



**BILLING CODE 3510-22-P**

**DEPARTMENT OF COMMERCE**

**National Oceanic and Atmospheric Administration**

**RIN 0648-XG144**

**Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Marine Geophysical Survey in the North Pacific 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 Lamont-Doherty Earth Observatory of Columbia University (L-DEO) to incidentally take, by Level A and/or Level B harassment, marine mammals during a Marine Geophysical Survey in the North Pacific Ocean.

**DATES:** This Authorization is effective from September 1, 2018, through August 31, 2019.

**FOR FURTHER INFORMATION CONTACT:** Rob Pauline, 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:

*<https://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**

The MMPA prohibits the “take” of marine mammals, with certain exceptions. 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 incidental take authorization may be provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other “means of effecting the least practicable [adverse] impact” on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in shorthand as “mitigation”); and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

## **Summary of Request**

On March 16, 2018, NMFS received a request from the L-DEO for an IHA to take marine mammals incidental to conducting a marine geophysical survey in the North Pacific Ocean. L-DEO submitted a revised application on June 11, 2018. On June 13, 2018, we deemed L-DEO’s application for authorization to be adequate and complete. L-DEO’s request is for take of small numbers of 39 species of marine mammals by Level A and Level B harassment.

Underwater sound associated with airgun use may result in the behavioral harassment or auditory injury of marine mammals in the ensonified areas. Mortality is not an anticipated outcome of airgun surveys such as this, and, therefore, an IHA is appropriate.

NMFS has issued an IHA to L-DEO authorizing the take of 39 species by Level A and Level B harassment. The IHA is effective from September 1, 2018 through August 31, 2019.

### **Description of Planned Activity**

The planned activity consists of two high-energy seismic surveys conducted at different locations in the North Pacific Ocean. Researchers from L-DEO and University of Hawaii, with funding from the U.S. National Science Foundation (NSF), in collaboration with researchers from United States Geological Survey (USGS), Oxford University, and GEOMAR Helmholtz Centre for Ocean Research Kiel (GEOMAR), plan to conduct the surveys from the Research Vessel (R/V) *Marcus G. Langseth (Langseth)* in the North Pacific Ocean. The first planned seismic survey would occur in the vicinity of the Main Hawaiian Islands in 2018 and a subsequent survey would take place at the Emperor Seamounts in 2019. The planned timing for the Hawaii survey is late summer/early fall 2018; the timing for the Emperor Seamounts survey would likely be late spring/early summer 2019. Both surveys would use a 36-airgun towed array with a total discharge volume of ~6,600 in<sup>3</sup>. The main goal of the surveys planned by L-DEO and the University of Hawaii is to gain fundamental insight into the formation and evaluation of Hawaiian-Emperor Seamount chain, and inform a more comprehensive assessment of geohazards for the Hawaiian Islands region.

The Hawaii survey would be expected to last for 38 days, including ~19 days of seismic operations, 11 days of equipment deployment/retrieval, ~5 days of operational contingency time (*e.g.*, weather delays, etc.), and ~3 days of transit. The Emperor Seamounts survey would be

expected to last 40 days, including ~13 days of seismic operations, ~11 days of equipment deployment/retrieval, ~3 days of operational contingency time, and 13 days of transit.

Representative survey tracklines are shown in Figures 1 and 2 in the application. Water depths in the Hawaii survey area range from ~700 m to more than 5,000 m. The water depths in the Emperor Seamounts survey area range from 1,500–6,000 m. The Hawaii seismic survey will be conducted within the U.S. exclusive economic zone (EEZ); the Emperor Seamounts survey will take place in International Waters.

The procedures to be used for the planned surveys would be similar to those used during previous seismic surveys by L-DEO and would use conventional seismic methodology. The surveys would involve one source vessel, the *Langseth*, which is owned by NSF and operated on its behalf by Columbia University's L-DEO. The *Langseth* would deploy an array of 36 airguns as an energy source with a total volume of ~6,600 in<sup>3</sup>. The receiving system would consist of ocean bottom seismometers (OBSs) and a single hydrophone streamer 15 km in length. As the airgun arrays are towed along the survey lines, the hydrophone streamer would transfer the data to the on-board processing system, and the OBSs would receive and store the returning acoustic signals internally for later analysis.

A detailed description of the planned project is provided in the **Federal Register** notice for the proposed IHA (83 FR 30480; June 28, 2018). Since that time, no changes have been made to the planned activities. Therefore, a detailed description is not provided here. Please refer to that **Federal Register** notice for the description of the specific activity.

### **Comments and Responses**

NMFS published a notice of proposed IHA in the **Federal Register** on June 28, 2018 (83 FR 30480). During the 30-day public comment period, NMFS received comments from the

Marine Mammal Commission (Commission), the Marine Seismic Research Oversight Committee (MSROC), the Cascadia Research Consortium (CRC), the Natural Resources Defense Council (NRDC) and from members of the general public. NMFS has posted the comments online at: <https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-research-and-other-activities>. The following is a summary of the public comments and NMFS' responses.

*Comment:* The Commission noted that several of the density estimates used by NMFS were outdated or incorrect.

*Response:* NMFS used several density sources to estimate take including Bradford *et al.* (2015, 2017) and methods described in Department of the Navy (2017). As the Commission recommended, for the final IHA notice, NMFS has revised the densities for striped dolphins to 25 from 5.36 animals/1,000 km<sup>2</sup> and for Fraser's dolphins to 21 from 4.17 animals/1,000 km<sup>2</sup> based on Bradford (2017). In the proposed notice, NMFS divided by three the unidentified *Mesoplodon* spp. density of 1.89 animals/1,000 km<sup>2</sup> from Bradford *et al.* (2017) (resulting in 0.63 animals/1,000 km<sup>2</sup>) for ginkgo-toothed, Deraniyagala's, and Hubb's beaked whale densities. NMFS revised the density for each species in the notice to 1.89 animals/1,000 km<sup>2</sup>, since there was no data available identifying separate densities for these species. NMFS updated the false killer whale densities to animals/100 km<sup>2</sup> as take had been incorrectly estimated using a density of animals/1,000 km<sup>2</sup> in the notice of proposed IHA (Bradford *et al.* 2015). NMFS further indicated it would amend all takes accordingly. NMFS utilized an average group size from Bradford *et al.* (2017) to increase the number of recalculated Level B harassment takes of killer whales to five. NMFS also increased Level A harassment takes for humpback and sei whales to average group size.

*Comment:* The Commission recommended that NMFS re-calculate the monk seal density based on an abundance of 1,324 from Baker *et al.* (2016) as this is thought to be the best available density information. The Commission also recommended that NMFS re-estimate the number of Level B harassment takes of monk seals based on this data.

*Response:* NMFS has recalculated authorized Level B harassment takes based on the Commission's recommendation. A complete description may be found in the Estimated Take section.

*Comment:* The Commission and NRDC expressed concerns about potential impacts to small and resident populations of marine mammals located in Main Hawaiian Islands. The Commission recommended that NMFS require L-DEO to implement shut-down procedures if a melon-headed whale or group of melon-headed whales is observed in the habitat of the Kohala resident stock and ensure that the estimated number of Level B harassment takes is sufficient based on group size of melon-headed whales for the Hawaiian Islands stock. The Commission noted that similar issues exist for the various MHI insular stocks of spinner and common bottlenose dolphins. However, the group sizes for those species are much less than for melon-headed whales. The Commission recommended that NMFS (1) authorize only those numbers of Level B harassment takes of the various MHI insular stocks of spinner and bottlenose dolphins for which NMFS can make a small numbers determination and (2) if the authorized takes are met for any of those stocks, require L-DEO to implement shut-down procedures if a spinner or bottlenose dolphin or group of dolphins is observed approaching or within the Level B harassment zone in the habitat of the specific MHI insular stock.

*Response:* L-DEO will be required to implement shut-down procedures if a melon-headed whale or group of melon-headed whales is observed in Kohala resident stock habitat.

NMFS has also revised authorized take numbers to ensure that the number of estimated takes is sufficient based on group size of melon-headed whales for the Hawaiian Islands stock (see *Take Calculation and Estimation* section for detail). NMFS also has made small numbers determinations for the stocks described in the comment above and will require L-DEO to implement shut-down procedures if a spinner or bottlenose dolphin or group of dolphins is observed approaching or within the Level B harassment zone in the habitat of the specific MHI insular stock if the authorized takes are met for any of these stocks.

*Comment:* The Commission noted that various datasets used for estimating densities in the area of the Emperor survey were compiled 30 to 35 years ago while others originated from other geographic regions with presumed assumptions. The Commission had previously recommended that NMFS should adjust the density estimates used to estimate the numbers of potential takes by incorporating some measure of uncertainty when available density data originate from other geographical areas, temporal scales, and species. Since many of the references from which the density data originated include coefficients of variation (CVs), standard errors (SEs), or confidence intervals (CI), which provide information on uncertainty relative to the underlying data, the Commission recommended that NMFS adjust the density estimates using some measure of uncertainty (i.e., CV, SD, SE, upper CI) for the Emperor survey area. The Commission also recommended that NMFS convene a working group of scientists to determine how best to incorporate uncertainty in density data that are extrapolated.

*Response:* The Commission recommended that NMFS adjust density estimates using some measure of uncertainty when available density data originate from different geographic areas, temporal scales, and species, especially for actions which will occur outside the U.S. EEZ where site- and species-specific density estimates tend to be scant, such as L-DEO's planned

survey in the Emperor Seamounts area. We have attempted to do so in this IHA, and feel the 25 percent correction factor is an appropriate method in this case to account for uncertainties in the density data that were available for use in the take estimates. NMFS is open to consideration of other correction factors for use in future IHAs and looks forward to further discussion with the Commission on how best to incorporate uncertainty in density estimates in instances where density data is limited.

Regarding the Commission's recommendation that NMFS convene an internal working group to determine what data sources are considered best available for the various species and in the various areas, NMFS may consider future action to address these issues, but currently intends to address these questions through ongoing interactions with the U.S. Navy, academic institutions, and other research organizations.

*Comment:* The Commission recommended that NMFS require L-DEO to specify why it is using radial distances for SELcum and SPLrms metrics and radii for SPLpeak metrics.

*Response:* The radius is commonly used to determine Level A harassment isopleths, as well as those for Level B. In order for L-DEO to be able to account for accumulation associated with NMFS Revised Technical Guidance's SELcum thresholds, including the use of the NMFS optional User Spreadsheet tool, they needed to determine far-field source level. In order to do, L-DEO relied upon the more conservative radial distance, since the radial distance is larger than the radius. They used the radial distance to determine modified far-field source levels, which were directly incorporated in the NMFS optional User Spreadsheet to determine Level A isopleths using the SELcum metric. L-DEO also used the more conservative radial distance to back calculate their modified far-field source levels for SPLpeak. The radius was then determined by

plugging the radial distance into the Pythagorean theorem (as the hypotenuse). This radius value was then used to calculate the peak sound pressure level isopleth.

In summary, use of the radius is not inconsistent with how isopleths have been calculated for other sources, including seismic activities. Use of the radius will also account for animals at depth that are at the longest radial distance. Note that the use of radial distance was used only to establish modified far-field source levels.

*Comment:* The Commission recommended that NMFS provide justification for why it believes that L-DEO's use of the Nucleus source model, which does not provide data above 2.5 kHz, is appropriate for determining the extents of the Level A harassment zones for MF and HF cetaceans.

*Response:* Experience and amplitude spectral density showed in the L-DEO application indicate that most of the energy output for *Langseth*-type source is below 1 kHz, and so the error done by omitting higher frequencies will be fairly small. To evaluate the impact of the high frequencies (> 1 KHz), L-DEO calculated amplitude spectral densities using information from the *Langseth* Gulf of Mexico calibration experiment (Tolstoy *et al.*, 2009) and compared them to the results used in the L-DEO application (up to 3KHz). Scenario A is the one used in the L-DEO application (spectrum up to 3 KHz). Scenario B considers the same spectrum up to 10 KHz. The spectrum was obtained by upsampling the farfield signature obtained from the Nucleus modeling package. Scenario C considers the spectrum derived from the farfield signature obtained using the Nucleus modeling package from 1 Hz to ~200 Hz and L-DEO extended the spectrum with a realistic decay curve ( -35dB/decade) from ~ 200 Hz up to 10 kHz. The -35dB/decade decay curve is derived from the slope hydrophone data from the Gulf of Mexico study (Fig. 14 of Tolstoy *et al.*, 2009). Because this decay curve boosts/increases the amplitudes

between 200 Hz and 1 KHz much more than the predicted spectrum derived from the Nucleus modeling package and that is valid in that frequency range, for scenario D, L-DEO took a -30dB/decade decay curve around ~600 Hz.

Results show that the adjustment factors slightly decrease for scenarios C and D and the corresponding PTS SELcum Isopleths to thresholds are a little higher for those two scenarios (<20m) but are always smaller than the PTS SELcum Isopleths to thresholds derived from the Peak SPL that was used here.

*Comment:* The Commission recommended that NMFS require L-DEO to re-estimate the proposed Level A and B harassment zones and associated takes of marine mammals using (1) both 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<sup>41</sup> 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 incidental harassment authorization. Specifically, the Commission reiterates that L-DEO should be using the ray-tracing sound propagation model BELLHOP—which is a free, standard propagation code that readily incorporates all environmental inputs listed herein, rather than the limited, in-house MATLAB code currently in use.

