



**BILLING CODE 3510-22-P**

**DEPARTMENT OF COMMERCE**

**National Oceanic and Atmospheric Administration**

**RIN 0648-XG948**

**Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Marine Geophysical Surveys in the Northeast 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 (L-DEO) to incidentally harass, by Level A and Level B harassment, marine mammals during seismic activities associated with a marine geophysical survey in the Northeast Pacific Ocean.

**DATES:** This Authorization is effective from July 10, 2019 through July 9, 2020.

**FOR FURTHER INFORMATION CONTACT:** Amy Fowler, 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/permit/incidental-take-authorizations-under-marine-mammal-protection-act>*. 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 December 21, 2018, NMFS received a request from L-DEO for an IHA to take marine mammals incidental to a marine geophysical survey of the Axial Seamount in the Northeast Pacific Ocean. The application was deemed adequate and complete on May 3, 2019. L-DEO’s request is for take of a small number of 26 species of marine mammals by Level B harassment and Level A harassment. Neither L-DEO nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

## **Description of Specified Activity**

Researchers from the University of Texas at Austin, University of Nevada Reno, University of California San Diego, with funding from the U.S. National Science Foundation (NSF), plan to conduct high-energy seismic surveys from Research Vessel (R/V) *Marcus G. Langseth (Langseth)* in the Northeast Pacific Ocean during summer 2019. The NSF-owned *Langseth* is operated by Columbia University's L-DEO under an existing Cooperative Agreement. The planned two-dimensional (2-D) and three-dimensional (3-D) seismic surveys would occur in International Waters outside of the U.S. Exclusive Economic Zone (EEZ). The 2-D survey would use a 36-airgun towed array with a total discharge volume of ~6,600 cubic inches (in<sup>3</sup>); the 3-D survey would employ an 18-airgun array with a discharge volume of ~3,300 in<sup>3</sup>. The total survey duration would be approximately 35 days. A total of ~3,760 kilometers (km) of transect lines would be surveyed in the Northeast Pacific Ocean: ~3,196 km during the 3-D survey and 564 km during the 2-D survey.

A detailed description of the planned geophysical survey is provided in the **Federal Register** notice for the proposed IHA (84 FR 26940; June 10, 2019). Since that time, no changes have been made to the planned survey activities. Therefore, a detailed description is not provided here. Please refer to that **Federal Register** notice for the description of the specific activity.

## **Comments and Responses**

A notice of NMFS's proposal to issue an IHA to L-DEO was published in the **Federal Register** on June 10, 2019 (84 FR 26940). That notice described, in detail, L-DEO's activity, the marine mammal species that may be affected by the activity, and the anticipated effects on marine mammals. During the 30-day public comment period, NMFS received comments from the Marine Mammal Commission (Commission).

*Comment:* The Commission recommended that NMFS require L-DEO to re-estimate the proposed Level A and Level 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 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 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 (84 FR 26940; June 10, 2019) describe the applicant's approach to modeling Level A and Level B harassment zones. The model L-DEO 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, L-DEO 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, L-DEO 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, L-DEO 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). L-DEO used the deep-water radii obtained from model results down to a maximum water depth of 2,000 meters (m) (Figures 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 *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 L-DEO's modeled 180 decibel (dB) and 160 dB zones were approximately 28 percent and 33 percent larger, respectively, than the in-situ, site-specific measurements, thus confirming that L-DEO's model was conservative in that case.

The following is a summary of two additional analyses of in-situ data that support L-DEO's use of the modeled Level A and Level B harassment zones in this particular case. In 2010, L-DEO 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; 3,280.8 ft) (Diebold *et al.*, 2010). In 2012, L-DEO 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 *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 L-DEO'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 L-DEO'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 L-DEO to address the issue of incorporating site-specific information for future authorizations for seismic surveys. However, L-DEO'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 L-DEO'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 L-DEO'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.

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 prescribe specific model parameters nor a specific model for applicants as part of the MMPA incidental take authorization process at this time, although we do review methods to ensure they adequately predict 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 ocean bottom seismometers (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 for depths from shallow to deep. 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.

*Comment:* The Commission recommended that NMFS recalculate the densities (and thus, estimated take) of Guadalupe fur seals, northern fur seals, and northern elephant seals to include more recent data and population growth through 2019 rather than 2017.

*Response:* Through discussions with the Commission, NMFS has recalculated the densities of these species. The density of Guadalupe fur seals increased to 0.00343 animals per square kilometer ( $\text{km}^2$ ), the density of northern fur seals increased to 0.01065 animals per  $\text{km}^2$ , and the density of northern elephant seals increased to 0.03333 animals per  $\text{km}^2$ . Estimated take of these three species increased accordingly. Further detail regarding these changes is included in the Estimated Take section later in this document.

*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-reviewed 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 power downs to the single 40 in<sup>3</sup> airgun are only allowed/required in lieu of shutdown when certain species of dolphins, specifically identified in the *Mitigation* section below, 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 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 and further requires that L-DEO provide an estimate of take, including marine mammals that were not detected in their reporting for this survey, as it has in previous actions. NMFS welcomes L-DEO's input on a method to generate this quantitative method, but in the absence of a new procedure, recommends that use of the Commission's method for marine geophysical surveys, which was attached to the Commission's comment letter. We look forward to engaging further with L-DEO, the Commission and other applicants to refine methods to incorporate consideration of  $g(0)$  and  $f(0)$  values into post-survey take estimates.

