possible with the availability of research funds and other resources. Obtaining research funds is typically accomplished through a competitive process, including those submitted to U.S. Federal agencies. The use of models for calculating Level A

and Level B harassment zones and for developing take estimates is not a requirement of the MMPA incidental take authorization process. Further, NMFS does not provide specific guidance on model parameters nor prescribe a specific model for applicants as part of the MMPA incidental take authorization process at this time, although we do review methods to ensure adequate for prediction of take. There is a level of variability not only with parameters in the models, but also the uncertainty associated with data used in models, and therefore, the quality of the model results submitted by applicants. NMFS considers this variability when evaluating applications and the take estimates and mitigation measures that the model informs. NMFS takes into consideration the model used, and its results, in determining the potential impacts to marine mammals; however, it is just one component of the analysis during the MMPA authorization process as NMFS also takes into consideration other factors associated with the activity (*e.g.*, geographic location, duration of activities, context, sound source intensity, etc.).

Comment 2: The Commission recommended that NMFS better evaluate the numbers of Level A and B harassment takes it plans to propose for authorization by considering both ecological/biological information and implementation of mitigation measures for all proposed authorizations prior to submitting them for publication in the *Federal Register*. The Commission specifically questioned the proposed authorization of 42 Level A takes of harbor porpoises and recommended that NMFS reduce the numbers of Level A takes for that particular species.

NMFS Response: We appreciate the Commission's concern with authorizing appropriate numbers of take and their suggestion regarding the specific number of Level A takes that it deems appropriate in this instance. We base take analyses on the best available information; in this case, as SIO's survey is planned in a geographic area where data on marine mammal abundance and density is relatively limited, the best available information on cetacean density

(including harbor porpoise density) was represented by density modeling by Mannocci et al. (2017). We relied on this information to calculate the estimated numbers of takes (including Level A takes of harbor porpoise), as described in the proposed IHA. We also acknowledged in the proposed IHA that harbor porpoises would be expected to be relatively uncommon in the proposed survey area, and that take estimates are conservative. That said, given the fact that Mannocci et al. (2017) predict relatively high densities of harbor porpoises in offshore waters north of ~40° N (where much of the survey would occur) and given the relative lack of information regarding the marine mammals that may be encountered by SIO's survey, we do not think a reduction in the number of Level A takes of harbor porpoises is necessary in this instance, given the applicant's request.

Comment 3: the Commission questioned the necessity of the 100 m exclusion zone, specifically for mid-frequency (MF) cetaceans, noting that the Level A harassment zone is estimated to be less than 1 m for MF cetaceans. The Commission stated that NMFS should ensure that marine mammals are sufficiently protected from Level A harassment and that activities can be completed in an appropriate manner and within an appropriate timeframe, and recommended that NMFS more thoroughly assess the proposed exclusion zones that are to be implemented for this authorization and for future proposed incidental take authorizations, prior to publication in the *Federal Register*.

NMFS Response: NMFS agrees with the Commission that mitigation measures should ensure sufficient protection of marine mammals while facilitating the timely completion of the specified activities so as to minimize the overall duration of those activities and their impacts on marine mammals. It is for this reason that NMFS has included a waiver to the shutdown requirement specifically for small delphinoids (which are expected to constitute the vast majority

of MF cetaceans encountered by SIO's survey) that would otherwise result in a shutdown of SIO's survey. The shutdown requirement referenced by the Commission will be in place for marine mammals with the exception of small delphinoids (which are all in the MF functional hearing group) under certain circumstances. The small delphinoid 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). The exception to the shutdown requirement applies solely to specific genera of small dolphins – *Tursiops*, *Steno*, *Stenella*, *Lagenorhynchus* and *Delphinus*. We have included this exception because shutdown requirements for small delphinoids under all circumstances represent practicability concerns without likely commensurate benefits for the animals in question, as referenced by the Commission. Small delphinoids are generally the most commonly observed marine mammals in the specific geographic region and would typically be the only marine mammals likely to intentionally approach the vessel. As referenced by the Commission, auditory injury is extremely unlikely to occur for MF cetaceans (*e.g.*, delphinids), as this group is relatively insensitive to sound produced at the predominant frequencies in an airgun pulse while also having a relatively high threshold for the onset of auditory injury. We refer the reader to the *Federal Register* notice for the proposed IHA (83 FR 18644; April 27, 2018) for further discussion of sound metrics and thresholds and marine mammal hearing.

A large body of anecdotal evidence indicates that small delphinoids commonly approach vessels and/or towed arrays during active sound production for purposes of bow riding, with no apparent effect observed in those delphinoids (*e.g.*, Barkaszi *et al*., 2012). As referenced by the Commission, the potential for increased shutdowns resulting from such a measure would require the *Atlantis* to revisit the missed track line to reacquire data, potentially resulting in an increase

in the total duration over which the survey is active in a given area and an overall increase in the total sound energy input to the marine environment. Although other mid-frequency hearing specialists (*e.g.*, large delphinoids) are no more likely to incur auditory injury than are small delphinoids, they are much less likely to approach vessels. Therefore, contrary to the Commission's concerns, retaining a shutdown requirement for large delphinoids would not have similar impacts in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water. We also anticipate some benefit for a shutdown requirement for large delphinoids in that it simplifies somewhat the total range of decision-making for protected species observers (PSOs) and may preclude any potential for physiological effects other than to the auditory system as well as some more severe behavioral reactions for any such animals in close proximity to the source vessel. Shutdown requirements, including the waiver to shutdown requirements for small delphinoids, are discussed in greater detail in the *Mitigation* section below.

Comment 4: The Commission expressed concern that the method used to estimate the numbers of takes, which summed fractions of takes for each species across project days, does not account for and negates the intent of NMFS' 24-hour reset policy, and recommended that NMFS provide the draft criteria for take calculation in a timely manner.

NMFS Response: We appreciate the Commission's ongoing concern in this matter. Calculating predicted takes is not an exact science and there are arguments for taking different mathematical approaches in different situations, and for making qualitative adjustments in other situations. We believe, however, that the methodology used for take calculation in this IHA remains appropriate and is not at odds with the 24-hour reset policy the Commission references. We will share draft guidance on this issue as soon as possible with the Commission.

Comment 5: The Commission expressed concern that information was missing or incorrect in the proposed IHA and SIO's application, including information on the proposed activities related to the proposed source levels, shot intervals, and source velocities and mitigation measures. Therefore the Commission recommended that NMFS review more thoroughly applications prior to deeming them complete and NMFS' draft notices prior to submitting them for publication in the *Federal Register*.

NMFS Response: We appreciate the Commission pointing out the deficiencies in the notice of proposed IHA. In response to the Commission's concerns we have ensured source levels, shot intervals, source velocities and mitigation measures are accurately described in this notice and are accurately factored into harassment zones and authorized take numbers. Resultant changes to harassment zones and take estimates are minimal and are described in the *Take Estimate* section below. NMFS thoroughly reviews all applications prior to deeming them complete, and thoroughly reviews draft notices prior to publishing in the *Federal Register*, and will continue to do so.

Comment 6: The Commission requested clarification regarding certain issues associated with NMFS' notice that one-year renewals could be issued in certain limited circumstances and expressed concern that the process would bypass the public notice and comment requirements. The Commission recommended that NMFS refrain from implementing its proposed renewal process and instead use abbreviated *Federal Register* notices and reference existing documents to streamline the incidental harassment authorization process. The Commission suggested that NMFS should discuss the possibility of renewals through a more general route, such as a rulemaking, instead of notice in a specific authorization. The Commission further recommended that if NMFS did not pursue a more general route, that the agency provide the Commission and

the public with a legal analysis supporting our conclusion that this process is consistent with the requirements of section 101(a)(5)(D) of the MMPA.

NMFS Response: The process of issuing a renewal IHA does not bypass the public notice and comment requirements of the MMPA. The notice of the proposed IHA expressly notifies the public that under certain, limited conditions an applicant could seek a renewal IHA for an additional year. The notice describes the conditions under which such a renewal request could be considered and expressly seeks public comment in the event such a renewal is sought. Importantly, such renewals would be limited to circumstances where: the activities are identical or nearly identical to those analyzed in the proposed IHA; monitoring does not indicate impacts that were not previously analyzed and authorized; and, the mitigation and monitoring requirements remain the same, all of which allow the public to comment on the appropriateness and effects of a renewal at the same time the public provides comments on the initial IHA. NMFS has, however, modified the language for future proposed IHAs to clarify that all IHAs, including renewal IHAs, are valid for no more than one year and that the agency would consider only one renewal for a project at this time. In addition, notice of issuance or denial of a renewal IHA would be published in the *Federal Register*, as they are for all IHAs. The option for issuing renewal IHAs has been in NMFS's incidental take regulations since 1996. We will provide any additional information to the Commission and consider posting a description of the renewal process on our website before any renewal is issued utilizing this process.