*Response:* NMFS acknowledges the Commission's concerns about L-DEO's current modeling approach for estimating Level A and Level B harassment zones and takes. L-DEO's application and the **Federal Register** notice of the proposed IHA (83 FR 30480; June 28, 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.

L-DEO's application 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<sup>3</sup> 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:* Given the shortcomings noted for L-DEO's source and sound propagation modeling and the requirements that other action proponents are obliged to fulfill, the Commission recommended that NMFS require L-DEO to archive, analyze, and compare the in-situ data collected by the hydrophone streamer and OBSs to L-DEO's modeling results for the extents of the Level A and B harassment zones based on the various water depths to be surveyed and provide the data and results to NMFS.

*Response:* Based on information presented by the applicant and supported by published analysis such as Diebold *et al.* 2010, Tolstoy *et al.* 2009, Crone *et al.* 2014, Crone *et al.* 2017, Barton *et al.* 2006, and Diebold *et al.* 2006, L-DEO modeling results and predicted distances to harassment zones are likely more conservative than actual distances measured from data collected *in situ*. The Commission stated one reason for recommending that NMFS require L-DEO to conduct sound source verification efforts was due to the short-comings of the L-DEO model. However, as previously noted, the L-DEO model is conservative and is viewed appropriate for *R/V Langseth* operations. Use of the L-DEO model is further supported by ten years of successful operations with no observed harm to marine life. For these reasons, additional sound source verification efforts are not warranted at this time.

L-DEO has met with the Commission and NMFS on several occasions to explain the model and why it is, although conservative, the most appropriate approach to use for *R/V Langseth* operations. The planned survey will mainly occur in deep water (98.5%) and as

demonstrated in Diebold *et al.* 2010 and Tolstoy *et al.* 2009 for deep water, the results show that the predicted distances were conservative relative to measured values. Even allowing for scaling of actual measurements between different tow depths of Tolstoy (2009) from 6 m to 12 m in the IHA, this yields a radius of 4,940 which is much less than model predictions of 6,733 m included in the IHA application.

*Comment:* The Commission recommended that NMFS use a consistent approach for requiring all geophysical and seismic survey operators to abide by the same general mitigation measures, including prohibiting L-DEO from using power downs and the mitigation airgun during its geophysical surveys.

*Response:* NMFS is in the process of developing protocols that could be applied to geophysical and seismic surveys. The protocols are being developed on the basis of detailed review of available literature, including peer-review science, review articles, gray literature, and protocols required by other countries around the world. NMFS will share the protocols with the Commission when they are ready for external comment and review.

Note that powerdowns are only allowed/required in lieu of shutdown when certain species of dolphins, specifically identified in the *Mitigation* section, enter the shutdown zone. In all other cases, shutdown would be implemented under conditions as described in the IHA.

*Comment:* The Commission noted that monitoring and reporting requirements adopted need to be sufficient to provide a reasonably accurate assessment of the manner of taking and the numbers of animals taken incidental to the specified activity. Those assessments should account for all animals in the various survey areas, including those animals directly on the trackline that are not detected and how well animals are detected based on the distance from the observer which is achieved by incorporating  $g(0)$  and  $f(0)$  values. The Commission recommended that

NMFS require L-DEO to use the Commission's method as described in the Commission's Addendum to better estimate the numbers of marine mammals taken by Level A and B harassment for the incidental harassment authorization. The Commission stated that all other NSF-affiliated entities and all seismic operators should use this method as well.

*Response:* NMFS agrees that reporting of the manner of taking and the numbers of animals incidentally taken should account for all animals taken, including those animals directly on the trackline that are not detected and how well animals are detected based on the distance from the observer, to the extent practicable. NMFS appreciates the Commission's recommendations but we believe that the Commission's described method needs further consideration in relation to the observations conducted during marine geophysical surveys. Therefore, at this time we do not prescribe a particular method for accomplishing this task. We look forward to engaging further both L-DEO, the Commission and other applicants to reach a determination on the most suitable method to for estimating  $g(0)$  and  $f(0)$  values.

*Comment:* The Commission and NRDC recommended that NMFS refrain from implementing its proposed one-year renewal process and instead use abbreviated **Federal Register** notices and reference existing documents to streamline the incidental harassment authorization process. The Commission further recommends that NMFS provide the Commission and the public with a legal analysis supporting its conclusion that the process is consistent with the requirements under section 101(a)(5)(D) of the MMPA. Furthermore, if NMFS decides to bypass the notice and comment process in advance of issuing a renewal, it should nevertheless publish notice in the **Federal Register** whenever such a renewal has been issued.

*Response:* NMFS appreciates the streamlining achieved by the use of abbreviated FR notices and intends to continue using them for proposed IHAs that include minor changes from previously issued IHAs, but which do not satisfy the renewal requirements. We believe our proposed method for issuing renewals meets statutory requirements and maximizes efficiency. 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. Last, NMFS will publish on our website a description of the renewal process before any renewal is issued utilizing the new process.

*Comment:* The Commission recommends that NMFS require earlier submission of applications and other documentation so that it has adequate time to review and provide comments on the adequacy and accuracy of the application, allow applicants to make necessary revisions or additions to the application, draft its proposed authorization, and consider the comments received from the public.

*Response:* There are no regulations stipulating a required time frame for submission of an IHA applications in advance of the requested date of issuance. However, NMFS has provided to the public recommended time frames for submission of applications for IHAs and

rulemakings/letter of authorization (LOAs) which are posted at <https://www.fisheries.noaa.gov/node/23111>. NMFS will continue to strongly encourage applicants to submit applications well in advance of the anticipated issuance dates such that applications can undergo thorough review and revisions can be made as appropriate.

*Comment:* The planned survey will pass through the ranges of a number of small island-associated populations around the main Hawaiian Islands. These include the range of the endangered Kohala resident stock of melon-headed whales and the newly designated critical habitat area for the Main Hawaiian Islands insular false killer whale Distinct Population Segment (83 FR 35062; July 24, 2018). Given that visual observation at night will be ineffective at detecting animals of either species, CRC recommended that seismic surveys through ranges of these species should only be allowed during daylight hours.

*Response:* L-DEO has agreed to attempt to time their surveys such that most of the seismic activity would occur within the ranges of the two species of concern only during daylight hours. However, unforeseen circumstances (*e.g.* weather, equipment breakdown) may preclude L-DEO from conducting all seismic operations during daylight within these species' ranges. Various operational requirements and protocols associated with marine seismic surveys do not generally allow for the prolonged stoppage or delay of seismic activities when a trackline is being surveyed. Additionally, it will take the *Langseth* approximately 10.6 hours per pass along Trackline 1 to traverse the stock boundaries of the Kohala resident stock. There will be two passes along both Tracklines 1 and 2 with each pass separated by several days. It will take the *Langseth* about 18.6 hours per pass on Trackline 1 and 12.5 hours per pass on Trackline 2 to traverse the larger insular false killer whale critical habitat area. The amount of time spent

within the identified boundary areas will be limited and the majority of monitoring will occur during daylight hours.

*Comment:* CRC and a single individual both recommended that NMFS require additional monitoring of the melon-headed whale population during Trackline 1 of the seismic survey. This could be achieved by deploying satellite tags on individual melon-headed whales immediately (i.e., within a few days) prior to the survey vessel undertaking Trackline 1. The proximity of one or more groups of melon-headed whales to survey activities could be monitored. CRC recommended that NMFS should either require L-DEO to implement this type of monitoring program themselves or notify independent researchers who are permitted to work in the area during the timing of the survey with enough advance notice to allow for satellite tag monitoring.

*Response:* NMFS generally does not require applicants to implement highly technical monitoring regimes, especially when the applicant would need to secure additional research permits. Furthermore, NMFS cannot direct an applicant to divulge what they deem to be highly sensitive information (i.e. ship location and/or route). Instead, NMFS encouraged CRC to contact L-DEO directly. Also, as noted above, the time spent in the vicinity of the small resident population of melon-headed whale will be minimal.

*Comment:* MSROC noted the scientific and societal importance of the planned *Langseth* seismic surveys, endorsed these collaborative research programs, and strongly encouraged NMFS to approve and issue an IHA. They urged NMFS to issue the IHA as soon as possible following the close of the public comment period.

*Response:* NMFS appreciates the importance of this research and has issued the IHA to L-DEO in a timely manner.

*Comment:* An individual referred to recent research findings (McCauley *et al.* 2017) indicating that use of airgun arrays may damage a range of invertebrates. The individual also felt that NOAA has the capacity & obligation to substantiate these claims prior to issuing any further permits.

*Response:* Relatively little research has been focused on assessing the impacts of airguns on invertebrates. The study by McCauley *et al.* (2017) found that exposure to airgun sound decreased zooplankton abundance compared to control samples, and caused a two- to three-fold increase in adult and larval zooplankton mortality. They observed impacts on the zooplankton as far as 1.2 km from the exposure location – a much greater impact range than previously thought; however, there was no consistent decline in the proportion of dead zooplankton as distance increased and received levels decreased. The authors also stated that in order to have significant impacts on r-selected species such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned, and it is possible that the findings reflect avoidance by zooplankton rather than mortality (McCauley *et al.*, 2017). In addition, the results of this study are inconsistent with a large body of research that generally finds limited spatial and temporal impacts to zooplankton as a result of exposure to airgun noise (e.g., Dalen and Knutsen, 1987; Payne, 2004; Stanley *et al.*, 2011).

A modeling exercise was conducted as a follow-up to the McCauley *et al.* (2017) study (as recommended by McCauley *et al.* (2017)), in order to assess the potential for impacts on ocean ecosystem dynamics and zooplankton population dynamics (Richardson *et al.*, 2017). Richardson *et al.* (2017) found that for copepods with a short life cycle in a high-energy environment, a full-scale airgun survey would impact copepod abundance up to three days following the end of the survey, suggesting that effects such as those found by McCauley *et al.*

(2017) would not be expected to be detectable downstream of the survey areas, either spatially or temporally. However, these findings are relevant for zooplankton with rapid reproductive cycles in areas where there is a high natural replenishment rate resulting from new water masses moving in, and the findings may not apply in lower-energy environments or for zooplankton with longer life-cycles. In fact, the study found that by turning off the current, as may reflect lower-energy environments, the time to recovery for the modelled population extended from several days to several weeks.

In the absence of further validation of the McCauley *et al.* (2017) findings, if we assume a worst-case likelihood of severe impacts to zooplankton within approximately 1 km of the acoustic source, the large spatial scale and wide dispersal of tracklines does not lead us to expect any meaningful follow-on effects to the prey base for marine mammals predators. While the large scale of effect observed by McCauley *et al.* (2017) may be of concern, especially in a more temperate environment, NMFS concludes that these findings indicate a need for more study, particularly where repeated noise exposure is expected—a condition unlikely to occur in relation to these planned surveys

### **Description of Marine Mammals in the Area of the Specified Activity**

Section 4 of the IHA application summarizes available information regarding status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species. More general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' website (<https://www.fisheries.noaa.gov/find-species>). Table 1 lists all species with expected potential for occurrence in the North Pacific Ocean and summarizes information related to the population, including regulatory status under the MMPA and ESA. Some of the populations of marine mammals considered in this document occur within

the U.S. EEZ and are therefore assigned to stocks and are assessed in NMFS' Stock Assessment Reports (<https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments>). 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.

Twenty-eight cetacean species, including 21 odontocetes (dolphins and small- and large-toothed whales) and seven mysticetes (baleen whales), and one pinniped species, could occur in the planned Hawaii survey area (Table 4). In the Emperor Seamounts survey area, 27 marine mammal species could occur, including 15 odontocetes (dolphins and small- and large-toothed whales), eight mysticetes (baleen whales), and four pinniped species. Some species occur in both locations. In total, 39 species are expected to occur in the vicinity of the specified activity.

Marine mammal abundance estimates presented in this document represent the total number of individuals estimated within a particular study or survey area. All values presented in Table 1 are the most recent available at the time of publication.

**Table 1. Marine Mammals that Could Occur in the Survey Areas**

Common Name	Scientific Name	Stock	ESA/MMPA status; Strategic (Y/N) <sup>1</sup>	Stock abundance (CV, Nmin, most recent abundance survey) <sup>2</sup>	PBR	Annual M/SI <sup>3</sup>	Present at Time of Survey (Y/N)	
							HI	Emperor Seamounts
Order Cetartiodactyla-Cetacea-Superfamily Mysticeti (baleen whales)								
Family Eschrichtiidae								
Gray whale	<i>Eschrichtius robustus</i>	Western North Pacific	E/D; Y	140 (0.04, 135, 2011) <sup>4</sup>	0.06	unk	N	Y

Family Balaenidae								
North Pacific right whale	<i>Eubalaena japonica</i>	Eastern North Pacific	E/D; Y	31 (0.226, 26, 2013) <sup>6</sup>	N/A	0	N	Y
		N/A	--	450 <sup>5</sup>	--	--		
Family Balaenopteridae (rorquals)								
Humpback whale	<i>Megaptera novaeangliae</i>	Central North Pacific	-/-; N	10,103 (0.03, 7,890, 2006) <sup>6</sup>	83	25	Y	Y
		Western North Pacific	E/D; Y	1,107 (0.30, 865,2006) <sup>6</sup>	3	3.2		
Minke whale	<i>Balaenoptera acutorostrata</i>	Hawaii	--	UNK	--	--	N	Y
		N/A	--	22,000 <sup>7</sup>	--	--		
Bryde's whale	<i>(Balaenoptera edeni/brydei)</i>	Hawaii	-/-; N	1,751 (0.29, 1,378, 2010) <sup>17</sup>	13.8	0	Y	Y
		Eastern Tropical Pacific	-/-; N --	UNK	--UND	UNK--		
Sei whale	<i>Balaenoptera borealis</i>	Hawaii	E/D; Y	178 (0.9, 93, 2010) <sup>4</sup>	0.2 --	0.2 --	Y	Y
Fin whale	<i>Balaenoptera physalus physalus</i>	Hawaii	E/D; Y	154 (1.05, 75, 2010) <sup>17</sup>	0.1	0	Y	Y
		N/A	--	13,620-18,680 <sup>9</sup>	--	--		
Blue whale	<i>Balaenoptera musculus musculus</i>	Central North Pacific	E/D; Y	133 (1.09, 63, 2010) <sup>17</sup>	0.1	0	Y	Y
Superfamily Odontoceti (toothed whales, dolphins, porpoises)								
Family Physeteridae								
Sperm whale	<i>Physeter macrocephalus</i>	Hawaii	E/D; Y	4,559 (0.33, 3,478, 2010) <sup>17</sup>	13.9	0.7	Y	Y
		N/A	N/A	29,674 <sup>10</sup> -26,300 <sup>11</sup>	--	--		
Family Kogiidae								
Pygmy sperm whale	<i>Kogia breviceps</i>	Hawaii	-/-; N	7,138 <sup>4</sup>	UND	0	Y	Y
Dwarf sperm whale	<i>Kogia sima</i>	Hawaii	-/-; N	17,519 <sup>4</sup>	UND	0	Y	Y
Family Ziphiidae (beaked whales)								
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Hawaii	-, -, N	723 (0.69, 428, 2010) <sup>17</sup>	4.3	0	Y	Y

		N/A	-	20,000 <sup>12</sup>	--	--		
Longman's beaked whale	<i>Indopacetus pacificus</i>	Hawaii	-, -, N	7,619 (0.66, 4,592, 2010) <sup>17</sup>	46	0	y	N
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	Hawaii	-, -, N	2,105 (1.13, 1,980, 2010) <sup>17</sup>	10	0	Y	N
Stejneger's beaked whale	<i>Mesoplodon stejnegeri</i>	Alaska	N	UNK	UND	0	N	Y
Ginkgo-toothed beaked whale	<i>Mesoplodon ginkgodens</i>	N/A	--	25,300 <sup>12</sup>	--	--	Rare	Absent
Deraniyagala's beaked whale	<i>Mesoplodon hotaula</i>	N/A	--	25,300 <sup>12</sup>	--	--	Y	N
Hubb's beaked whale	<i>Mesoplodon carlhubbsi</i>	N/A	--	25,300 <sup>12</sup>	--	--	Y	N
Baird's beaked whale	<i>Berardius bairdii</i>	N/A	--	10,190 <sup>13</sup>			N	Y
Family Delphinidae								
Rough-toothed dolphin	<i>Steno bredanensis</i>	Hawaii	-, -, N	72,528 (0.39, 52,033, 2010) <sup>17</sup>	46	UNK	Common	N
Common bottlenose dolphin	<i>Tursiops truncatus</i>	Hawaii Pelagic	-/-; N	21,815 (0.57, 13,957, 2010) <sup>17</sup>	140	0.2	Common	N
		Kaua'i and Ni'ihau	-/-; N	184 (0.11, 168, 2005) <sup>4</sup>	1.7	unk	Common	N
		O'ahu	-/-; N	743 (0.54, 485, 2006) <sup>4</sup>	4.9	unk	Common	N
		4 Islands Region	-/-; N	191 (0.24, 156, 2006)	unk	unk	Common	N
		Hawaii Island	-/-; N	128 (0.13, 115, 2006) <sup>4</sup>	1.6	unk	Common	N
Common dolphin	<i>Delphinus delphis</i>	N/A	--	2,963,000 <sup>14</sup>	--	--	N	Y
Pantropical spotted dolphin	<i>Stenella attenuata</i>	Hawaii Pelagic	-/-; N	55,795 (0.40, 40,338, 2010) <sup>17</sup>	403	0	Y	N
		O'ahu	-/-; N	unk	unk	unk		
		4 Island Region	-/-; N	unk	unk	unk		
		Hawaii Island	-/-; N	unk	unk	≥ 0.2		
Spinner dolphin	<i>Stenella longirostris</i>	Hawaii Pelagic	-/-; N	unk	unk	unk	Y	N
		Hawaii Island	-/-; N	631 (0.04, 585, 2013) <sup>4</sup>	5.9	unk	Common	N

		Oahu/4-Islands	-/-; N	355 (0.09, 329, 2013) <sup>4</sup>	3.3	unk	Y	N
Striped dolphin	<i>Stenella coeruleoalba</i>	Hawaii	-/-; N	61,021 (0.38, 44,922, 2010) <sup>17</sup>	449	unk	Y	Y
		N/A	--	964,362 <sup>15</sup>	--	--		
Fraser's dolphin	<i>Lagenodelphis hosei</i>	Hawaii	-/-; N	51,491 (0.66, 31,034, 2010) <sup>17</sup>	310	0	Y	N
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	Central North Pacific	--	988,333 <sup>16</sup>	--	--	N	Y
Northern right whale dolphin	<i>Lissodelphis borealis</i>	N/A	--	307,784 <sup>16</sup>	--	--	N	Y
Risso's dolphin	<i>Grampus griseus</i>	Hawaii	-/-; N	11,613 (0.39, 8,210, 2010) <sup>17</sup>	82	0	Y	Y
		N/A/	--	110,457 <sup>15</sup>	--	--		
Melon-headed whale	<i>Peponocephala electra</i>	Hawaii	-/-; N	8,666 (1.00, 4,299, 2010) <sup>17</sup>	43	0	Y	N
		Kohala Resident	-/-; N	447 (0.12, 404, 2009) <sup>4</sup>	4	0		
Pygmy killer whale	<i>Feresa attenuata</i>	Hawaii	-/-; N	10,640 (0.53, 6,998, 2010) <sup>17</sup>	56	1.1	Y	N
False killer whale	<i>Pseudorca crassidens</i>	Hawaii Insular	E/D;Y	167 (0.14, 149, 2015) <sup>17</sup>	0.3	0	Y	Y
		Northwest Hawaiian Islands	-/-; N	617 (1.11, 290, 2010) <sup>17</sup>	2.3	0.4		
		Hawaii Pelagic	-/-; N	1,540 (0.66, 928, 2010) <sup>17</sup>	9.3	7.6		
		N/A	--	16,668 <sup>18</sup>	--	--		
Killer whale	<i>Orcinus orca</i>	Hawaii	-/-; N	146 (0.96, 74, 2010)	0.7	0	Y	Y
		N/A	--	8,500 <sup>19</sup>	--	--		
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Hawaii	-/-; N	19,503 (0.49, 13,197, 2010)	106	0.9	Y	Y
		N/A	--	53,608 <sup>16</sup>	--	--		
Family Phoenidae (porpoises)								
Dall's porpoise	<i>Phocoenoides dalli</i>	N/A	--	1,186,000 <sup>20</sup>			N	Y

Order Carnivora-Superfamily Pinnipedia								
Family Otariidae (eared seals and sea lions)								
Steller sea lion	<i>Eumetopias jubatus</i>	Western DPS	E/D; Y	50,983 (-50,983, 2015)			N	Y
Northern fur seal	<i>Callorhinus ursinus</i>	Eastern Pacific	-/D; Y	626,734 (0.2, 530,474, 2014)	11,405	437	N	Y
		N/A	--	1,100,000 <sup>5</sup>	--	--		
Family Phocidae (earless seals)								
Hawaiian monk seal	<i>Neomonachus schauinslandi</i>	Hawaii	E/D; Y	1,324 (0.03, 1,261, 2015) <sup>17</sup>	4.4	≥1.6	Y	N
Northern elephant seal	<i>Mirounga angustirostris</i>	--	--	210,000-239,000 <sup>21</sup>	--	--	N	Y
Ribbon seal	<i>Histriophoca fasciata</i>	Alaska	-/-; N	184,000 (0.12, 163,000, 2013)	9,785	3.8	N	Y

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

2 - NMFS marine mammal stock assessment reports online at: [www.nmfs.noaa.gov/pr/sars/](http://www.nmfs.noaa.gov/pr/sars/). CV is coefficient of variation; Nmin is the minimum estimate of stock abundance.

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

4 - Carretta et al. 2017.

5 - Jefferson et al. 2015.

6 - Muto et al., 2017.

7 - IWC 2018.

8 - Central and Eastern North Pacific (Hakamada and Matsuoka 2015a)

9- Ohsumi and Wada, 1974.

10 - Whitehead 2002

11 - Barlow and Taylor 2005.

12 - Wade and Gerrodette 1993.

13 - Western Pacific Ocean (Okamura et al. 2012).

14 - ETP (Gerrodette and Forcada 2002 in Hammond et al. 2008b).

15 - Gerrodette et al. 2008.

16 - North Pacific (Miyashita 1993b).

17 - Carretta et al. 2018.

18 - Western North Pacific (Miyashita 1993a).

19 - Ford 2009.

20 - Buckland et al. 1993.

21 - Lowry et al. 2014

**NOTE - *Italicized species are not expected to be taken or authorized for take***

All species that could potentially occur in the planned survey area are included in Table

1. With the exception of Steller sea lions, these species or stocks temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur. However, the temporal and/or spatial occurrence of Steller sea lions is such that take is not expected to occur,

and they are not discussed further beyond the explanation provided here. The Steller sea lion occurs along the North Pacific Rim from northern Japan to California (Loughlin *et al.* 1984). They are distributed around the coasts to the outer shelf from northern Japan through the Kuril Islands and Okhotsk Sea, through the Aleutian Islands, central Bering Sea, southern Alaska, and south to California (NMFS 2016c). There is little information available on at-sea occurrence of Steller sea lions in the northwestern Pacific Ocean. The Emperor Seamounts survey area is roughly 1,200 kilometers away from the Aleutian Islands in waters 2,000 to more than 5,000 meters deep. Steller sea lions are unlikely to occur in the offshore survey area based on their known distributional range and habitat preference. Therefore, it is extremely unlikely that Steller sea lions would be exposed to the stressors associated with seismic activities and will not be discussed further.

A detailed description of the of the species likely to be affected by the planned project, 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 for the proposed IHA (83 FR 30480; June 28, 2018); since that time, we are not aware of any changes in the status of these species and stocks; therefore, detailed descriptions are not provided here. Please refer to that **Federal Register** notice for these descriptions. Please also refer to NMFS' website ([www.nmfs.noaa.gov/pr/species/mammals/](http://www.nmfs.noaa.gov/pr/species/mammals/)) for generalized species accounts.

### **Potential Effects of Specified Activities on Marine Mammals and their Habitat**

The effects of underwater noise from marine geophysical survey activities have the potential to result in behavioral harassment and, in a limited number of instances, auditory injury (PTS) of marine mammals in the vicinity of the action area. The **Federal Register** notice of

proposed IHA (83 FR 30480; June 28, 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 serious injury or mortality are expected as a result of L-DEO's survey 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 whether the number of takes is "small" and the negligible impact determination. As described in detail below, modifications have been made to several take estimates based on recommendations from the public regarding density or occurrence of certain marine mammal species or stocks.

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 seismic airguns has the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) for mysticetes and high frequency cetaceans (i.e., kogiidae spp.), due to larger predicted auditory injury zones for those functional hearing groups. The required mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable.

Auditory injury is unlikely to occur for mid-frequency species given very small modeled zones of injury for those species (13.6 m). Moreover, the source level of the array is a theoretical definition assuming a point source and measurement in the far-field of the source (MacGillivray, 2006). As described by Caldwell and Dragoset (2000), an array is not a point source, but one that spans a small area. In the far-field, individual elements in arrays will effectively work as one source because individual pressure peaks will have coalesced into one relatively broad pulse. The array can then be considered a “point source.” For distances within the near-field, *i.e.*, approximately 2-3 times the array dimensions, pressure peaks from individual elements do not arrive simultaneously because the observation point is not equidistant from each element. The effect is destructive interference of the outputs of each element, so that peak pressures in the near-field will be significantly lower than the output of the largest individual element. Here, the 230 dB peak isopleth distances would in all cases be expected to be within the near-field of the array where the definition of source level breaks down. Therefore, actual locations within this distance of the array center where the sound level exceeds 230 dB peak SPL would not necessarily exist. In general, Caldwell and Dragoset (2000) suggest that the near-field for airgun arrays is considered to extend out to approximately 250 m.

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 authorized takes.

### *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.* 2012). 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 160 dB re 1  $\mu$ Pa (rms) for non-explosive impulsive (*e.g.*, seismic airguns) sources. L-DEO's activity includes the use of impulsive seismic sources. Therefore, the 160 dB re 1  $\mu$ Pa (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). The Technical Guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, reflects the best available science, and better predicts the potential for auditory injury than does NMFS’ historical criteria.