Description of Marine Mammals in the Area of Specified Activity

Sections 3 and 4 of SIO's IHA application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may

be found in NMFS' Stock Assessment Reports (SAR; *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region*) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' website (*www.fisheries.noaa.gov/species-directory*).

The populations of marine mammals considered in this document do not occur within the U.S. exclusive economic zone (EEZ) and are therefore not assigned to stocks and are not assessed in NMFS' Stock Assessment Reports (SAR). As such, information on potential biological removal (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) and on annual levels of serious injury and mortality from anthropogenic sources are not available for these marine mammal populations. Abundance estimates for marine mammals in the survey location are lacking; therefore the abundance estimates presented here are based on the U.S. Atlantic SARs (Hayes *et al*., 2017) and on the Canadian Trans-North Atlantic Sighting Survey which provided full coverage of the Atlantic Canadian coast (Lawson and Gosselin, 2009), as these sources are considered the best available information on potential abundance of marine mammals in the area. However, as described above, the marine mammals encountered by the proposed survey are not assigned to stocks. All abundance estimate values presented in Table 2 are the most recent available at the time of publication and are available in the 2017 U.S. Atlantic draft SARs (e.g., Hayes *et al*. 2017) available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*, except where noted otherwise.

Table 2 lists all species with expected potential for occurrence in the survey area and with the potential to be taken as a result of the proposed survey, and summarizes information related

to the population, including regulatory status under the MMPA and ESA. For taxonomy, we follow Committee on Taxonomy (2016).

Table 2. Marine Mammal Species Potentially Present in the Project Area and That May be Affected by the Specified Activities.

Species	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Abundance [2]	Relative Occurrence in Project Area
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)				
Family: Balaenopteridae				
Humpback whale [3] (*Megaptera novaeangliae*)	n/a	-/-; N	12,312	Uncommon
Minke whale [4] (*Balaenoptera acutorostrata)*	n/a	-/-; N	20,741	Uncommon
Bryde's whale (*Balaenoptera brydei*)	n/a	-/-; N	unknown	Uncommon
Sei whale (*Balaenoptera borealis)*	n/a	E/D; Y	357	Uncommon
Fin whale [4] (*Balaenoptera physalus*	n/a	E/D; Y	3,522	Uncommon
Blue whale (*Balaenoptera musculus)*	n/a	E/D; Y	440	Uncommon
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family: Physeteridae				
Sperm whale (*Physeter macrocephalus*)	n/a	E/D; Y	2,288	Uncommon
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family: Kogiidae				
Pygmy sperm whale [5] (*Kogia breviceps*)	n/a	-/-; N	3,785	Rare
Dwarf sperm whale [5] (*Kogia sima*)	n/a	-/-; N	3,785	Rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family delphinidae				
Killer whale (*Orcinus orca*)	n/a	-/-; N	unknown	Uncommon
False killer whale (*Pseudorca crassidens*)	n/a	-/-; N	442	Uncommon

Pygmy killer whale (*Feresa attenuata*)	n/a	-/-; N	unknown	Rare
Short-finned pilot whale (*Globicephala macrorhynchus*)	n/a	-/-; N	21,515	Uncommon
Long-finned pilot whale (*Globicephala melas*)	n/a	-/-; N	5,636	Uncommon
Harbor porpoise (*Phocoena phocoena)*	n/a	-/-; N	79,833	Uncommon
Bottlenose dolphin (*Tursiops truncatus*)	n/a	-/-; N	77,532	Uncommon
Striped dolphin (*Stenella coeruleoala*)	n/a	-/-; N	54,807	Uncommon
Risso's dolphin (*Grampus griseus*)	n/a	-/-; N	18,250	Uncommon
Common dolphin [4] (*Delphinus delphis*)	n/a	-; N	173,486	Uncommon
Atlantic white-sided dolphin (*Lagenorhynchus obliquidens*)	n/a	-; N	48,819	Uncommon
Atlantic spotted dolphin (*Stenella frontalis*)	n/a	-; N	44,715	Uncommon
Pantropical spotted dolphin (*Stenella attenuate*)	n/a	-; N	3,333	Uncommon
White beaked dolphin (*Lagenorhynchus albirostris*)	n/a	-; N	2,003	Uncommon
Rough-toothed dolphin (*Steno bredanensis*)	n/a	-; N	271	Rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family:Ziphiidae				
Cuvier's beaked whale (*Ziphius cavirostris*)	n/a	-/-; N	6,532	Uncommon
Blainville's beaked whale [6]*(Mesoplodon densirostris)*	n/a	-; N	7,092	Uncommon
True's beaked whale [6] (*Mesoplodon mirus*)	n/a	-/-; N	7,092	Rare
Gervais beaked whale [6] (*Mesoplodon europaeus*)	n/a	-; N	7,092	Uncommon
Sowerby's beaked whale [6] (*Mesoplodon bidens*)	n/a	-; N	7,092	Uncommon

Northern bottlenose whale (*Hyperoodon ampullatus*)	n/a	-; N	unknown	Uncommon
Order Carnivora – Superfamily Pinnipedia				
Family Phocidae (earless seals)				
Hooded seal (*Cystophora cristata*)	n/a	-; N	592,100	Rare
Harp seal (*Pagophilus groenlandicus*)	n/a	-; N	7,100,000	Rare
Ringed seal (*Pusa hispida*) [7]	n/a	-; N	unknown	Rare

1 Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.
2 Abundance estimates are from the NMFS 2017 draft Atlantic SAR (Hayes *et al.*, 2017) unless otherwise noted. We note that marine mammals in the survey area would not belong to NMFS stocks, as the survey area is outside the geographic boundaries for stock assessments, thus stock abundance estimates are provided for comparison purposes only.
3 NMFS defines a stock of humpback whales only on the basis of the Gulf of Maine feeding population; however, multiple feeding populations originate from the Distinct Population Segment (DPS) that is expected to occur in the proposed survey area (the West Indies DPS). As West Indies DPS whales from multiple feeding populations may be encountered in the proposed survey area, the total abundance of the West Indies DPS best reflects the abundance of the population that may encountered by the proposed survey. The West Indies DPS abundance estimate shown here reflects the latest estimate as described in the NMFS Status Review of the Humpback Whale under the Endangered Species Act (Bettridge *et al.*, 2015).
4 Abundance for these species is from the 2007 TNASS, which provided full coverage of the Atlantic Canadian coast (Lawson and Gosselin, 2009). Abundance estimates from TNASS were corrected for perception and availability bias, when possible. In general, where the TNASS survey effort provided superior coverage of a stock's range (as compared with NOAA shipboard survey effort), we elect to use the resulting abundance estimate over the current NMFS abundance estimate (derived from survey effort with inferior coverage of the stock range).
5 Abundance estimate represents pygmy and dwarf sperm whales combined
6 Abundance estimate represents all species of *Mesoplodon* in the Atlantic.
7 NMFS does not have a defined stock of ringed seals in the Atlantic Ocean.

Four marine mammal species that are listed under the Endangered Species Act (ESA) may be present in the survey area and are included in the take request: the fin whale, sei whale, blue whale and sperm whale. Though marine mammal species other than those described in Table 2 are known to occur in the North Atlantic Ocean, the temporal and/or spatial occurrence of several of these species is such that take of these species is not expected to occur, and they are therefore not discussed further beyond the explanation provided here. Four cetacean species, although present in the wider North Atlantic Ocean, likely would not be found near the proposed

project area because their ranges generally do not extend as far north: Clymene dolphin, Fraser's dolphin, spinner dolphin, and melon-headed whale. Another cetacean species, the North Atlantic right whale, occurs in nearshore waters off the U.S. coast, and its range does not extend as far offshore as the proposed project area. Another three cetacean species occur in arctic waters, and their ranges generally do not extend as far south as the proposed project area: the bowhead whale, narwhal, and beluga. Two additional cetacean species, the Atlantic humpback dolphin (which occurs in coastal waters of western Africa) and the long-beaked common dolphin (which occurs in coastal waters of South America and western Africa) do not occur in deep offshore waters. Several pinniped species also are known to occur in North Atlantic waters, but are not expected to occur in deep offshore waters of the proposed project area, including the gray seal, harbor seal, and bearded seal.