These thresholds were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product, and are provided in Table 2 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance. As described above, L-DEO’s activity includes the use of intermittent and impulsive seismic sources.

**Table 2. Thresholds Identifying the Onset of Permanent Threshold Shift in Marine Mammals**

Hearing Group	PTS Onset Thresholds	
	Impulsive*	Non-impulsive
<b>Low-Frequency (LF) Cetaceans</b>	$L_{pk,flat}$ : 219 dB $L_{E,LF,24h}$ : 183 dB	$L_{E,LF,24h}$ : 199 dB
<b>Mid-Frequency (MF) Cetaceans</b>	$L_{pk,flat}$ : 230 dB $L_{E,MF,24h}$ : 185 dB	$L_{E,MF,24h}$ : 198 dB
<b>High-Frequency (HF) Cetaceans</b>	$L_{pk,flat}$ : 202 dB $L_{E,HF,24h}$ : 155 dB	$L_{E,HF,24h}$ : 173 dB
<b>Phocid Pinnipeds (PW) (Underwater)</b>	$L_{pk,flat}$ : 218 dB $L_{E,PW,24h}$ : 185 dB	$L_{E,PW,24h}$ : 201 dB
<b>Otariid Pinnipeds (OW) (Underwater)</b>	$L_{pk,flat}$ : 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 ( $L_{pk}$ ) has a reference value of 1  $\mu$ Pa, and cumulative sound exposure level (LE) has a reference value of 1  $\mu$ Pa<sup>2</sup>s. 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 relevant acoustic thresholds.

The surveys will acquire data with the 36-airgun array with a total discharge of 6,600 in<sup>3</sup> at a maximum tow depth of 12 m. L-DEO model results are used to determine the 160-dBrms radius for the 36-airgun array and 40-in<sup>3</sup> airgun at a 12-m tow depth in deep water (>1000 m) down to a maximum water depth of 2,000 m. Received sound levels were predicted by L-DEO's model (Diebold *et al.*, 2010) which 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 the 36-airgun array at a tow depth of 6 m have been reported in deep water (approximately 1,600 m), intermediate water depth on the slope (approximately 600–1,100 m), and shallow water (approximately 50 m) in the Gulf of Mexico in 2007–2008 (Tolstoy *et al.* 2009; Diebold *et al.* 2010).

For deep and intermediate-water cases, the field measurements cannot be used readily to derive Level A and Level B isopleths, as at those sites the calibration hydrophone was located at a roughly constant depth of 350–500 m, which may not intersect all the sound pressure level (SPL) isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of ~2,000 m. At short ranges, where the direct arrivals dominate and the effects of seafloor interactions are minimal, the data recorded at the deep and slope sites are suitable for comparison with modeled levels at the depth of the calibration hydrophone. At

longer ranges, the comparison with the model—constructed from the maximum SPL through the entire water column at varying distances from the airgun array—is the most relevant.

In deep and intermediate-water depths, comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are in good agreement (Fig. 12 and 14 in Appendix H of NSF-USGS, 2011)..

Consequently, isopleths falling within this domain can be predicted reliably by the L-DEO model, although they may be imperfectly sampled by measurements recorded at a single depth. At greater distances, the calibration data show that seafloor-reflected and sub-seafloor-refracted arrivals dominate, whereas the direct arrivals become weak and/or incoherent. Aside from local topography effects, the region around the critical distance is where the observed levels rise closest to the model curve. However, the observed sound levels are found to fall almost entirely below the model curve. Thus, analysis of the GoM calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for conservatively estimating isopleths.

For deep water (>1,000 m), L-DEO used the deep-water radii obtained from model results down to a maximum water depth of 2000 m. The radii for intermediate water depths (100–1,000 m) were derived from the deep-water ones by applying a correction factor (multiplication) of 1.5, such that observed levels at very near offsets fall below the corrected mitigation curve (See Fig. 16 in Appendix H of NSF-USGS, 2011).

Measurements have not been reported for the single 40-in<sup>3</sup> airgun. L-DEO model results are used to determine the 160-dB (rms) radius for the 40-in<sup>3</sup> airgun at a 12 m tow depth in deep water (See LGL 2018, Figure A-2). For intermediate-water depths, a correction factor of 1.5 was applied to the deep-water model results.

L-DEO’s modeling methodology is described in greater detail in the IHA application (LGL 2018). The estimated distances to the Level B harassment isopleth for the *Langseth’s* 36-airgun array and single 40-in<sup>3</sup> airgun are shown in Table 3.

**Table 3: Predicted Radial Distances from R/V Langseth Seismic Source to Isopleths Corresponding to Level B Harassment Threshold**

Source and Volume	Tow Depth (m)	Water Depth (m)	Predicted distances (in m) to the 160-dB Received Sound Level
Single Bolt airgun, 40 in <sup>3</sup>	12	>1000 m	431 <sup>1</sup>
		100–1000 m	647 <sup>2</sup>
4 strings, 36 airguns, 6600 in <sup>3</sup>	12	>1000 m	6,733 <sup>1</sup>
		100–1000 m	10,100 <sup>2</sup>

<sup>1</sup> Distance is based on L-DEO model results.

<sup>2</sup> Distance is based on L-DEO model results with a 1.5 × correction factor between deep and intermediate water depths.

Predicted distances to Level A harassment isopleths, which vary based on marine mammal hearing groups, were calculated based on modeling performed by L-DEO using the NUCLEUS software program and the NMFS User Spreadsheet, described below. The updated acoustic thresholds for impulsive sounds (*e.g.*, airguns) contained in the Technical Guidance were presented as dual metric acoustic thresholds using both SEL<sub>cum</sub> and peak sound pressure metrics (NMFS 2016). 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<sub>cum</sub> 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<sub>cum</sub> 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 *Langseth* airgun array were derived from calculating the modified farfield signature (Table 4). 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 large 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. L-DEO used the acoustic modeling methodology as used for Level B harassment with a small grid step of 1 m in both the inline and depth directions. The propagation modeling takes into account all airgun interactions at short distances from the source, including interactions between subarrays which are modeled using the NUCLEUS

software to estimate the notional signature and MATLAB software to calculate the pressure signal at each mesh point of a grid.

**Table 4: Modeled Source Levels Based on Modified Farfield Signature for the R/V Langseth 6,600 in<sup>3</sup> Airgun Array, and single 40 in<sup>3</sup> Airgun.**

	Low frequency cetaceans ( $L_{pk,flat}$ : 219 dB, $L_{E,LF,24h}$ : 183 dB)	Mid frequency cetaceans ( $L_{pk,flat}$ : 230 dB, $L_{E,MF,24h}$ : 185 dB)	High frequency cetaceans ( $L_{pk,flat}$ : 202 dB; $L_{E,HF,24h}$ : 155 dB)	Phocid Pinnipeds (Underwater) ( $L_{pk,flat}$ : 218 dB; $L_{E,HF,24h}$ : 185 dB)	Otariid Pinnipeds (Underwater) ( $L_{pk,flat}$ : 232 dB; $L_{E,HF,24h}$ : 203 dB)
6,600 in <sup>3</sup> airgun array (Peak $SPL_{flat}$ )	252.06	252.65	253.24	252.25	252.52
6,600 in <sup>3</sup> airgun array ( $SEL_{cum}$ )	232.98	232.83	233.08	232.83	232.07
40 in <sup>3</sup> airgun (Peak $SPL_{flat}$ )	223.93	N.A.	223.92	223.95	N.A.
40 in <sup>3</sup> airgun ( $SEL_{cum}$ )	202.99	202.89	204.37	202.89	202.35

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 *Langseth’s* airgun array (modeled in 1 hertz (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 ( $\mu$ Pa) 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 and source velocities and shot intervals specific to each of the three planned surveys (Table 1), potential radial distances to auditory injury zones were then calculated for  $SEL_{cum}$  thresholds.

Inputs to the User Spreadsheets in the form of estimated SLs are shown in Table 5. User Spreadsheets used by L-DEO to estimate distances to Level A harassment isopleths for the 36-airgun array and single 40 in<sup>3</sup> airgun for the surveys are shown in Tables A-2, A-3, A-5, and A-8 in Appendix A of the IHA application (LGL 2018). Outputs from the User Spreadsheets in the form of estimated distances to Level A harassment isopleths for the surveys are shown in Table 5. As described above, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the dual metrics ( $SEL_{cum}$  and Peak  $SPL_{flat}$ ) is exceeded (i.e., metric resulting in the largest isopleth).

**Table 5. Modeled Radial Distances (m) to Isopleths Corresponding to Level A Harassment Thresholds**

	Low frequency cetaceans ( $L_{pk,flat}$ : 219 dB; $L_{E>LF,24h}$ : 183 dB)	Mid frequency cetaceans ( $L_{pk,flat}$ : 230 dB; $L_{E>MF,24h}$ : 185 dB)	High frequency cetaceans ( $L_{pk,flat}$ : 202 dB; $L_{E>HF,24h}$ : 155 dB)	Phocid Pinnipeds (Underwater) ( $L_{pk,flat}$ : 218 dB; $L_{E>HF,24h}$ : 185 dB)	Otariid Pinnipeds (Underwater) ( $L_{pk,flat}$ : 232 dB; $L_{E>HF,24h}$ : 203 dB)
6,600 in <sup>3</sup> airgun array (Peak $SPL_{flat}$ )	45.0	13.6	364.75	51.6	10.6
6,600 in <sup>3</sup> airgun array ( $SEL_{cum}$ )	320.2	N.A.	1	10.4	N.A.
40 in <sup>3</sup> airgun (Peak $SPL_{flat}$ )	1.76	N.A.	12.5	1.98	N.A.
40 in <sup>3</sup> airgun ( $SEL_{cum}$ )	0.5	N.A.	N.A.	N.A.	N.A.

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 harassment. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 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 planned 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).

In the planned survey area in the Hawaiian EEZ, densities from Bradford *et al.* (2017) were used, when available. For the pygmy sperm whale, dwarf sperm whale, and spinner dolphin, densities from Barlow *et al.* (2009) were used because densities were not provided by Bradford *et al.* (2017). Densities for striped dolphin and Fraser's dolphins were revised based on input from the Commission. As noted previously, NMFS had divided the unidentified *Mesoplodon* species' density of 1.89 animals/1,000 km<sup>2</sup> from Bradford *et al.* (2017) by three. For this notice, NMFS assumed that each species of those species could have a density of 1.89 animals/1,000 km<sup>2</sup>. For the humpback, sei, minke, and killer whales, the calculated take was increased to mean group size

For Hawaiian monk seals, NMFS followed the methods used by the U.S. Navy (Navy 2017a) to determine densities. The U.S. Navy calculated density of Hawaiian monk seal for three areas: the Main Hawaiian Islands in waters less than 200 meters, the Northwest Hawaiian Islands in waters less than 200 meters, and waters 200 meters deep to the Hawaiian EEZ boundary.

The 200 meter isobath was selected as a boundary because of information related to Hawaiian monk seal foraging behavior that came out of the final rule for designated critical habitat. Ninety-eight percent of recorded dives were within the 200-meter isobath in the Main Hawaiian Islands this depth boundary was considered sufficient for foraging habitat for adults and juveniles. The area around the Main Hawaiian Islands to the 200-meter isobath was

estimated to be 6,630 km<sup>2</sup> (6,142 km<sup>2</sup> in the Northwest Hawaiian Islands). The area from the 200-meter isobath to the Hawaiian EEZ is estimated to be 2,461,994 km<sup>2</sup>. The U.S. Navy also assumed that 90 percent of the population would occur inside the 200-meter isobath.

The U.S. Navy used the following calculation to estimate density:

$$\left[ \frac{\text{number of seals} \times \text{percent of the population in or out of the 200-m}}{200\text{-m area}} \right] \times \text{In-water factor}$$

By applying the U.S. Navy's methodology using updated population estimates for the 2017 stock assessment report for the U.S. Pacific (Carretta *et al.* 2018) and haul-out factors, we can estimate Hawaiian monk seal density. NMFS had used older abundance data in the proposed notice.

Main Hawaiian Islands inside 200 m isobath

$$\left[ \frac{145 \text{ seals} \times 0.90}{6,630 \text{ km}^2} \right] \times 0.68 = 0.0134 \text{ seals/km}^2$$

Northwest Hawaiian Islands inside 200 m isobath

$$\left[ \frac{1,179 \text{ seals} \times 0.90}{6,142 \text{ km}^2} \right] \times 0.68 = 0.1175 \text{ seals/km}^2$$

Hawaiian EEZ

$$\left[ \frac{1,324 \times 0.10}{2,461,994 \text{ km}^2} \right] \times 0.68 = 0.000037 \text{ seals/km}^2$$

Based on where the action will occur, it NMFS utilized the density estimate for the Hawaiian EEZ.

There are very few published data on the densities of cetaceans or pinnipeds in the Emperor Seamounts area, so NMFS relied on a range of sources to establish marine mammal densities. As part of the Navy's Final Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement for SURTASS LFA Sonar Routine Training, Testing, and Military Operations, the Navy modelled densities for a designated

mission area northeast of Japan during the summer season. These values were used for the North Pacific right whale, sei whale, fin whale, sperm whale, Cuvier's beaked whale, Stejneger's beaked whale, and Baird's beaked whale.

For northern right whale dolphin, Dall's porpoise, and northern fur seal, L-DEO used densities from Buckland *et al.* (1993). Forney and Wade (2006) reported a density of 0.3/100 km<sup>2</sup> for killer whales at latitudes 43–48°N where the planned survey would be conducted. Although Miyashita (1993) published data on the abundance of striped, Pantropical spotted, bottlenose, and Risso's dolphins, and false killer and short-finned pilot whales in the Northwest Pacific Ocean as far north as 41°N, the distributional range of the Pantropical spotted and bottlenose dolphins does not extend as far north as the planned survey area. For the other species, we used data from 40–41°N, 160–180°E to calculate densities and estimate the numbers of individuals that could be exposed to seismic sounds during the survey. Risso's dolphin, false killer whale, and short-finned pilot whale are expected to be rare in the survey area, and the calculated densities were zero. Thus, we used the mean group size from Bradford *et al.* (2017) for Risso's dolphin and short-finned pilot whale, and the mean group size of false killer whales from Barlow (2006).

The short-beaked common dolphin is expected to be rare in the Emperor Seamounts survey area; thus, there are no density estimates available. L-DEO used the mean group size (rounded up) for the California Current from Barlow (2016). The density of Bryde's whale in the planned survey area was assumed to be zero, based on information from Hakamada *et al.* (2009, 2017) and Forney *et al.* (2015); its known distribution range does not appear to extend that far north. For this species, L-DEO rounded up the mean group size from Bradford *et al.* (2017). For

pygmy and dwarf sperm whales, NMFS assumed densities in the Emperor Seamounts would be equivalent to those in the Hawaii survey area and used densities from Bradford *et al.* 2017.

The densities for the remaining species were obtained from calculations using data from the papers presented to the IWC. For blue and humpback whales, L-DEO used a weighted mean density from Matsuoka *et al.* (2009) for the years 1994–2007 and Hakamada and Matsuoka (2015) for the years 2008–2014. L-DEO used Matsuoka *et al.* (2009) instead of Matsuoka *et al.* (2015), as the later document did not contain all of the necessary information to calculate densities. L-DEO used densities for their Block 9N which coincides with the planned Emperor Seamounts survey area. The density for each survey period was weighted by the number of years in the survey period; that is, 14 years for Matsuoka *et al.* (2009) and 7 years for Hakamada and Matsuoka (2015), to obtain a final density for the 21-year period. For minke whales L-DEO used the estimates of numbers of whales in survey blocks overlapping the Emperor Seamounts survey area from Hakamada *et al.* (2009); densities were estimated by dividing the number of whales in Block 9N by the area of Block 9N. For gray whales, NMFS used a paper by Rugh *et al.* (2005) that looked at abundance of eastern DPS gray whales. The paper provides mean group sizes for their surveys, which ranged from 1 to 2 individuals. For purposes of estimating exposures we will assume that the western DPS group sizes would not vary greatly from the eastern DPS. As such, NMFS assumes that there will be two western DPS gray whales Level B takes, based on mean group size.

Finally, no northern elephant seals have been reported during any of the above surveys although Buckland *et al.* (1993) estimated fur seal abundance during their surveys. Telemetry studies, however, indicate that elephant seals do forage as far west as the Emperor Seamounts survey area. Here, L-DEO assumed a density of 0.00831/1000 km<sup>2</sup>, which is 10% of that used by

LGL Limited (2017) for an area off the west coast of the U.S. However, densities of northern elephant seals in the region are expected to be much less than densities of northern fur seals. For species that are unlikely to occur in the survey area, such as ribbon seals, exposures are set at 5 individuals. Densities for animals in Emperor Seamounts are shown in Table 8.

#### *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 A harassment or Level B harassment, radial distances from the airgun array to predicted isopleths corresponding to the Level A harassment and Level B harassment thresholds are calculated, as described above. Those radial 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 harassment and Level B harassment thresholds. The area estimated to be ensonified in a single day of active seismic operations is then calculated (Table 6) based on the areas predicted to be ensonified around the array and the estimated trackline distance traveled per day. For purposes of Level B take calculations, areas estimated to be ensonified to Level A harassment thresholds are subtracted from 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). The daily ensonified areas are multiplied by density estimates for each species to arrive at a daily exposure rate. The daily exposure rate is subsequently multiplied by the number of planned survey days plus a 25 percent contingency factor. Active seismic operations are planned for 13 days at Emperor Seamounts and 19 days at Hawaii. Therefore, the number of survey days is increased to 16 in the Emperor Seamounts and 24 in Hawaii area. Estimated exposures for the

Hawaii survey and the Emperor Seamounts survey are shown respectively in Table 7 and Table 8.

**Table 6. Areas (km<sup>2</sup>) Estimated to be Ensonified to Level A and Level B Harassment Thresholds, Per Day for Hawaii and Emperor Seamounts Surveys**

Survey	Criteria	Daily Ensonified Area (km <sup>2</sup> )	Planned Survey Days	Total Survey Days (25% Increase)	Relevant Isoleth (m)
Hawaii Level B					
Multi-depth line (intermediate water)	160 dB	538.5	12	15	10,100
Multi-depth line (deep water)	160 dB	2349.8	12	15	6,733
Multi-depth line (total)	160 dB	2888.2	12	15	6,733
Deep-water line	160 dB	2566.3	7	9	6,733
Hawaii Level A <sup>1</sup>					
Hawaii	LF Cetacean	115.6	19	24	320.2
	MF Cetacean	4.9	19	24	13.6
	HF Cetacean	96.8	19	24	268.3
	Phocid	15.7	19	24	43.7
Emperor Seamounts Level B					
Emperor Seamounts	160 dB	2566.3	13	16	6,733
Emperor Seamounts Level A <sup>1</sup>					
Emperor Seamounts	LF Cetacean	115.6	13	16	320.2
	MF Cetacean	4.9	13	16	13.6
	HF Cetacean	96.8	13	16	268.3
	Phocid	15.7	13	16	43.7
	Otariid	3.8	13	16	10.6

<sup>1</sup> Level A ensonified areas are estimated based on the greater of the distances calculated to Level A isopleths using dual criteria (SEL<sub>cum</sub> and peakSPL).

**Table 7. Densities, Exposures, Percentage of Stock or Population Exposed, and Number of Authorized Takes During Hawaii Survey.**

Species	Stock	Density (#/1000 km <sup>2</sup> )	Total Exposures	Percentage of stock/population	Authorized Takes	
					Level A	Level B
Humpback Whale	Central North Pacific	--	2 <sup>4</sup>	<0.01	0	2
	Western North Pacific	--		0.2		
Minke whale,	Hawaii	0 <sup>3</sup>	1 <sup>4</sup>	<0.01	0	1
Bryde's whale	Hawaii	0.72 <sup>1</sup>	47	2.8	2	45
Sei whale	Hawaii	0.16 <sup>1</sup>	11	6.2	0	11

Fin whale	Hawaii	0.06 <sup>1</sup>	4	2.7	0	4
Blue whale	Central north Pacific	0.05 <sup>1</sup>	5	3.9	0	5
<b>Odontocetes</b>						
Sperm whale	Hawaii	1.86 <sup>1</sup>	123	2.7	0	123
Pygmy sperm whale	Hawaii	2.91 <sup>2</sup>	191	2.8	7	184
Dwarf sperm whale	Hawaii	7.14 <sup>2</sup>	470	2.8	16	454
Cuvier's beaked whale	Hawaii pelagic	0.30 <sup>1</sup>	20	2.8	0	20
Longman's beaked whale	Hawaii	3.11 <sup>1</sup>	205	2.7	0	205
Blainville's beaked whale	Hawaii pelagic	0.86 <sup>1</sup>	57	2.7	0	57
Ginkgo-toothed beaked whale	N/A	1.89 <sup>6</sup>	124	0.5	0	124
Deraniyala's beaked whale	N/A	1.89 <sup>6</sup>	124	0.5	0	124
Hubb's beaked whale	N/A	1.89 <sup>6</sup>	124	0.5	0	124
Rough-toothed dolphin	Hawaii	29.63 <sup>1</sup>	1,949	2.7	0	1,949
Common bottlenose dolphin	HI Pelagic	8.99 <sup>1</sup>	592	2.7 <sup>7</sup>	0	592
	Oahu			1.2		
	HI Islands			7.0		
Pantropical spotted dolphin	HI Pelagic	23.32 <sup>1</sup>	1,534	2.6 <sup>8</sup>	0	1,534
	Oahu			N.A.		
	HI Islands			N.A.		
Spinner dolphin	HI Pelagic	6.99 <sup>2</sup>	460	N.A.	0	460
	HI Island			3.8 <sup>9</sup>		
	Oahu/4 island			6.7		
Striped dolphin	HI Pelagic	25 <sup>1</sup>	1,644	0.6	0	1,644
Fraser's dolphin	Hawaii	21.0 <sup>1</sup>	1,381	2.7	0	1,381
Risso's dolphin	Hawaii	4.74 <sup>1</sup>	312	2.7	0	312
Melon-headed whale	HI Islands	3.54 <sup>1</sup>	810	8.6	0	810 <sup>10</sup>
	Kohala resident			13.4		
Pygmy killer whale	Hawaii	4.35 <sup>1</sup>	286	2.7	0	286
False killer	MHI	0.09 <sup>3</sup>	5	11.9	0	20 <sup>11</sup>

whale	Insular					
	HI Pelagic	0.06 <sup>5</sup>	40	2.6	0	40
Killer whale	Hawaiian Islands	0.06 <sup>1</sup>	5 <sup>4</sup>	2.42	0	5
Short-finned pilot whale	Hawaii	7.97 <sup>1</sup>	524	2.7	0	524
<b>Pinnipeds</b>						
Hawaiian monk seal	Hawaii	0.000037 <sup>3</sup>	3	0.22	0	3

1 - Bradford *et al.* 2017.

2 - Barlow *et al.* 2009.

3 - Baker *et al.* 2016

4 - Requested take authorization (Level B only) increased to mean group size from Mobley *et al.* 2001

5 - Bradford *et al.* 2015.

6 - From Bradford *et al.* (2017) for 'Unidentified *Mesoplodon*'.

7 - Assumes 98.5 percent of takes are from Hawaii pelagic stock (588) with remaining 1 percent from Oahu stock (6) and 0.5 percent from Hawaiian Islands (3) stock. Assumed average group size of 9 for Oahu and Hawaii Island stocks.

8- Assumes 94.16 percent of takes are from Hawaii pelagic stock (1,461), 5.25 percent are from Hawaii Island stock (82), and 0.59 are from Oahu stock. Populations of insular stocks are unknown.

9 - Assumes 0.36 percent for Oahu/4-Islands stock (1), 0.95 percent for Hawaii Island stock (4) and remaining from Pelagic stock (459) stocks. NMFS will assume average group size of 24 for the Oahu/4-Island and Hawaii Island stock exposures (NMFS 2016).

10 - Assumes Level B harassment of 3 groups of 20 Kohala resident stock whales and 3 groups of 250 Hawaiian Island stock animals.

11 - Increased to average group size of 20 (Oleson *et al.* 2010).

*Changes to Main Hawaiian Islands insular false killer whale take estimates* - NMFS has recalculated exposures of Main Hawaiian Islands insular false killer whale DPS due to recently designated critical habitat for this species (83 FR 35062; July 24, 2018). A total of 3,455-kilometers of tracklines will be surveyed around the Main Hawaiian Islands where insular false killer whales show a preference for deeper waters just offshore (45-meters) to the 3,200-meter depth boundary. The majority of the planned tracklines are outside this area in waters deeper than 3,200-meters. NMFS used critical habitat to serve as the range boundary for this DPS. In order to calculate the amount of exposure for Main Hawaiian Islands Insular false killer whales during the planned action, NMFS determined the amount of tracklines within the DPS's range. There are 236.6 km of planned tracklines in Main Hawaiian Islands insular false killer whale range (or about 6.8 percent of the tracklines for the entire Hawaii seismic survey). Only portions of Tracklines 1 and 2 are within the DPS's range. Because the size of the ensouffied areas

changes with water depth, NMFS determined the amount of tracklines in each depth range. All of Trackline 1 takes place in deep water (>1,000 meters/141.6 km), and most of Trackline 2 takes place in deep water (76.6 km) with 18.4 km in intermediate depth water (100 to 1,000 m). Tracklines 1 and 2 would be surveyed twice, once for reflection data, and once for refraction data. At a speed of 7.6 km/hr, it would take the *Langseth* about 37.3 hours to survey Trackline 1, and 25 hours to survey Trackline 2 (both passes), for about 2.6 days in total.

NMFS calculated ensonified area along the tracklines to arrive at a total of 3,940-km<sup>2</sup> within the species' range. As noted previously, a contingency of 25 percent was added to the number of survey days, which is the equivalent of adding 25 percent to the planned line tracklines. The total amount of ensonified area with the 25 percent contingency is 4,925 km<sup>2</sup>. Bradford *et al.* (2015) calculated the density of Main Hawaiian Islands Insular false killer whales at 0.09 individuals per 100 km<sup>2</sup>, which was multiplied by the total ensonified area plus contingency, resulting in five Main Hawaiian Island insular false killer whale exposures. False killer whales are commonly sighted in groups of 10 to 20 (Baird 2009; Baird *et al.* 2010; Wade and Gerrodette 1993) with 20 individuals being regarded as about the average group size (Oleson *et al.* 2010). Therefore, authorized Level B harassment takes was increased from 5 individuals to 20.