A detailed description of the species likely to be affected by SIO's survey, including brief introductions to the species and relevant stocks as well as available information regarding population trends and threats, and information regarding local occurrence, were provided in the *Federal Register* notice of the proposed IHA (83 FR 18644; April 27, 2018); since that time, we are not aware of any changes in the status of these species and stocks; therefore, detailed descriptions are not repeated here. Please refer to that *Federal Register* notice for these descriptions. Please also refer to NMFS' web site (*www.fisheries.noaa.gov/species-directory*) for generalized species accounts.

Information concerning marine mammal hearing, including marine mammal functional hearing groups, was provided in the *Federal Register* notice of the proposed IHA (83 FR 18644; April 27, 2018), therefore that information is not repeated here; please refer to that *Federal Register* notice for this information. For further information about marine mammal functional

hearing groups and associated frequency ranges, please see NMFS (2016) for a review of available information. Thirty-three marine mammal species (thirty cetacean and three pinniped (all phocid) species) have the reasonable potential to co-occur with the proposed survey activities (Table 2). Of the cetacean species that may be present, six are classified as low-frequency cetaceans (*i.e.*, all mysticete species), twenty-two are classified as mid-frequency cetaceans (*i.e.*, all delphinid species, beaked whales, and sperm whale), and three are classified as a high-frequency cetaceans (*i.e.*, harbor porpoise, pygmy and dwarf sperm whales).

Potential Effects of Specified Activities on Marine Mammals and their Habitat

The effects of underwater noise from SIO's survey activities have the potential to result in behavioral harassment of marine mammals in the vicinity of the survey area. The *Federal Register* notice of the proposed IHA (83 FR 18644; April 27, 2018) included a discussion of the effects of anthropogenic noise on marine mammals and their habitat, therefore that information is not repeated here; please refer to that *Federal Register* notice for that information. No instances of hearing threshold shifts, injury, serious injury, or mortality are expected as a result of the planned activities.

Estimated Take

This section provides an estimate of the number of incidental takes authorized through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination.

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

Authorized takes would primarily be by Level B harassment, as use of the seismic airguns have the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result, primarily for high frequency cetaceans. Auditory injury is unlikely to occur for low- and mid-frequency cetaceans given very small modeled zones of injury for those species. The mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. As described previously, no mortality is anticipated or authorized for this activity. Below we describe how the take is estimated.

Described in the most basic way, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) and the number of days of activities. Below, we describe these components in more detail and present the exposure estimate and associated numbers of take authorized.

Acoustic Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (e.g., frequency, predictability, duty cycle), the environment (e.g., bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.* 2011). Based on the best available science and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider to fall under Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (e.g. vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (e.g., seismic airguns) or intermittent (e.g., scientific sonar) sources. SIO's proposed activity includes the use of impulsive seismic sources. Therefore, the 160 dB re 1 μPa (rms) criteria is applicable for analysis of level B harassment.

Level A harassment for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS, 2016) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). As described above, SIO's proposed activity includes the use of intermittent and impulsive seismic sources. These thresholds are provided in Table 3.

These thresholds are provided in the table below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: *http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm*.

Table 3. Thresholds Identifying the Onset of Permanent Threshold Shift in Marine Mammals.

Hearing Group	PTS Onset Thresholds	
	Impulsive*	Non-impulsive
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	$L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	$L_{E,OW,24h}$: 219 dB

Note: *Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (Lpk) has a reference value of 1 µPa, and cumulative sound exposure level (LE) has a reference value of 1µPa2s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into estimating the area ensonified above the acoustic thresholds.

The survey would entail the use of a 2-airgun array with a total discharge of 90 in^3 at a tow depth of 2-4 m. The distances to the predicted isopleths corresponding to the threshold for Level B harassment (160 dB re 1 µPa) were calculated for both array configurations based on

results of modeling performed by LDEO. Received sound levels were predicted by LDEO's model (Diebold *et al.* 2010) as a function of distance from the airgun array. The LDEO modeling approach uses ray tracing for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer unbounded by a seafloor). In addition, propagation measurements of pulses from a 36-airgun array at a tow depth of 6 m have been reported in deep water (~1,600 m), intermediate water depth on the slope (~600–1100 m), and shallow water (~50 m) in the Gulf of Mexico in 2007–2008 (Tolstoy *et al.* 2009; Diebold *et al.* 2010). The estimated distances to Level B harassment isopleths for the two configurations of the *Atlantis* airgun array are shown in Table 4.

Table 4. Predicted Radial Distances from R/V Atlantis 90 in^3 Seismic Source to Isopleth Corresponding to Level B Harassment Threshold.

Array configuration	Predicted Distance to Threshold (160 dB re 1 µPa)
2 m airgun separation	578 m
8 m airgun separation	539 m

For modeling of radial distances to predicted isopleths corresponding to harassment thresholds in deep water (>1,000 m), LDEO used the deep-water radii for various Sound Exposure Levels obtained from LDEO model results down to a maximum water depth of 2,000 m (see Figures 2 and 3 in the IHA application). LDEO's modeling methodology is described in greater detail in the IHA application (LGL, 2018) and we refer to the reader to that document rather than repeating it here.

Predicted distances to Level A harassment isopleths, which vary based on marine mammal functional hearing groups (Table 3), were calculated based on modeling performed by

LDEO using the Nucleus software program and the NMFS User Spreadsheet, described below. The updated acoustic thresholds for impulsive sounds (such as airguns) contained in the Technical Guidance (NMFS, 2016) were presented as dual metric acoustic thresholds using both cumulative sound exposure level (SEL_{cum}) and peak sound pressure level metrics. As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded *(i.e.,* metric resulting in the largest isopleth). The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group. In recognition of the fact that the requirement to calculate Level A harassment ensonified areas could be more technically challenging to predict due to the duration component and the use of weighting functions in the new SEL_{cum} thresholds, NMFS developed an optional User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to facilitate the estimation of take numbers.

The values for SEL_{cum} and peak SPL for the *Atlantis* airgun array were derived from calculating the modified farfield signature (Table 5). The farfield signature is often used as a theoretical representation of the source level. To compute the farfield signature, the source level is estimated at a large distance below the array (e.g., 9 km), and this level is back projected mathematically to a notional distance of 1 m from the array's geometrical center. However, when the source is an array of multiple airguns separated in space, the source level from the theoretical farfield signature is not necessarily the best measurement of the source level that is physically achieved at the source (Tolstoy *et al.* 2009). Near the source (at short ranges, distances <1 km), the pulses of sound pressure from each individual airgun in the source array do not stack constructively, as they do for the theoretical farfield signature. The pulses from the different

airguns spread out in time such that the source levels observed or modeled are the result of the summation of pulses from a few airguns, not the full array (Tolstoy *et al.* 2009). At larger distances, away from the source array center, sound pressure of all the airguns in the array stack coherently, but not within one time sample, resulting in smaller source levels (a few dB) than the source level derived from the farfield signature. Because the farfield signature does not take into account the array effect near the source and is calculated as a point source, the modified farfield signature is a more appropriate measure of the sound source level for distributed sound sources, such as airgun arrays. Though the array effect is not expected to be as pronounced in the case of a 2-airgun array as it would be with a larger airgun array, the modified farfield method is considered more appropriate than use of the theoretical farfield signature.

Table 5. Modeled Source Levels (dB) for R/V Atlantis 90 in^3 Airgun Array.