*Changes to melon-headed whale take estimates* - NMFS had estimated in the proposed notice that there would be 235 Level B harassment takes of melon-headed whales from the combined Kohala resident stock and the Hawaiian Islands stock. Kohala resident stock members could only be affected during Trackline 1 operations off of the Kohala Peninsula and the west coast of Hawaii Island in waters of less than 2,500 m of water. This segment of the survey represents a small portion of the total Hawaiian Island tracklines. The Hawaiian Islands stock of

melon-headed whales may be found along any of the planned tracklines, including within the range of the Kohala resident stock. Kohala resident whales can be found in large groups of up to several hundred with a median group size of 210 (Forney *et al.* 2017). However, they have also been observed in smaller groups of 4 and 17 individuals (Aschettino *et al.* 2011). Additionally, these smaller groups were often followed by much larger groups, which suggests that the small groups may have branched off from larger groups.

L-DEO is required to shutdown whenever a melon-headed whale is detected while passing through the Kohala resident stock's range. L-DEO also intends to pass through this range during daylight hours to maximize the potential for detection. PSOs should be able to observe the larger groups containing hundreds of animals at a significant distance and implement shutdown accordingly. When a small group of whales is observed, shutdown will also be implemented and PSOs will shift to state of heightened alert since a larger main group may be in close proximity. Given this information, NMFS will assume that up to 3 groups of 20 Kohala resident whales may be taken by Level B harassment if they enter the zone undetected by PSOs. This would result in up to 60 Level B harassment takes. Given the species' large group sizes, NMFS will also assume that up to 3 groups of 250 Hawaiian Island animals may be taken during the remainder of the cruise outside of the range of Kohala resident stock. Therefore, NMFS authorizes the take of up to 810 melon headed whales.

*Changes to common bottlenose dolphin take estimates* - There are four individual common bottlenose dolphin stocks within the Hawaiian Islands complex. None of the planned survey tracklines will traverse the ranges of the Kauai/Niihau or 4-Islands stocks so animals from these stocks will not be impacted by seismic activities. In the proposed notice NMFS had estimated that a small number of takes would be accrued to the 4 Islands stock. Therefore, takes

of this stock are not authorized in the final IHA and NMFS revised the number of authorized takes estimated to accrue to the remaining Hawaii pelagic, Oahu, and Hawaiian Islands stocks as described below.

During the survey along Trackline 1 a short time will be spent traversing the northern boundary of the Hawaiian Island stock while along Trackline 2 the survey will run through the northwest boundary of the Oahu stock. The vast majority of planned survey tracklines occur in waters that are greater than 1,000 m which marks the boundary between the Hawaiian pelagic and Hawaiian insular stocks. According to a GIS analysis, an estimated 0.47 percent of all Hawaii tracklines will take place in waters less than 1,000 m deep northwest of Oahu along Trackline 2 and 1.00 percent will occur in depths less than 1,000 m north of Hawaii along Trackline 1. Therefore, NMFS will assume that the remaining 98.5% percent (588) of total takes will be accrued by the pelagic stock, 0.5 percent (3) will accrue to the Oahu stock and 1 percent (6) will accrue to the Hawaiian Island stock. Insular stocks have an average group size of group size of 8.5 rounded up to 9, so 9 takes will accrue to the Oahu stock and 9 takes to the Hawaiian Island stock (Baird et al. 2002). Note that the ranges of these two insular stocks completely encompass the islands for which they are named out to the 1,000 m bathymetric contour line. Given such expansive ranges, it is unlikely that large numbers of either stock would be concentrated near a trackline during the short time the vessel is within the delineated stock boundaries.

*Changes to spinner dolphin take estimates* – For the final IHA, NMFS conducted a comprehensive GIS analysis to determine how spinner dolphin takes should be accrued among the various stocks in the region. This had not been done for the proposed IHA. There are four stocks of spinner dolphins within the U.S. EEZ of the Hawaiian Islands. Planned seismic survey

tracklines would traverse the ranges of the Hawaii Island, Oahu/4-Islands, and Hawaii Pelagic stocks. Stock boundaries for the Hawaii Island and Oahu/4-Islands stocks extend out 10 nautical miles (nmi) from the coasts of these islands. An estimated 0.36 percent of all tracklines will take place in the range of the Oahu/4-Island stock northwest of Oahu along Trackline 2, and 0.95 percent will occur in the range of the Hawaii Island stock north of Hawaii along Trackline 1, with remaining takes being accrued by the Hawaii Pelagic stock. This results in 1 estimated Oahu/4-Island stock exposure, 4 Hawaii Island stock exposures, and 459 Pelagic stock exposures. NMFS will assume average group size of 24 individuals for the Oahu/4-Island and Hawaii Island stock exposures (NMFS 2016).

*Changes to pantropical spotted dolphin take estimates* – A comprehensive GIS analysis was also conducted for the pantropical spotted dolphin stock takes estimates, which had not been included in the proposed IHA. There are four management stocks of pantropical spotted dolphins within the Hawaiian Islands EEZ (Oleson *et al.* 2013) including: 1) the Oahu stock, which includes spotted dolphins within 20 km of Oahu, 2) the 4-Island stock, which includes spotted dolphins within 20 km of Maui, Molokai, Lanai, and Kahoolawe collectively, 3) the Hawaii Island stock, which includes spotted dolphins found within 65 km of Hawaii Island, and 4) the Hawaii pelagic stock, which includes spotted dolphins inhabiting the waters throughout the Hawaiian Islands EEZ, outside of the insular stock areas, but including adjacent high seas. Planned seismic survey lines would traverse the Hawaii Island, Oahu, and Hawaii Pelagic stocks. An estimated 0.59 percent of all tracklines will take place in the range of the Oahu stock northwest of Oahu along Trackline 2, and 5.25 percent will occur in the range of the Hawaii Island stock north and west of Hawaii along Trackline 1 with the remaining accrued by the

Hawaii Pelagic stock. This results in an estimated 9 Oahu stock exposures, 82 Hawaii Island stock exposures, and 1,461 Pelagic stock exposures.

For Hawaiian monk seals, NMFS used an updated abundance estimate (Baker *et al.* 2016) recommended by the Commission to estimate density. NMFS multiplied the updated estimated density by the daily ensonified area (160 dB zone) on one day, times the 1.25 percent operational contingency. Since the planned action will take place in different water depths, there are two different daily ensonified areas. For deep water (>1,000 meters), the daily ensonified area is 2,349.8 km<sup>2</sup>. For intermediate depths (100-1,000 meters), the daily ensonified area is 538.5 km<sup>2</sup>. The vast majority of the survey (3,403 kilometers) will take place in deep water. Only 52 km will take place in intermediate depths. However, use of the updated abundance and density estimates resulted in the same number of authorized Level B harassment takes (3) that was included in the proposed IHA.

**Table 8. Densities, Exposures, Percentage of Stock or Population Exposed, and Number of Authorized Takes During Emperor Seamounts Survey.**

Species	Stock	Estimated Density (#/1000 km <sup>2</sup> )	Total Exposures	% of Pop. (Total Takes)	Authorized Takes	
					Level A	Level B
Gray whale	N/A	N.A.	2 <sup>2</sup>	1.43	0	2
North Pacific right whale	N/A/	0.01 <sup>1</sup>	2 <sup>10</sup>	0.45	0	2
Humpback whale	Central North Pacific	0.41 <sup>1</sup>	18	0.17 <sup>11</sup>	2 <sup>13</sup>	16 <sup>11</sup>
	Western North Pacific DPS			0.18 <sup>11</sup>		
Minke whale	N/A	2.48	103	0.47	5	98
Bryde's whale	N/A	N.A.	2 <sup>3</sup>	<0.01	0	2
Sei whale	N/A	0.29 <sup>1</sup>	14	0.05	3 <sup>3</sup>	11
Fin whale	N/A	0.20 <sup>1</sup>	8	0.06	0	8
Blue whale	Central north Pacific	0.13	5	3.7	0	5
<b>Odontocetes</b>						

Sperm whale	N/A	2.20 <sup>1</sup>	90	0.30	0	90
Pygmy sperm whale	N/A	2.91 <sup>4</sup>	121	1.7	0	121
Dwarf sperm whale	N/A	7.14 <sup>4</sup>	298	1.7	0	298
Cuvier's beaked whale	N/A	5.40 <sup>1</sup>	225	1.11	0	225
Stejner's beaked whale	Alaska	0.5 <sup>1</sup>	21	0.08	0	21
Baird's beaked whale	N/A	2.9 <sup>1</sup>	121	1.19	0	121
Short-beaked common dolphin	N/A	180 <sup>5</sup>	N.A.	<0.01	0	180
Striped dolphin	N/A	9.21 <sup>6</sup>	384	0.04	0	384
Pacific white-sided dolphin	N/A	68.81 <sup>7</sup>	2,870	0.29	0	2,870
Northern right whale dolphin	N/A	3.37 <sup>7</sup>	141	0.04	0	141
Risso's dolphin	N/A	27 <sup>3</sup>	1,126	1.02	0	1,126
False killer whale	N/A	10 <sup>5</sup>	417	2.5	0	417
Killer whale	N/A	3.00 <sup>8, 12</sup>	1,253	14.7	0	1,253
Short-finned pilot whale	N/A	41 <sup>3</sup>	1,713	3.2	0	1,713
Dall's porpoise	N/A	35.46	1,479	0.13	56	1,423
<b>Pinnipeds</b>						
Northern fur seal	N/A	3.56 <sup>7</sup>	149	0.01	0	149
Northern elephant seal	N/A	8.31	343	0.15	0	343
Ribbon seal	Alaska	N.A.	5 <sup>9</sup>	<0.01	0	5

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2- Mean group size based on Rugh *et al.* (2005).

- 3-Mean group size from Bradford *et al.* (2017).
- 4 – Bradford *et al.* (2017).
- 5- Mean group size from Barlow (2016).
- 6 - Miyashita (1993).
- 7 - Buckland *et al.* (1993).
- 8 - Forney and Wade (2006).
- 9 – Estimated exposures increased to 5 for pinnipeds.
- 10 – Mean group size from Matsuoka *et al.* (2009).
- 11 – Based on population size, take is split proportionally between central north Pacific (91.2 percent of total take) and western north Pacific DPS stocks (9.8 percent of total take). Assumes 2 Level B harassment takes of western north Pacific DPS
- 12 – Density is based on number of animals/100 km<sup>2</sup>
- 13 - Mean group size from Mobley *et al.* (2001).

The only stocks that occur in both the Emperor Seamounts and the Hawaiian Islands are the Central North Pacific (CNP) humpback whale, Western North Pacific (WNP) humpback whale, and Central North Pacific (CNP) blue whale stocks. NMFS combined take estimates from both surveys and calculated the percentage of each stock taken. The results were 0.18 percent for the CNP humpback stock, 0.36 percent for the WNP humpback stock, and 7.5 percent for the CNP blue whale stock.

It should be noted that authorized take numbers shown in Tables 7 and 8 are expected 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 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, and in recognition of the uncertainties in the density estimates used to estimate take as described above. Additionally, marine mammals would be expected to move away from a loud sound source that represents an aversive stimulus, such as an airgun array, potentially reducing the number of Level A takes. However, the extent to which marine mammals would move away from the sound source is difficult to quantify and is, therefore, not accounted for in the take estimates.

## **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.

L-DEO 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 planned mitigation measures into their project description based on the above sources.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, L-DEO will implement mitigation measures for marine mammals. Mitigation measures that will be adopted during the planned surveys include (1) Vessel-based visual mitigation monitoring; (2) Vessel-based passive acoustic monitoring; (3) Establishment of an exclusion zone; (4) Power down procedures; (5) Shutdown procedures; (6) Ramp-up procedures; and (7) Vessel strike avoidance measures. Note that additional measures have been included in the final IHA that were not contained in the proposed IHA. These measures are described in the following sections.

### **Vessel-Based Visual Mitigation Monitoring**

Visual monitoring requires the use of trained observers (herein referred to as visual PSOs) to scan the ocean surface visually for the presence of marine mammals. The area to be scanned visually includes primarily the exclusion zone, but also the buffer zone. The buffer zone means an area beyond the exclusion zone to be monitored for the presence of marine mammals that may enter the exclusion zone. During pre-clearance monitoring (i.e., before ramp-up begins), the buffer zone also acts as an extension of the exclusion zone in that observations of marine mammals within the buffer zone would also prevent airgun operations from beginning (i.e. ramp-up). The buffer zone encompasses the area at and below the sea surface from the edge of the 0–500 meter exclusion zone, out to a radius of 1,000 meters from the edges of the airgun array (500–1,000 meters). Visual monitoring of the exclusion zones and adjacent waters is intended to establish and, when visual conditions allow, maintain zones around the sound source

that are clear of marine mammals, thereby reducing or eliminating the potential for injury and minimizing the potential for more severe behavioral reactions for animals occurring close to the vessel. Visual monitoring of the buffer zone is intended to (1) provide additional protection to naïve marine mammals that may be in the area during pre-clearance, and (2) during airgun use, aid in establishing and maintaining the exclusion zone by alerting the visual observer and crew of marine mammals that are outside of, but may approach and enter, the exclusion zone. Note that L-DEO must monitor the Level B harassment zone beyond 1,000 meters and enumerate any takes beyond this buffer zone.