Functional Hearing Group	**8-kt survey with 8-m airgun separation: Peak SPL_{flat}**	**8-kt survey with 8-m airgun separation: SEL_{cum}**	**5-kt survey with 2-m airgun separation: Peak SPL_{flat}**	**5-kt survey with 2-m airgun separation: SEL_{cum}**
Low frequency cetaceans ($L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB)	228.8	207	232.8	206.7
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB)	N/A	206.7	229.8	206.9
High frequency cetaceans (**$L_{pk,flat}$**: 202 dB; $L_{E,HF,24h}$: 155 dB)	233	207.6	232.9	207.2
Phocid Pinnipeds (Underwater) ($L_{pk,flat}$: 218 dB; $L_{E,HF,24h}$: 185 dB)	230	206.7	232.8	206.9
Otariid Pinnipeds (Underwater) ($L_{pk,flat}$: 232 dB; $L_{E,HF,24h}$: 203 dB)	N/A	203	225.6	207.4

In order to more realistically incorporate the Technical Guidance's weighting functions over the seismic array's full acoustic band, unweighted spectrum data for the *Atlantis*'s airgun array (modeled in 1 Hz bands) was used to make adjustments (dB) to the unweighted spectrum

levels, by frequency, according to the weighting functions for each relevant marine mammal hearing group. These adjusted/weighted spectrum levels were then converted to pressures (μPa) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within the User Spreadsheet (*i.e.*, to override the Spreadsheet's more simple weighting factor adjustment). Using the User Spreadsheet's "safe distance" methodology for mobile sources (described by Sivle *et al*., 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 2.57 m/second (for the 2 m airgun separation survey) and 4.12 m/second (for the 8 m airgun separation survey), and a shot interval of 9.72 seconds (for the 2 m airgun separation survey) and 12.15 seconds (for the 8 m airgun separation survey) (LGL, 2018), potential radial distances to auditory injury zones were calculated for SEL_{cum} thresholds, for both array configurations. Inputs to the User Spreadsheet are shown in Table 5. Outputs from the User Spreadsheet in the form of estimated distances to Level A harassment isopleths are shown in Table 6. As described above, the larger distance of the dual criteria (SEL_{cum} or Peak SPL_{flat}) is used for estimating takes by Level A harassment. The weighting functions used are shown in Table 3 of the IHA application.

Table 6. Modeled radial distances (m) from R/V Atlantis 90 in^3 airgun array to isopleths corresponding to Level A harassment thresholds.

Functional Hearing Group (Level A harassment thresholds)	**8-kt survey with 8-m airgun separation: Peak SPL_{flat}**	**8-kt survey with 8-m airgun separation: SEL_{cum}**	**5-kt survey with 2-m airgun separation: Peak SPL_{flat}**	**5-kt survey with 2-m airgun separation: SEL_{cum}**
Low frequency cetaceans ($L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB)	3.08	2.4	4.89	6.5
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB)	0	0	0.98	0
High frequency cetaceans	35.53 [1]	0	35.13 [1]	0

(*L*pk,flat: 202 dB; *L*E,HF,24h: 155 dB)				
Phocid Pinnipeds (Underwater) (*L*pk,flat: 218 dB; *L*E,HF,24h: 185 dB)	4.02	0	5.51	0.1
Otariid Pinnipeds (Underwater) (*L*pk,flat: 232 dB; *L*E,HF,24h: 203 dB)	0	0	0.48	0

1 Distances to isopleths corresponding to Level A harassment threshold for HF cetaceans (peak SPL) have been revised from those shown in the proposed IHA based on use of radial distances (vs radii) to estimate Level A isopleths for high frequency cetaceans.

We note that radial distances to isopleths corresponding to the Level A harassment threshold for high frequency cetaceans shown in Table 6, for the peak SPL metric, are slightly different than the distances that were presented in the proposed IHA. The proposed IHA presented the radii (versus radial distances) to the Level A isopleth for high frequency cetaceans, for the peak SPL metric, as shown in Table 6 of the IHA application (the distances to radii are 34.62 m for the 2-m airgun separation survey and 34.84 m for the 8-m airgun separation survey). However, as radial distances to the Level A isopleth for high frequency cetaceans, for the peak SPL metric, are slightly larger than the radii, we determined that, to be conservative, the radial distances (as shown in Table 6) should be used to calculate ensonified areas and to estimate take.

Note that because of some of the assumptions included in the methods used, isopleths produced may be overestimates to some degree, which will ultimately result in some degree of overestimate of Level A take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools and will qualitatively address the output where appropriate. For mobile sources, such as the proposed seismic survey, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed.

Marine Mammal Occurrence

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations. The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). For all cetacean species, densities calculated by Mannocci *et al*. (2017) were used. These represent the most comprehensive and recent density data available for cetacean species in the survey area. Mannocci *et al*. (2017) modeled marine mammal densities using available line transect survey data and habitat-based covariates and extrapolated model predictions to unsurveyed regions, including the proposed survey area. The authors considered line transect surveys that used two or more protected species observers and met the assumptions of the distance sampling methodology as presented by Buckland *et al.* (2001), and included data from shipboard and aerial surveys conducted from 1992 to 2014 by multiple U.S. organizations (details provided in Roberts *et al.* (2016)). The data underlying the model predictions for the proposed survey area originated from shipboard survey data presented in Waring *et al.* (2008). To increase the success of model transferability to new regions, the authors considered biological covariates expected to be related directly to cetacean densities (Wenger & Olden, 2012), namely biomass and production of epipelagic micronekton and zooplankton predicted with the Spatial Ecosystem and Population DYnamics Model (SEAPODYM) (Lehodey *et al.* 2010). Zooplankton and epipelagic micronekton (*i.e.*, squid, crustaceans, and fish) constitute potential prey for many of the cetaceans considered, in particular dolphins and mysticetes (Pauly *et al*. 1998), and all these covariates correlate with cetacean distributions (e.g., Ferguson *et al.* 2006; Doniol-Valcroze et al. 2007; Lambert *et al*. 2014). There is some uncertainty related to the estimated density data and the assumptions used in their calculations, as with all density data estimates. However, the approach used is based on the best available data.

Take Calculation and Estimation

Here we describe how the information provided above is brought together to produce a quantitative take estimate. In order to estimate the number of marine mammals predicted to be exposed to sound levels that would result in Level B harassment or Level A harassment, radial distances to predicted isopleths corresponding to the Level A harassment and Level B harassment thresholds are calculated, as described above (Table 7). Those distances are then used to calculate the area(s) around the airgun array predicted to be ensonified to sound levels that exceed the Level A and Level B harassment thresholds. The areas estimated to be ensonified in a single day of the survey are then calculated, based on the areas predicted to be ensonified around the array and the estimated trackline distance traveled per day (Table 8). This number is then multiplied by the number of survey days (*i.e.*, 7.5 days for the 5-kt survey with 2-m airgun separation and 17.5 days for the 8-kt survey with 8-m airgun separation). The product is then multiplied by 1.25 to account for an additional 25 percent contingency for potential additional seismic operations due to airgun testing, mechanical failure, etc. This results in an estimate of the total areas (km^2) expected to be ensonified to the Level A harassment and Level B harassment thresholds. For purposes of Level B take calculations, areas estimated to be ensonified to Level A harassment thresholds are subtracted from total areas estimated to be ensonified to Level B harassment thresholds in order to avoid double counting the animals taken (i.e., if an animal is taken by Level A harassment, it is not also counted as taken by Level B harassment). Areas estimated to be ensonified over the duration of the survey are shown in Table 9. The marine mammals predicted to occur within these respective areas, based on estimated densities, are assumed to be incidentally taken. Estimated takes for all marine mammal species are shown in Table 10.

Table 7. Distances (m) to Isopleths Corresponding to Level A and Level B Harassment Thresholds.

Survey	Level B harassment threshold	Level A harassment threshold [1]				
	All marine mammals	Low frequency cetaceans	Mid frequency cetaceans	High frequency cetaceans	Otariid Pinnipeds	Phocid Pinnipeds
5-kt survey with 2-m airgun separation	539	6.5	0.98	35.13 [2]	5.51	0.48
8-kt survey with 8-m airgun separation	578	3.08	0	35.53 [2]	4.02	0

1 Level A ensonified areas are estimated based on the greater of the distances calculated to Level A isopleths using dual criteria (SEL_{cum} and peak SPL).
2 Distances to isopleths corresponding to Level A harassment threshold for HF cetaceans have been revised from those shown in the proposed IHA based on use of radial distances (vs radii) to estimate Level A isopleths for high frequency cetaceans, as described above.

Table 8. Areas (km^2) Estimated to be Ensonified to Level A and Level B Harassment Thresholds Per Day.

Survey	Level B harassment threshold	Level A harassment threshold[1]				
	All marine mammals	Low frequency cetaceans	Mid frequency cetaceans	High frequency cetaceans	Otariid Pinnipeds	Phocid Pinnipeds
5-kt survey with 2-m airgun separation	240.68	2.90	0.44	15.63 [2]	2.45	0.21
8-kt survey with 8-m airgun separation	412.10	2.19	0	25.28 [2]	2.86	0

[1] Level A ensonified areas are estimated based on the greater of the distances calculated to Level A isopleths using dual criteria (SEL_{cum} and peak SPL).
2 Ensonified areas have been revised from those shown in the proposed IHA based on use of radial distances (vs radii) to estimate Level A isopleths for high frequency cetaceans, as described above.
Note: Estimated areas shown for single day do not include additional 25 percent contingency.

Table 9. Areas (km^2) Estimated to be Ensonified to Level A and Level B Harassment Thresholds over Duration of Survey.

Survey	Level B harassment threshold	Level A harassment threshold[1]				
	All marine mammals	Low frequency cetaceans	Mid frequency cetaceans	High frequency cetaceans	Otariid Pinnipeds	Phocid Pinnipeds
5-kt survey with 2-m airgun separation	2256.33	27.10	4.09	146.57 [2]	22.97	2.0

8-kt survey with 8-m airgun separation	9014.56	47.84	0	552.93 [2]	62.50	0

[1] Level A ensonified areas are estimated based on the greater of the distances calculated to Level A isopleths using dual criteria (SEL_{cum} and peak PL).
2 Ensonified areas have been revised from those shown in the proposed IHA based on use of radial distances (vs radii) to estimate Level A isopleths for high frequency cetaceans, as described above.
Note: Estimated areas shown include additional 25 percent contingency.

Table 10. Numbers of Potential Incidental Take of Marine Mammals Authorized.

Species	Density (# / 1,000 km^2)	Estimated Level A Takes	Authorized Level A Takes	Estimated Level B Takes	Authorized Level B Takes	Total Takes Authorized	Total Instances of Takes as a Percentage of SAR Abundance [1]
Humpback whale [2]	10	1	0	112	113	113	0.9 *
Minke whale	4	0	0	45	45	45	0.2 *
Bryde's whale	0.1	0	0	1	1	1	unknown
Sei whale [2]	10	1	0	112	113	113	31.4
Fin whale	8	1	0	89	90	90	2.6 *
Blue whale	0	0	0	0	1	1	0.2
Sperm whale	40	0	0	451	451	451	19.7
Cuvier's beaked whale [3]	60	0	0	135	135	135	2.0
Northern bottlenose whale [4]	0.8	0	0	9	9	9	unknown
True's beaked whale [3]	60	0	0	135	135	135	1.9
Gervais beaked whale [3]	60	0	0	135	135	135	1.9
Sowerby's beaked whale [3]	60	0	0	135	135	135	1.9
Blainville's beaked whale [3]	60	0	0	135	135	135	1.9
Rough-toothed dolphin	3	0	0	34	34	34	12.5

Bottlenose dolphin [4]	60	0	0	676	676	676	0.9
Pantropical spotted dolphin	10	0	0	113	113	113	3.4
Atlantic spotted dolphin	40	0	0	451	451	451	1.0
Striped dolphin	80	0	0	902	902	902	1.6
Atlantic white-sided dolphin [4]	60	0	0	676	676	676	1.4
White-beaked dolphin	1	0	0	11	11	11	0.6
Common dolphin	800	3	0	9014	9017	9017	5.2 *
Risso's dolphin [4]	20	0	0	225	225	225	1.2
Pygmy killer whale [5]	1.5	0	0	17	17	17	unknown
False killer whale	2	0	0	23	23	23	5.2
Killer whale [5 6]	0.2	0	0	2	5	5	unknown
Long-finned / short-finned Pilot whale [7]	200	1	0	2253	2254	2254	8.3
Pygmy/ dwarf sperm whale	0.6	0	0	7	7	7	0.2
Harbor porpoise [8]	60	42	42	634	634	676	0.8
Ringed seal [5]	0	0	0	0	1	1	unknown
Hooded seal	0	0	0	0	1	1	<0.1
Harp seal	0	0	0	0	1	1	<0.1

1 While we have in most cases provided comparisons of the instances of takes as a percentage of SAR abundance as the best available information regarding population abundance, we note that these are likely underestimates of the relevant North Atlantic populations, as the proposed survey area is outside the U.S. EEZ.
* Instances of takes are shown as a percentage of abundance as described by TNASS or NMFS Status Review, as described above.
2 Level A takes of these species were estimated based on NMFS' take calculation methodology, but NMFS has determined Level A take of these species is not likely to occur, as described in more detail in the text below. To avoid undercounting the takes estimated to occur, the number of takes by Level A harassment that had been estimated for these species, but that NMFS has determined are unlikely to occur as described below, are therefore assumed to be Level B harassment takes. Thus the number of Level A harassment takes that had been calculated for these species has been added to the number of Level B takes authorized for the species.
3 Density value represents the density for all beaked whale species combined. Requested take and take authorized are based on the proportion of all beaked whales expected to be taken (thus 677 total estimated beaked whale takes were calculated based on the density of all beaked whales combined, and this number has been divided by 5 (for the 5 species of beaked whales expected to be taken) for a total of 135 takes per species of beaked whale.
4 Number of take authorized has been revised slightly from that shown in proposed IHA due to math error.
5 The population abundance for the species is unknown
6 Authorized take number for killer whales has been increased from the calculated take to mean group size for the species. Source for mean group size is Waring *et al.* (2008).
7 Values for density, take number, and percentage of population authorized are for short-finned and long-finned pilot whales combined.
8 Number of Level A and Level B takes authorized is slightly different than shown in proposed IHA due to use of radial distance (vs radii) to level A isopleth as described above.

For some marine mammal species, we authorize a different number of incidental takes than the number of incidental takes requested by SIO (see Table 8 in the IHA application for requested take numbers). For instance, SIO requested 1 take of a North Atlantic right whale and 3 takes of bowhead whales; however, we have determined the likelihood of the survey encountering these species is so low as to be discountable, therefore we do not authorize takes of these species. Also, SIO requested Level A takes of humpback whales, sei whales, fin whales, common dolphins, and pilot whales; however, due to very small zones corresponding to Level A harassment for low-frequency and mid-frequency cetaceans (Table 6) we have determined the likelihood of Level A take occurring for species from these functional hearing groups is so low as to be discountable, therefore we do not authorize Level A take of these species. Note that the Level A takes that were calculated for these species (humpback whales, sei whales, fin whales, common dolphins, and pilot whales) have been included in the number of Level B takes. Finally, SIO requested 2,254 takes of short-finned pilot whales and 2,254 takes of long-finned pilot

whales (total 4,508 pilot whale takes requested); however, as Mannocci *et al*. (2017) presents one single density estimate for all pilot whales (the pilot whale "guild"), a total of 2,254 takes of pilot whales were calculated as potentially taken by the proposed survey. Thus SIO's request take number is actually double the number of take that was calculated. We do not think doubling the take estimate is warranted, thus we authorize a total of 2,254 takes of pilot whales (short-finned and long-finned pilot whales combined). We note that numbers of take authorized for bottlenose dolphin, Atlantic white-sided dolphin, and Risso's dolphin have changed slightly (each has been reduced by one take) from the numbers of take presented in the proposed IHA due to a math error. We note also that the number of instances of authorized Level A take of harbor porpoise has increased by one, and the number of instances of authorized Level B take of harbor porpoise has decreased by one, versus the numbers of take presented in the proposed IHA, due to the slight change in the estimate of the Level A ensonified area for high frequency cetaceans as described above; the total number of harbor porpoise takes has not changed from the total presented in the proposed IHA.

Species with Take Estimates Less than Mean Group Size: Using the approach described above to estimate take, the take estimate for killer whales was less than the average group size estimated for the species (Waring *et al.*, 2008). Information on the social structure and life history of the species indicates it is common for the species to be encountered in groups. The results of take calculations support the likelihood that SIO's survey may encounter and incidentally take the species, and we believe it is likely that the species may be encountered in groups; therefore it is reasonable to conservatively assume that one group of the species will be taken during the proposed survey. We therefore authorize the take of the average (mean) group

size for the species to account for the possibility that SIO's survey encounters a group of killer whales.

Species with No Available Density Data: No density data were available for the blue whale; however, blue whales have been observed in the survey area (Waring *et al*., 2008), thus we determined there is a possibility that the proposed survey may encounter one blue whale and that one blue whale may be taken by Level B harassment by the proposed survey; we therefore authorize one take of blue whale as requested by SIO. No density data were available for ringed seal, hooded seal or harp seal; however based on the ranges of these species we have determined it is possible they may be encountered and taken by Level B harassment by the proposed survey, therefore we authorize one take of each species as requested by SIO.