L-DEO must use at least five dedicated, trained, NMFS-approved Protected Species Observers (PSOs). 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 shall be provided to NMFS for approval.

At least one of the visual and two of the acoustic PSOs aboard the vessel must have a minimum of 90 days at-sea experience working in those roles, respectively, during a deep penetration (*i.e.*, “high energy”) seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. One visual PSO with such experience shall be designated as the lead for the entire protected species observation team. The lead PSO shall serve as primary point of contact for the vessel operator and ensure all PSO requirements per the IHA are met. To the maximum extent practicable, the experienced PSOs should be scheduled to be on duty with those PSOs with appropriate training but who have not yet gained relevant experience.

During survey operations (*e.g.*, any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of

two visual PSOs must be on duty and conducting visual observations at all times during daylight hours (i.e., from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array. Visual monitoring of the exclusion and buffer zones must begin no less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset. Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

PSOs shall establish and monitor the exclusion and buffer zones. These zones shall be based upon the radial distance from the edges of the acoustic source (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source (i.e., anytime airguns are active, including ramp-up), occurrences of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown or powerdown of the acoustic source.

During use of the airgun (i.e., anytime the acoustic source is active, including ramp-up), occurrences of marine mammals within the buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown or powerdown of the acoustic source. Visual PSOs will immediately communicate all observations to the on duty acoustic PSO(s), including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination. Any observations of marine mammals by crew members shall be relayed to the PSO team. During good conditions (e.g., daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and

without use of the acoustic source and between acquisition periods, to the maximum extent practicable. Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (visual and acoustic but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO.

For the final IHA, NMFS had added the requirement L-DEO must make a good faith effort to schedule their surveys to maximize the amount of seismic activity that takes place during daylight hours within the defined ranges of the Kohala resident stock of melon-headed whale and the Main Hawaiian Islands insular stock of false killer whales. This will greatly assist PSOs in their efforts to effectively monitor these species. Furthermore, L-DEO must implement shutdown procedures if a melon-headed whale or group of melon-headed whales is observed in the Kohala resident stock's range.

### **Passive Acoustic Monitoring**

Acoustic monitoring means the use of trained personnel (sometimes referred to as passive acoustic monitoring (PAM) operators, herein referred to as acoustic PSOs) to operate PAM equipment to acoustically detect the presence of marine mammals. Acoustic monitoring involves acoustically detecting marine mammals regardless of distance from the source, as localization of animals may not always be possible. Acoustic monitoring is intended to further support visual monitoring (during daylight hours) in maintaining an exclusion zone around the sound source that is clear of marine mammals. In cases where visual monitoring is not effective (*e.g.*, due to weather, nighttime), acoustic monitoring may be used to allow certain activities to occur, as further detailed below.

PAM would take place in addition to the visual monitoring program. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, if PSOs are unable to detect marine mammals when they are below the surface or beyond visual range. Acoustical monitoring can be used in addition to visual observations to improve detection, identification, and localization of cetaceans. The acoustic monitoring would serve to alert visual PSOs when vocalizing cetaceans are detected. It is only useful when marine mammals call, but it can be effective either by day or by night, and does not depend on good visibility. It would be monitored in real time so that the visual observers can be advised when cetaceans are detected.

The *R/V Langseth* will use a towed PAM system, which must be monitored by a minimum one on duty acoustic PSO beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source. Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (acoustic and visual but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO.

Survey activity may continue for 30 minutes when the PAM system malfunctions or is damaged, while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional five hours without acoustic monitoring during daylight hours. In the proposed IHA, NMFS stated that only two hours of operations would be allowed without acoustic monitoring. However, L-DEO reported that approximately five hours are required to redeploy the spare PAM system if the

primary PAM system fails. Note that operations may continue only under the following conditions:

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

#### **Establishment of an Exclusion Zone and Buffer Zone**

An exclusion zone (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 would establish a minimum EZ with a 500 m radius for the 36 airgun array. The 500 m EZ would 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 or enters this zone, the acoustic source would be shut down.

The 500 m EZ is intended to be precautionary in the sense that it would be expected to contain sound exceeding the injury criteria for all cetacean hearing groups, (based on the dual criteria of SELcum and peak SPL), while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. Additionally, a 500 m EZ is expected to minimize the likelihood that marine mammals will be exposed to levels likely to result in more severe behavioral responses. Although significantly

greater distances may be observed from an elevated platform under good conditions, we believe that 500 m is likely regularly attainable for PSOs using the naked eye during typical conditions.

### **Pre-clearance and Ramp-up**

Ramp-up (sometimes referred to as "soft start") means the gradual and systematic increase of emitted sound levels from an airgun array. Ramp-up begins by first activating a single airgun of the smallest volume, followed by doubling the number of active elements in stages until the full complement of an array's airguns are active. Each stage should be approximately the same duration, and the total duration should not be less than approximately 20 minutes. The intent of pre-clearance observation (30 minutes) is to ensure no protected species are observed within the buffer zone prior to the beginning of ramp-up. During pre-clearance is the only time observations of protected species in the buffer zone would prevent operations (i.e., the beginning of ramp-up). The intent of ramp-up is to warn protected species of pending seismic operations and to allow sufficient time for those animals to leave the immediate vicinity. A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. All operators must adhere to the following pre-clearance and ramp-up requirements:

- The operator must notify a designated PSO of the planned start of ramp-up as agreed upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up in order to allow the PSOs time to monitor the exclusion and buffer zones for 30 minutes prior to the initiation of ramp-up (pre-clearance).
- Ramp-ups shall be scheduled so as to minimize the time spent with the source activated prior to reaching the designated run-in.

- One of the PSOs conducting pre-clearance observations must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.
- Ramp-up may not be initiated if any marine mammal is within the applicable exclusion or buffer zone. If a marine mammal is observed within the applicable exclusion zone or the buffer zone during the 30 minute pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the zones or until an additional time period has elapsed with no further sightings (15 minutes for small odontocetes and 30 minutes for all other species).
- Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Duration shall not be less than 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed.
- PSOs must monitor the exclusion and buffer zones during ramp-up, and ramp-up must cease and the source must be shut down upon observation of a marine mammal within the applicable exclusion zone. Once ramp-up has begun, observations of marine mammals within the buffer zone do not require shutdown or powerdown, but such observation shall be communicated to the operator to prepare for the potential shutdown or powerdown.
- Ramp-up may occur at times of poor visibility, including nighttime, if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to

beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances.

- If the acoustic source is shut down for brief periods (i.e., less than 30 minutes) for reasons other than that described for shutdown and powerdown (e.g., mechanical difficulty), it may be activated again without ramp-up if PSOs have maintained constant visual and/or acoustic observation and no visual or acoustic detections of marine mammals have occurred within the applicable exclusion zone. For any longer shutdown, pre-clearance observation and ramp-up are required. For any shutdown at night or in periods of poor visibility (e.g., BSS 4 or greater), ramp-up is required, but if the shutdown period was brief and constant observation was maintained, pre-clearance watch of 30 min is not required.
- Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance of 30 min.

### **Shutdown and Powerdown**

The shutdown of an airgun array requires the immediate de-activation of all individual airgun elements of the array while a powerdown requires immediate de-activation of all individual airgun elements of the array except the single 40-in<sup>3</sup> airgun. Any PSO on duty will have the authority to delay the start of survey operations or to call for shutdown or powerdown of the acoustic source if a marine mammal is detected within the applicable exclusion zone. The operator must also establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown and powerdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and

acoustic PSOs are on duty, all detections will be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs. When the airgun array is active (i.e., anytime one or more airguns is active, including during ramp-up and powerdown) shutdown must occur under the following conditions:

- A marine mammal appears within or enters the applicable exclusion zone; and
- A marine mammal (other than delphinids, see below) is detected acoustically and localized within the applicable exclusion zone.

The shutdown requirements described below have been added to the final IHA as they were not included in the proposed IHA. Under the following conditions L-DEO must implement shutdown:

- A marine mammal species, for which authorization was granted but the takes have been met, approaches the Level A or B harassment zones;
- A large whale with a calf or an aggregation of large whales is observed regardless of the distance from the *Langseth*;
- A melon-headed whale or group of melon-headed whales is observed in the range of the Kohala resident stock. This stock is found off the the Kohala Peninsula and west coast of Hawaii Island and at a depth of less than 2,500 m (Carretta *et al.* 2018). L-DEO will attempt to time their seismic operations along Trackline 1 so they will traverse the Kohala resident stock's range during daytime.
- A spinner or bottlenose dolphin or group of dolphins is observed approaching or is within the Level B harassment zone in the habitat of the specific MHI insular stock if the authorized takes have been met for any of these stocks.

When shutdown is called for by a PSO, the acoustic source will be immediately deactivated and any dispute resolved only following deactivation. Additionally, shutdown will occur whenever PAM alone (without visual sighting), confirms presence of marine mammal(s) in the EZ. If the acoustic PSO cannot confirm presence within the EZ, visual PSOs will be notified but shutdown is not required.

Following a shutdown, airgun activity would not resume until the marine mammal has cleared the 500 m EZ. The animal would be considered to have cleared the 500 m EZ if it is visually observed to have departed the 500 m EZ, or it has not been seen within the 500 m EZ for 15 min in the case of small odontocetes and pinnipeds, or 30 min in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales.

The shutdown requirement can be waived for small dolphins in which case the acoustic source shall be powered down to the single 40-in<sup>3</sup> airgun if an individual is visually detected within the exclusion zone. 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 would apply solely to specific genera of small dolphins including *Tursiops*, *Delphinus*, *Lagenodelphis*, *Lagenorhynchus*, *Lissodelphis*, *Stenella* and *Steno*. The acoustic source shall be powered down to 40-in<sup>3</sup> airgun if an individual belonging to these genera is visually detected within the 500 m exclusion zone. Note that when the acoustic source is powered down to the 40-in<sup>3</sup> airgun due to the presence of specified dolphins, a shutdown zone of 100 m and Level B harassment zone of 430 m will be in effect for species other than specified dolphin genera that may approach the survey vessel. This mitigation measure had not been included in the notice of proposed IHA.

Powerdown conditions shall be maintained until delphinids for which shutdown is waived are no longer observed within the 500 m exclusion zone, following which full-power operations may be resumed without ramp-up. Visual PSOs may elect to waive the powerdown requirement if delphinids for which shutdown is waived appear to be voluntarily approaching the vessel for the purpose of interacting with the vessel or towed gear, and may use best professional judgment in making this decision.

We include this small delphinoid exception because power-down/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 above, 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).

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 Langseth 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 power-down / 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 power-down / 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.

Visual PSOs shall use best professional judgment in making the decision to call for a shutdown if there is uncertainty regarding identification (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived or one of the species with a larger exclusion zone). If PSOs observe any behaviors in a small delphinid for which shutdown is waived that indicate an adverse reaction, then powerdown will be initiated immediately.

Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) has been observed exiting the applicable exclusion zone (i.e., animal is not required to fully exit the buffer zone where applicable) or following 15 minutes for small odontocetes and 30 minutes for all other species with no further observation of the marine mammal(s).

In the event of a live stranding (or near-shore atypical milling) event, L-DEO must adhere to recently established protocols, which were not contained in the proposed IHA. If the stranding event occurs within 50 km of the survey operations, where the NMFS stranding network is engaged in herding or other interventions to return animals to the water, the Director of OPR, NMFS (or designee) will advise the IHA-holder of the need to implement shutdown

procedures for all active acoustic sources operating within 50 km of the stranding. Shutdown procedures for live stranding or milling marine mammals include the following:

- If at any time, the marine mammal(s) die or are euthanized, or if herding/intervention efforts are stopped, the Director of OPR, NMFS (or designee) will advise the IHA-holder that the shutdown around the animals' location is no longer needed.
- Otherwise, shutdown procedures will remain in effect until the Director of OPR, NMFS (or designee) determines and advises the IHA-holder that all live animals involved have left the area (either of their own volition or following an intervention).
- If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the IHA-holder will be required to determine what measures are necessary to minimize that likelihood (*e.g.*, extending the shutdown or moving operations farther away) and to implement those measures as appropriate.

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

### **Vessel Strike Avoidance**

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

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

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

3. All vessels must maintain a minimum separation distance of 100 m from large whales (*i.e.*, sperm whales and all baleen whales).

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

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

gear.

We have carefully evaluated the suite of mitigation measures described here and considered a range of other measures in the context of ensuring that we prescribe the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Based on our evaluation of the planned 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 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).
  - Mitigation and monitoring effectiveness.

#### *Vessel-Based Visual Monitoring*

As described above, PSO observations would take place during daytime airgun operations and nighttime start ups (if applicable) of the airguns. During seismic operations, at least five visual PSOs would be based aboard the *Langseth*. Monitoring shall be conducted in accordance with the following requirements:

- The operator shall provide PSOs with bigeye binoculars (*e.g.*, 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.*, Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel.