It should be noted that the take numbers shown in Table 10 are believed to be conservative for several reasons. First, in the calculations of estimated take, 25 percent has been added in the form of operational survey days (equivalent to adding 25 percent to the proposed line km to be surveyed) to account for the possibility of additional seismic operations associated with airgun testing, and repeat coverage of any areas where initial data quality is sub-standard.

Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS 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)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned) the likelihood of effective implementation (probability implemented as planned); and

2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

SIO has reviewed mitigation measures employed during seismic research surveys authorized by NMFS under previous incidental harassment authorizations, as well as recommended best practices in Richardson *et al.* (1995), Pierson *et al.* (1998), Weir and Dolman (2007), Nowacek *et al*. (2013), Wright (2014), and Wright and Cosentino (2015), and has incorporated a suite of mitigation measures into their project description based on the above sources.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, SIO has proposed to implement the following mitigation measures for marine mammals:

1) Vessel-based visual mitigation monitoring;
2) Establishment of a marine mammal exclusion zone (EZ);
3) Shutdown procedures;
4) Ramp-up procedures; and
5) Vessel strike avoidance measures.

In addition to the measures proposed by SIO, NMFS has incorporated the following mitigation measure: Establishment of a marine mammal buffer zone.

PSO observations will take place during all daytime airgun operations and nighttime start-ups (if applicable) of the airguns. If airguns are operating throughout the night, observations will begin 30 minutes prior to sunrise. If airguns are operating after sunset, observations will continue until 30 minutes following sunset. Following a shutdown for any reason, observations will occur for at least 30 minutes prior to the planned start of airgun operations. Observations will also occur for 30 minutes after airgun operations cease for any reason. Observations will also be made during daytime periods when the *Atlantis* is underway without seismic operations, such as during transits, to allow for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods. Airgun operations will be suspended when marine mammals are observed within, or about to enter, the designated EZ (as described below).

During seismic operations, three visual PSOs will be based aboard the *Atlantis*. PSOs will be appointed by SIO with NMFS approval. During the majority of seismic operations, two PSOs will monitor for marine mammals around the seismic vessel. A minimum of one PSO must be on

duty at all times when the array is active. PSO(s) will be on duty in shifts of duration no longer than 4 hours. Other crew will also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew will be given additional instruction in detecting marine mammals and implementing mitigation requirements.

The *Atlantis* is a suitable platform from which PSOs will watch for marine mammals. Standard equipment for marine mammal observers will be 7 x 50 reticule binoculars and optical range finders. At night, night-vision equipment will be available. The observers will be in communication with ship's officers on the bridge and scientists in the vessel's operations laboratory, so they can advise promptly of the need for avoidance maneuvers or seismic source shutdown.

The PSOs must have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements. PSO resumes will be provided to NMFS for approval. At least one PSO must have a minimum of 90 days at-sea experience working as PSOs during a seismic survey. One "experienced" visual PSO will be designated as the lead for the entire protected species observation team. The lead will serve as primary point of contact for the vessel operator. The PSOs must have successfully completed relevant training, including completion of all required coursework and passing a written and/or oral examination developed for the training program, and must have successfully attained 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. The educational requirements may be waived if the

PSO has acquired the relevant skills through alternate training, including (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

Exclusion Zone and Buffer Zone

An EZ is a defined area within which occurrence of a marine mammal triggers mitigation action intended to reduce the potential for certain outcomes, *e.g.*, auditory injury, disruption of critical behaviors. The PSOs will establish a minimum EZ with a 100 m radius for the airgun array. The 100 m EZ will be based on radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). With certain exceptions (described below), if a marine mammal appears within, enters, or appears on a course to enter this zone, the acoustic source will be shut down (see Shutdown Procedures below).

The 100 m radial distance of the standard EZ is precautionary in the sense that it would be expected to contain sound exceeding injury criteria for all marine mammal hearing groups (Table 6) while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. In this case, the 100 m radial distance would also be expected to contain sound that would exceed the Level A harassment threshold based on sound exposure level (SEL_{cum}) criteria for all marine mammal hearing groups (Table 6). In the 2011 Programmatic Environmental Impact Statement for marine scientific research funded by the National Science Foundation or the U.S. Geological Survey (NSF-USGS 2011), Alternative B (the Preferred Alternative) conservatively applied a 100 m EZ for all low-energy acoustic sources in water depths >100 m, with low-energy acoustic sources defined as

any towed acoustic source with a single or a pair of clustered airguns with individual volumes of ≤250 in^3. Thus the 100 m EZ for this survey is consistent with the PEIS.

Our intent in prescribing a standard EZ distance is to (1) encompass zones 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 for PSOs, who need to monitor and implement the EZ; and (4) define a distance within which detection probabilities are reasonably high for most species under typical conditions.

PSOs will also establish and monitor a 200 m buffer zone. During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the EZ) will be communicated to the operator to prepare for potential shutdown of the acoustic source. The buffer zone is discussed further under *Ramp Up Procedures* below.

Shutdown Procedures

If a marine mammal is detected outside the EZ but is likely to enter the EZ, the airguns will be shut down before the animal is within the EZ. Likewise, if a marine mammal is already within the EZ when first detected, the airguns will be shut down immediately.

Following a shutdown, airgun activity will not resume until the marine mammal has cleared the 100 m EZ. The animal will be considered to have cleared the 100 m EZ if the following conditions have been met:

- it is visually observed to have departed the 100 m EZ; or
- it has not been seen within the 100 m EZ for 15 min in the case of small odontocetes and pinnipeds; or

- it has not been seen within the 100 m EZ for 30 min in the case of mysticetes and large odontocetes, including sperm, pygmy and dwarf sperm, and beaked whales.

This shutdown requirement will be in place for all marine mammals, with the exception of small delphinoids under certain circumstances. As defined here, the small delphinoid group is intended to encompass those members of the Family Delphinidae most likely to voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array (*e.g.*, bow riding). This exception to the shutdown requirement will apply solely to specific genera of small dolphins — *Tursiops*, *Steno*, *Stenella*, *Lagenorhynchus* and *Delphinus* — and will only apply if the animals were traveling, including approaching the vessel. If, for example, an animal or group of animals is stationary for some reason (*e.g.*, feeding) and the source vessel approaches the animals, the shutdown requirement applies. An animal with sufficient incentive to remain in an area rather than avoid an otherwise aversive stimulus could either incur auditory injury or disruption of important behavior. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, the shutdown will be implemented.

We include this small delphinoid exception because shutdown requirements for small delphinoids under all circumstances represent practicability concerns without likely commensurate benefits for the animals in question. Small delphinoids are generally the most commonly observed marine mammals in the specific geographic region and would typically be the only marine mammals likely to intentionally approach the vessel. As described below, auditory injury is extremely unlikely to occur for mid-frequency cetaceans (*e.g.*, delphinids), as this group is relatively insensitive to sound produced at the predominant frequencies in an airgun pulse while also having a relatively high threshold for the onset of auditory injury (*i.e.*,

permanent threshold shift). Please see the *Federal Register* notice of proposed IHA (83 FR 18644; April 27, 2018) for further discussion of sound metrics and thresholds and marine mammal hearing.

A large body of anecdotal evidence indicates that small delphinoids commonly approach vessels and/or towed arrays during active sound production for purposes of bow riding, with no apparent effect observed in those delphinoids (*e.g.*, Barkaszi *et al*., 2012). The potential for increased shutdowns resulting from such a measure would require the *Atlantis* 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. Although other mid-frequency hearing specialists (*e.g.*, large delphinoids) are no more likely to incur auditory injury than are small delphinoids, they are much less likely to approach vessels. Therefore, retaining a shutdown requirement for large delphinoids would not have similar impacts in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water. We do anticipate some benefit for a shutdown requirement for large delphinoids in that it simplifies somewhat the total range of decision-making for PSOs and may preclude any potential for physiological effects other than to the auditory system as well as some more severe behavioral reactions for any such animals in close proximity to the source vessel.

Shutdown of the acoustic source will also be required upon observation of any of the following:

- a large whale (*i.e.*, sperm whale or any baleen whale) with a calf observed at any distance;

- an aggregation of six or more large whales of any species (*i.e.*, sperm whale or any baleen whale) that does not appear to be traveling (*e.g.*, feeding, socializing, etc.) observed at any distance; or
- a species for which authorization has not been granted, or, a species for which authorization has been granted but the authorized number of takes are met, observed approaching or within the Level A or B harassment zone.

Ramp-up Procedures

Ramp-up of an acoustic source is intended to provide a gradual increase in sound levels following a shutdown, enabling animals to move away from the source if the signal is sufficiently aversive prior to its reaching full intensity. Ramp-up will be required after the array is shut down for any reason. Ramp-up will begin with the activation of one 45 in^3 airgun, with the second 45 in^3 airgun activated after 5 minutes.

At least two PSOs will be required to monitor during ramp-up. During ramp up, the PSOs will monitor the EZ, and if marine mammals were observed within the EZ or buffer zone, a shutdown will be implemented as though the full array were operational. If airguns have been shut down due to PSO detection of a marine mammal within or approaching the 100 m EZ, ramp-up will not be initiated until all marine mammals have cleared the EZ, during the day or night. Criteria for clearing the EZ will be as described above.

Thirty minutes of pre-clearance observation are required prior to ramp-up for any shutdown of longer than 30 minutes (*i.e.*, if the array were shut down during transit from one line to another). This 30 minute pre-clearance period may occur during any vessel activity (*i.e.*, transit). If a marine mammal were observed within or approaching the 100 m EZ during this pre-clearance period, ramp-up will not be initiated until all marine mammals cleared the EZ. Criteria

for clearing the EZ will be as described above. If the airgun array has been shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for a period of less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant visual observation and no detections of any marine mammal have occurred within the EZ or buffer zone. Ramp-up will be planned to occur during periods of good visibility when possible. However, ramp-up is allowed at night and during poor visibility if the 100 m EZ and 200 m buffer zone have been monitored by visual PSOs for 30 minutes prior to ramp-up.

The operator is required to 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. 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. The operator must provide information to PSOs documenting that appropriate procedures were followed. Following deactivation of the array for reasons other than mitigation, the operator is required to communicate the near-term operational plan to the lead PSO with justification for any planned nighttime ramp-up.

Vessel Strike Avoidance Measures

Vessel strike avoidance measures are intended to minimize the potential for collisions with marine mammals. These requirements do not apply in any case where compliance creates 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.

The measures include the following: Vessel operator and crew will maintain a vigilant watch for all marine mammals and slow down or stop the vessel or alter course to avoid striking any marine mammal. A visual observer aboard the vessel will monitor a vessel strike avoidance

zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone will be either third-party observers or crew members, but crew members responsible for these duties will be provided sufficient training to distinguish marine mammals from other phenomena. Vessel strike avoidance measures will be followed during surveys and while in transit.

The vessel will maintain a minimum separation distance of 100 m from large whales (*i.e.*, baleen whales and sperm whales). If a large whale is within 100 m of the vessel the vessel will reduce speed and shift the engine to neutral, and will not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established. If the vessel is stationary, the vessel will not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m. The vessel will maintain a minimum separation distance of 50 m from all other marine mammals (with the exception of delphinids of the genera *Tursiops*, *Steno*, *Stenella*, *Lagenorhynchus* and *Delphinus* that approach the vessel, as described above). If an animal is encountered during transit, the vessel will attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course. Vessel speeds will be reduced to 10 knots or less when mother/calf pairs or large assemblages of cetaceans (what constitutes "large" will vary depending on species) are observed within 500 m of the vessel. Mariners may use professional judgment as to when such circumstances warranting additional caution are present.

Based on our evaluation of the applicant's proposed measures, NMFS has determined that the mitigation measures provide the means effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth, requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

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

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*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 other important physical components of marine mammal habitat); and
- Mitigation and monitoring effectiveness.

SIO submitted a marine mammal monitoring and reporting plan in their IHA application. Monitoring that is designed specifically to facilitate mitigation measures, such as monitoring of the EZ to inform potential shutdowns of the airgun array, are described above and are not repeated here.

SIO's monitoring and reporting plan includes the following measures:

Vessel-Based Visual Monitoring

As described above, PSO observations will take place during daytime airgun operations and nighttime start-ups (if applicable) of the airguns. During seismic operations, three visual PSOs will be based aboard the *Atlantis*. PSOs will be appointed by SIO with NMFS approval. During the majority of seismic operations, one PSO will monitor for marine mammals around the seismic vessel. PSOs will be on duty in shifts of duration no longer than 4 hours. Other crew will also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). During daytime, PSOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7×50 Fujinon) and with the naked eye. At night, PSOs will be equipped with night-vision equipment.

PSOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data will be used to estimate numbers of animals potentially 'taken' by harassment (as defined in the MMPA). They will also provide information needed to order a shutdown of the airguns when a

marine mammal is within or near the EZ. When a sighting is made, the following information about the sighting will be recorded:

1) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.*, none, avoidance, approach, paralleling, etc.), and behavioral pace; and

2) Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

All observations and shutdowns will be recorded in a standardized format. Data will be entered into an electronic database. The accuracy of the data entry will be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared during and shortly after the field program and will facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving. The time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare will also be recorded at the start and end of each observation watch, and during a watch whenever there is a change in one or more of the variables.

Results from the vessel-based observations will provide:

1) The basis for real-time mitigation (*e.g.*, airgun shutdown);

2) Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS;

3) Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted;

4) Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity; and

5) Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Reporting

A report will be submitted to NMFS within 90 days after the end of the survey. The report will describe the operations that were conducted and sightings of marine mammals near the operations. The report will provide full documentation of methods, results, and interpretation pertaining to all monitoring and will summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report will also include estimates of the number and nature of exposures that occurred above the harassment threshold based on PSO observations, including an estimate of those on the trackline but not detected.

Negligible Impact Analysis and Determination

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 an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as

effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, our analysis applies to all the species listed in Table 2, given that NMFS expects the anticipated effects of the planned seismic survey to be similar in nature. Where there are meaningful differences between species or stocks, or groups of species, in anticipated individual responses to activities, impact of expected take on the population due to differences in population status, or impacts on habitat, NMFS has identified species-specific factors to inform the analysis.

NMFS does not anticipate that serious injury or mortality will occur as a result of SIO's planned seismic survey, even in the absence of mitigation. Thus the authorization does not authorize any mortality. As discussed in the *Potential Effects* section, non-auditory physical effects, stranding, and vessel strike are not expected to occur.

We authorize a limited number of instances of Level A harassment (Table 10) for one species. However, we believe that any PTS incurred in marine mammals as a result of the planned activity would be in the form of only a small degree of PTS and not total deafness that would not be likely to affect the fitness of any individuals, because of the constant movement of both the *Atlantis* and of the marine mammals in the project area, as well as the fact that the vessel is not expected to remain in any one area in which individual marine mammals would be

expected to concentrate for an extended period of time (*i.e.*, since the duration of exposure to loud sounds will be relatively short). Also, as described above, we expect that marine mammals would be likely to move away from a sound source that represents an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice of the *Atlantis's* approach due to the vessel's relatively low speed when conducting seismic surveys. We expect that the majority of takes would be in the form of short-term Level B behavioral harassment in the form of temporary avoidance of the area or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al.*, 2007).

Potential impacts to marine mammal habitat were discussed previously in this document (see *Potential Effects of the Specified Activity on Marine Mammals and their Habitat*). Marine mammal habitat may be impacted by elevated sound levels, but these impacts would be temporary. Feeding behavior is not likely to be significantly impacted, as marine mammals appear to be less likely to exhibit behavioral reactions or avoidance responses while engaged in feeding activities (Richardson *et al.*, 1995). Prey species are mobile and are broadly distributed throughout the project area; therefore, marine mammals that may be temporarily displaced during survey activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Because of the temporary nature of the disturbance, the availability of similar habitat and resources in the surrounding area, and the lack of important or unique marine mammal habitat, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. In addition, there are no feeding, mating or

calving areas known to be biologically important to marine mammals within the proposed project area.