- The operator will work with the selected third-party observer provider to ensure PSOs have all equipment (including backup equipment) needed to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals. (c) PSOs must have the following requirements and qualifications:
  - PSOs shall be independent, dedicated, trained visual and acoustic PSOs and must be employed by a third-party observer provider.
  - PSOs shall have no tasks other than to conduct observational effort (visual or acoustic), collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards),
  - PSOs shall have successfully completed an approved PSO training course appropriate for their designated task (visual or acoustic). Acoustic PSOs are required to complete specialized training for operating PAM systems and are encouraged to have familiarity with the vessel with which they will be working.
  - PSOs can act as acoustic or visual observers (but not at the same time) as long as they demonstrate that their training and experience are sufficient to perform the task at hand.
  - NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (i.e., experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

- NMFS shall have one week to approve PSOs from the time that the necessary information is submitted, after which PSOs meeting the minimum requirements shall automatically be considered approved.
- PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.
- PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics.
- The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver shall be submitted to NMFS and must include written justification. Requests shall be granted or denied (with justification) by NMFS within one week of receipt of submitted information. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored protected species surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

For data collection purposes, PSOs shall use standardized data collection forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior

before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source. If required mitigation was not implemented, PSOs should record a description of the circumstances. At a minimum, the following information must be recorded:

- Vessel names (source vessel and other vessels associated with survey) and call signs;
- PSO names and affiliations;
- Dates of departures and returns to port with port name;
- Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;
- Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;
- Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;
- Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions changed significantly), including BSS and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon;
- Factors that may have contributed to impaired observations during each PSO shift change or as needed as environmental conditions changed (*e.g.*, vessel traffic, equipment malfunctions); and
- Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any

other notes of significance (i.e., pre-clearance, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.).

The following information should be recorded upon visual observation of any protected species:

- Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
- PSO who sighted the animal;
- Time of sighting;
- Vessel location at time of sighting;
- Water depth;
- Direction of vessel's travel (compass direction);
- Direction of animal's travel relative to the vessel;
- Pace of the animal;
- Estimated distance to the animal and its heading relative to vessel at initial sighting;
- Identification of the animal (*e.g.*, genus/species, lowest possible taxonomic level, or unidentified) and the composition of the group if there is a mix of species;
- Estimated number of animals (high/low/best);
- Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
- Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

- Detailed behavior observations (*e.g.*, number of blows/ breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
- Animal's closest point of approach (CPA) and/or closest distance from any element of the acoustic source;
- Platform activity at time of sighting (*e.g.*, deploying, recovering, testing, shooting, data acquisition, other); and
- Description of any actions implemented in response to the sighting (*e.g.*, delays, shutdown, ramp-up) and time and location of the action.

If a marine mammal is detected while using the PAM system, the following information should be recorded:

- An acoustic encounter identification number, and whether the detection was linked with a visual sighting;
- Date and time when first and last heard;
- Types and nature of sounds heard (*e.g.*, clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal);
- Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

L-DEO will be required to shall submit a draft comprehensive report to NMFS on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of protected species near the activities, must provide full documentation of methods,

results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all protected species sightings (dates, times, locations, activities, associated survey activities). The report must 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. The report must also include geo-referenced time-stamped vessel tracklines for all time periods during which airguns were operating. Tracklines should include points recording any change in airgun status (*e.g.*, when the airguns began operating, when they were turned off, or when they changed from full array to single gun or vice versa). GIS files must be provided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates shall be referenced to the WGS84 geographic coordinate system. In addition to the report, all raw observational data must be made available to NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as described above and the IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

#### *Reporting Injured or Dead Marine Mammals*

NMFS has revised the standard protocols that apply when an injured or dead marine mammal is discovered and has included them here. These updated protocols were not described in the proposed IHA. In the event that personnel involved in survey activities covered by the authorization discover an injured or dead marine mammal, the IHA-holder shall report the

incident to the Office of Protected Resources (OPR), NMFS and to the NMFS Pacific Islands Regional Stranding Coordinator as soon as feasible. The report must include the following information:

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

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

- Status of all sound source use in the 48 hours preceding the estimated time of stranding and within 50 km of the discovery/notification of the stranding by NMFS; and
- If available, description of the behavior of any marine mammal(s) observed preceding (*i.e.*, within 48 hours and 50 km) and immediately after the discovery of the stranding.

Examples of circumstances that could trigger the additional information request include,

but are not limited to, the following:

- Atypical nearshore milling events of live cetaceans;
- Mass strandings of cetaceans (two or more individuals, not including cow/calf pairs);
- Beaked whale strandings;
- Necropsies with findings of pathologies that are unusual for the species or area; or
- Stranded animals with findings consistent with blast trauma.

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

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

- Time, date, and location (latitude/longitude) of the incident;
- Species identification (if known) or description of the animal(s) involved;
- Vessel's speed during and leading up to the incident;
- Vessel's course/heading and what operations were being conducted (if applicable);
- Status of all sound sources in use;
- Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

- Estimated size and length of animal that was struck;
- Description of the behavior of the marine mammal immediately preceding and following the strike;
- If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
- Estimated fate of the animal (*e.g.*, dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
- To the extent practicable, photographs or video footage of the animal(s).

### **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’ 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 species listed in Table 7 and 8, 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 would occur as a result of L-DEO's planned surveys, even in the absence of planned mitigation. As discussed in the *Potential Effects* section, non-auditory physical effects, stranding, and vessel strike are not expected to occur.

NMFS has authorized a limited number of instances of Level A harassment of 6 species and Level B harassment of 39 marine mammal species. However, we believe that any PTS incurred in marine mammals as a result of the activity would be in the form of only a small degree of PTS, not total deafness, and would be unlikely to affect the fitness of any individuals, because of the constant movement of both the *Langseth* and of the marine mammals in the project areas, 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). 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 areas; 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 relatively short duration (up to 24 days for Hawaii survey) and temporary nature of the disturbance as well as the availability of similar habitat and resources in the surrounding area, 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.

The activity is expected to impact a small percentage of all marine mammal stocks that would be affected by L-DEO's planned survey (less than 15 percent percent of all species, including those taken by both surveys). Additionally, the acoustic "footprint" of the planned surveys would be small relative to the ranges of the 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 planned survey area.

The required mitigation measures are expected to reduce the 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 power downs and/or 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 required mitigation will be effective in preventing at least some extent of potential PTS in marine mammals that may otherwise occur in the absence of the mitigation.

The ESA-listed marine mammal species under our jurisdiction that are likely to be taken by the planned surveys include the endangered sei, fin, blue, sperm, gray, North Pacific Right, Western North Pacific DPS humpback, and Main Hawaiian Islands Insular DPS false killer whale as well as the Hawaiian monk seal. We have authorized very small numbers of takes for these species relative to their population sizes. 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 the survey are not listed as threatened or endangered under the ESA. With the exception of the northern fur seal, none of the non-listed marine mammals for which we have authorized take are considered “depleted” or “strategic” by NMFS under the MMPA.

The tracklines of the Hawaii survey either traverse or are proximal to BIAs for 11 species that NMFS has authorized for take. Ten of the BIAs pertain to small and resident cetacean populations while a breeding BIA has been delineated for humpback whales. However, this designation is only applicable to humpback whales in the December through March timeframe (Baird *et al.*, 2015). Since the Hawaii survey is in September, there will be no effects on humpback whales. For cetacean species with small and resident BIAs in the Hawaii survey area, that designation is applicable year-round. There are up to 24 days of seismic operations planned

for the Hawaii survey. Only a portion of those days would involve seismic operations within BIA boundaries along Tracklines 1 and 2. Time spent in any single BIA during a trackline pass would be less than a day. No physical impacts to BIA habitat are anticipated from seismic activities. While SPLs of sufficient strength have been known to cause injury to fish and fish mortality, the most likely impact to prey species from survey activities would be temporary avoidance of the affected area. The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution and behavior is expected. Given the short operational seismic time near or traversing BIAs, as well as the ability of cetaceans and prey species to move away from acoustic sources, NMFS expects that there would be, at worst, minimal impacts to animals and habitat within the designated BIAs.

NMFS has included a number of mitigation and monitoring measures to reduce potential impacts to small and resident populations in the Main Hawaiian Islands. Given the small population and large recorded group sizes of Kohala resident melon-headed whales, L-DEO must shut down when a melon-headed whale or group of melon-headed whales is observed in the range of the Kohala resident stock. Furthermore, L-DEO will plan to time their seismic operations along Trackline 1 so they will traverse the Kohala resident stock's range during daytime. L-DEO will similarly plan to conduct daylight crossings of designated critical habitat for the Main Hawaiian Island insular false killer whale. Spinner and bottlenose dolphin stocks also have small and resident populations. Therefore, when a group of dolphins is observed approaching or is within the Level B harassment zone in the habitat of the specific MHI insular stock L-DEO must shut down if the authorized takes have been met for any of these stocks. Additional protective measures include mandatory shutdown when a large whale with a calf or an aggregation of large whales is observed regardless of the distance from the Langseth;

NMFS concludes that exposures to marine mammal species and stocks due to L-DEO's planned survey would result in only short-term (temporary and short in duration) effects to individuals exposed. Animals 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 that authorized take numbers will 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 marine mammal species or stocks through effects on annual rates of recruitment or survival:

- No mortality is anticipated or authorized;
- The planned activity is temporary and of relatively short duration;
- The anticipated impacts of the activity on marine mammals would primarily be temporary behavioral changes due to avoidance of the area around the survey vessel;
- The number of instances of PTS that may occur are expected to be limited. 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 survey to avoid exposure to sounds from the activity;
- The potential adverse effects on fish or invertebrate species that serve as prey species for marine mammals from the survey will be temporary and spatially limited;

- The required mitigation measures, including visual and acoustic monitoring, power-downs, and shutdowns, are expected to minimize potential impacts to marine mammals. Specific mitigation measures added to this final IHA include shutting down when a large whale with a calf or an aggregation of large whales is observed; shutting down when a melon-headed whale or group of melon-headed whales is observed in the range of the Kohala resident stock; shutting down when a spinner or bottlenose dolphin or group of dolphins approach the Level B harassment zone in the habitat of the specific MHI insular stock if the authorized takes have been met for any of these stocks; and timing surveys to traverse ranges of the Kohala resident stock of melon-headed whale and the Main Hawaiian Islands insular stock of false killer whales during daylight hours.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the required monitoring and mitigation measures, NMFS finds that the total marine mammal take from the planned 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; 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. Tables 7 and 8 provide numbers of authorized take by Level A harassment and Level B harassment. These are the numbers we use for purposes of the small numbers analysis.

The numbers of marine mammals for which we have authorized take across the two surveys would be considered small relative to the relevant populations (a maximum of 14.7 percent) for the species for which abundance estimates are available. Several small resident or insular populations that could experience Level B harassment during the Hawaii survey were discussed in the Estimated Take section. For the Kohala resident stock of melo-headed whales (pop. 447), NMFS assumed that up to 3 groups of 20 Kohala residents could be taken by Level B harassment, representing 13.4 percent of the Kohala stock, if they enter the zone undetected by PSOs. Additionally, the range of the Hawaiian Island stock overlaps the range of the Kohala resident stock. Therefore, any melon-headed whale takes within the Kohala resident stock's range could also be from either stock. Sesimic operations will occur in the ranges of the Hawaiian Island stock (pop. 128) and Oahu stock (pop. 743) of common bottlenose dolphins. Based on GIS analysis of the tracklines and the ranges of the stocks, NMFS determined that 7 percent of the Hawaii Island stock and 1.2 percent of the Oahu stock could be exposed to Level B harassment. Similar GIS analysis of the Hawaii Island (pop. 631) and Oahu/4-Island (pop. 355) stocks of spinner dolphins resulted in estimated Level B harassment of 3.8 percent of the Hawaii Islands stock population and 6.7 percent of the Oahu/4-Island stock population. Analysis of pantropical spotted dolphins determined that there would be 9 Oahu stock exposures and 82 Hawaii Island stock exposures. The populations of these stocks are unknown, so the percentage of stocks affected cannot be determined. However, the large ranges of these species (up to 20

km from Oahu and 65 km from Hawaii) make it likely that the survey would only impact limited numbers of these stocks.

Based on the analysis contained herein of the planned activity (including the required 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.

### **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 Endangered Species Act of 1973 (ESA: 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 issued a Biological Opinion on August 24, 2018 to NMFS's Office of Protected Resources which concluded that the specified activities are not likely to jeopardize the continued existence of the North Pacific right whale, sei whale, fin whale, blue whale, sperm whale, Western North Pacific DPS humpback whale, gray whale,

Hawaiian Islands Insular DPS false killer whale, and the Hawaiian monk seal or adversely modify critical habitat because none exists within the action area.

### **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 the proposed action (i.e., the issuance of regulations and an LOA) with respect to potential impacts on the human environment.

Accordingly, NMFS has adopted the L-DEO Final Environmental Assessment (EA), *Environmental Assessment/Analysis of Marine Geophysical Surveys by the R/V Marcus G. Langseth in the North Pacific Ocean, 2018/2019* and after an independent evaluation of the document found that it included adequate information analyzing the effects on the human environment of issuing incidental take authorizations. In August 2018, NMFS issued a Finding of No Significant Impact (FONSI).

### **Authorization**

As a result of these determinations, we have issued an IHA to L-DEO for conducting seismic surveys in the Pacific Ocean near the main Hawaiian Islands and the Emperor

Seamounts area from September 1, 2018 through August 31, 2019, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: August 27, 2018.

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