As described above, though marine mammals in the survey area would not be assigned to NMFS stocks, for purposes of the small numbers analysis we rely on stock numbers from the U.S. Atlantic SARs as the best available information on the abundance estimates for the species of marine mammals that could be taken. The activity is expected to impact a very small percentage of all marine mammal populations that would be affected by SIO's planned survey (less than 32 percent each for all marine mammal stocks, when compared with stocks from the U.S. Atlantic as described above). Additionally, the acoustic "footprint" of the proposed survey would be very small relative to the ranges of all marine mammals that would potentially be affected. Sound levels would increase in the marine environment in a relatively small area surrounding the vessel compared to the range of the marine mammals within the proposed survey area. The seismic array would be active 24 hours per day throughout the duration of the proposed survey. However, the very brief overall duration of the proposed survey (25 days) would further limit potential impacts that may occur as a result of the proposed activity.

The mitigation measures are expected to reduce the number and/or severity of takes by allowing for detection of marine mammals in the vicinity of the vessel by visual and acoustic observers, and by minimizing the severity of any potential exposures via shutdowns of the airgun array. Based on previous monitoring reports for substantially similar activities that have been previously authorized by NMFS, we expect that the mitigation measures will be effective in preventing at least some extent of potential PTS in marine mammals that may otherwise occur in the absence of mitigation measures.

Of the marine mammal species under our jurisdiction that are likely to occur in the project area, the following species are listed as endangered under the ESA: fin, sei, blue, and sperm whales. There are currently insufficient data to determine population trends for these species (Hayes *et al*., 2017); however, we are authorizing very small numbers of takes for these species (Table 10), relative to their population sizes (again, when compared to U.S. Atlantic stocks, for purposes of comparison only), therefore we do not expect population-level impacts to any of these species. The other marine mammal species that may be taken by harassment during SIO's seismic survey are not listed as threatened or endangered under the ESA. There is no designated critical habitat for any ESA-listed marine mammals within the project area; of the non-listed marine mammals for which we authorize take, none are considered "depleted" or "strategic" by NMFS under the MMPA.

NMFS concludes that exposures to marine mammal species due to SIO's seismic survey would result in only short-term (temporary and short in duration) effects to individuals exposed, or some small degree of PTS to a very small number of individuals of four species. Marine mammals may temporarily avoid the immediate area, but are not expected to permanently abandon the area. Major shifts in habitat use, distribution, or foraging success are not expected. NMFS does not anticipate the take estimates to impact annual rates of recruitment or survival.

In summary and as described above, the following factors primarily support our determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No mortality is anticipated or authorized;
- The anticipated impacts of the proposed activity on marine mammals would primarily be temporary behavioral changes due to avoidance of the area around the survey

vessel. The relatively short duration of the proposed survey (25 days) would further limit the potential impacts of any temporary behavioral changes that would occur;

- The number of instances of PTS that may occur are expected to be very small in number (Table 10). Instances of PTS that are incurred in marine mammals would be of a low level, due to constant movement of the vessel and of the marine mammals in the area, and the nature of the survey design (not concentrated in areas of high marine mammal concentration);
- The availability of alternate areas of similar habitat value for marine mammals to temporarily vacate the survey area during the proposed survey to avoid exposure to sounds from the activity;
- The proposed project area does not contain areas of significance for feeding, mating or calving;
- The potential adverse effects on fish or invertebrate species that serve as prey species for marine mammals from the proposed survey would be temporary and spatially limited; and
- The mitigation measures, including visual and acoustic monitoring and shutdowns, are expected to minimize potential impacts to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the monitoring and mitigation measures, NMFS finds that the total marine mammal take from the specified activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under Section 101(a)(5)(D) of the MMPA for specified activities other than military readiness activities. The

MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

Due to the location of SIO's survey, some of the marine mammals potentially taken by the proposed survey would not be expected to originate from the U.S. Atlantic stocks as defined by NMFS (Hayes *et al*., 2017). Population abundance data for marine mammal species in the survey area is not availableTherefore, in most cases the U.S. Atlantic SARs represent the best available information on marine mammal abundance in the Northwest Atlantic Ocean. For certain species (*i.e.,* fin whale, minke whale and common dolphin) the 2007 Canadian Trans-North Atlantic Sighting Survey (TNASS), which provided full coverage of the Atlantic Canadian coast (Lawson and Gosselin, 2009) represents the best available information on abundance, as noted previously. Abundance estimates from TNASS were corrected for perception and availability bias, when possible. In general, where the TNASS survey effort provided more extensive coverage of a stock's range (as compared with NOAA shipboard survey effort), we elected to use the resulting abundance estimate over the current NMFS abundance estimate (derived from survey effort with more limited coverage of the stock range). For the humpback whale, NMFS defines a stock of humpback whales in the Atlantic only on the basis of the Gulf of Maine feeding population; however, multiple feeding populations originate from the DPS of humpback whales that is expected to occur in the proposed survey area (the West Indies DPS). As West Indies DPS whales from multiple feeding populations may be encountered in the proposed survey area, the total abundance of the West Indies DPS best reflects the abundance of

the population that may encountered by the proposed survey. The West Indies DPS abundance estimate used here reflects the latest estimate as described in the NMFS Status Review of the Humpback Whale under the Endangered Species Act (Bettridge *et al.,* 2015). Therefore, we use abundance data from the SARs in most cases, as well as from the TNASS and NMFS Status Review, for purposes of the small numbers analysis.

The numbers of takes that we authorize are less than 10 percent of the population abundance for the majority of species and stocks, and 20 percent for sperm whales and 31 percent for fin whales, when compared to abundance estimates from U.S. Atlantic SARs and TNASS and NMFS Status Review (Table 10). We again note that while some animals from U.S. stocks may occur in the proposed survey area, the proposed survey area is outside the geographic boundaries of the U.S. Atlantic SARs, thus populations of marine mammals in the proposed survey area would not be limited to the U.S. stocks and those populations may in fact be larger than the U.S. stock abundance estimates. In addition, it should be noted that take numbers represent instances of take, not individuals taken. Given the relatively small survey grids (Figure 1 in the IHA application), it is reasonable to expect that some individuals may be exposed more than one time, which would mean that the number of individuals taken is somewhat smaller than the total instances of take indicated in Table 10.

No known current regional population estimates are available for five marine mammal species that could be incidentally taken as a result of the planned survey: the Bryde's whale, killer whale, pygmy killer whale, Northern bottlenose whale, and ringed seal. NMFS has reviewed the geographic distributions of these species in determining whether the numbers of takes authorized are likely to represent small numbers. Bryde's whales are distributed worldwide in tropical and sub-tropical waters (Kato and Perrin, 2009). Killer whales are broadly distributed

in the Atlantic from the Arctic ice edge to the West Indies (Waring *et al.*, 2015). The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994). Northern bottlenose whales are distributed in the North Atlantic from Nova Scotia to about 70º N in the Davis Strait, along the east coast of Greenland to 77º N and from England, Norway, Iceland and the Faroe Islands to the south coast of Svalbard (Waring *et al*., 2015). The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Lavigne and Kovacs 1988). Based on the broad spatial distributions of these species relative to the areas where the proposed survey would occur, NMFS concludes that the authorized take of these species represent small numbers relative to the affected species' overall population sizes, though we are unable to quantify the authorized take numbers as a percentage of population.

Based on the analysis contained herein of the specified activity (including the mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS finds that small numbers of marine mammals will be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

Section 7(a)(2) of the ESA of 1973 (16 U.S.C. 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or

adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally, in this case with the ESA Interagency Cooperation Division, whenever we propose to authorize take for endangered or threatened species.

The NMFS Permits and Conservation Division is authorizing the incidental take of 4 species of marine mammals which are listed under the ESA: the sei whale, fin whale, blue whale and sperm whale. Under Section 7 of the ESA, we requested initiation of Section 7 consultation with the NMFS OPR Interagency Cooperation Division for the issuance of this IHA. In June, 2018, the NMFS OPR Interagency Cooperation Division issued a Biological Opinion with an incidental take statement, which concluded that the issuance of the IHA was not likely to jeopardize the continued existence of the sei whale, fin whale, blue whale and sperm whale. The Biological Opinion also concluded that the issuance of the IHA would not destroy or adversely modify designated critical habitat for these species.

Authorization

NMFS has issued an IHA to SIO for the potential harassment of small numbers of 35 marine mammal species incidental to a low-energy marine geophysical survey in the northwest Atlantic Ocean, provided the previously mentioned mitigation, monitoring and reporting requirements are incorporated.

Dated: June 12, 2018.

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Donna S. Wieting,

Director, Office of Protected Resources,

National Marine Fisheries Service.

[FR Doc. 2018-12907 Filed: 6/14/2018 8:45 am; Publication Date: 6/15/2018]