*Comment:* The commission recommended that NMFS refrain from using the proposed renewal process for L-DEO's authorization based on the complexity of analysis and potential for impacts on marine mammals, and the potential burden on reviewers of reviewing key documents and developing comments quickly. Additionally, the Commission recommends that NMFS use the IHA renewal process sparingly and selectively for activities expected to have the lowest levels of impacts to marine mammals and that require less complex analysis.

*Response:* We appreciate the Commission's input and direct the reader to our recent response to the identical comment, which can be found at 84 FR 31032 (June 28, 2019), pg. 31035-31036

*Comment:* The Commission noted that the proposed surveys are scheduled to begin immediately after the public comment period closed and expressed concern that NMFS did not have adequate time to consider public comments before issuing the IHA. The Commission recommended NMFS more thoroughly review applications, draft **Federal Register** notices, and draft proposed authorizations prior to submitting any proposed authorizations to the **Federal**

**Register**, as well as require earlier submission of applications and other documentation to ensure sufficient time to prepare the proposed authorization and consider comments received from the public.

*Response:* NMFS thanks the Commission for its concerns regarding the IHA process. NMFS thoroughly reviewed the comments received and considered all comments in making appropriate revisions to the final IHA. NMFS encourages all applicants to submit applications for IHAs five to eight months in advance of the intended project start date and for rulemakings/LOAs at least nine months, and preferably 15 months, in advance of the intended project start date. More generally, NMFS publishes **Federal Register** notices for proposed IHAs as quickly as possible once the application is received and aims to allow more time on the back end of the comment period, but there are situations where the length of processing times are driven by the exigency of an applicant's activity start date or by the need to work with applicants to ensure we have the necessary information to deem an application adequate and complete. Here, NMFS provided the required 30-day notice for public comment, and has adequately considered the comments received in making the necessary findings for this IHA.

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

Sections 3 and 4 of the application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS's Stock Assessment Reports (SARs; <https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments>) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS's website (<https://www.fisheries.noaa.gov/find-species>).

Table 1 lists all species with expected potential for occurrence in the survey area and summarizes information related to the population or stock, including regulatory status under the MMPA and ESA and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2016). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS’s SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS’s stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS’s U.S. Pacific and Alaska SARs (Caretta *et al.*, 2018; Muto *et al.*, 2018). All values presented in Table 1 are the most recent available at the time of publication and are available in the 2017 SARs (Caretta *et al.*, 2018; Muto *et al.*, 2018) and draft 2018 SARs (available online at: <https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports>).

**Table 1. Marine Mammals That Could Occur in the Survey Area.**

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N) <sup>1</sup>	Stock abundance (CV, N <sub>min</sub> , most recent abundance survey) <sup>2</sup>	PBR	Annual M/SI <sup>3</sup>
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)						

Family Eschrichtiidae						
<i>Gray whale</i>	Eschrichtius robustus	Eastern North Pacific	-/-; N	26,960 (0.05, 25,849, 2016)	801	138
		Western North Pacific	E/D; Y	175 (0.05, 167, 2016)	0.07	Unknown
Family Balaenidae						
<i>North Pacific right whale</i>	Eubalaena japonica	Eastern North Pacific	E/D; Y	31 (0.226, 26, 2015)	0.05	0
Family Balaenopteridae (rorquals)						
Humpback whale	Megaptera novaeangliae	California/ Oregon/ Washington	-/-; Y	1,918 (0.03, 1,876, 2014)	11	> 9.2
Minke whale	Balaenoptera acutorostrata	California/ Oregon/ Washington	-/-; N	636 (0.72, 369, 2014)	3.5	> 1.3
Sei whale	Balaenoptera borealis	Eastern North Pacific	E/D; Y	519 (0.4, 374, 2014)	0.75	0
Fin whale	Balaenoptera physalus	California/ Oregon/ Washington	E/D; Y	9,029 (0.12, 8,127, 2014)	81	> 2.0
Blue whale	Balaenoptera musculus	Eastern North Pacific	E/D; Y	1,647 (0.07, 1,551, 2011)	2.3	> 0.2
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)						
Family Physteridae						
Sperm whale	Physeter macrocephalus	California/ Oregon/ Washington	E/D; Y	1,967 (0.57, 1,270, 2014)	2.5	0.9
Family Kogiidae						
Pygmy sperm whale	Kogia breviceps	California/ Oregon/ Washington	-/-; N	4,111 (1.12, 1,924, 2014)	19	0
Dwarf sperm whale	Kogia sima	California/ Oregon/ Washington	-/-; N	Unknown (Unknown, Unknown, 2014)	Undetermined	0
Family Ziphiidae (beaked whales)						
Cuvier's beaked whale	Ziphius cavirostris	California/ Oregon/ Washington	-/-; N	3,274 (0.67, 2,059, 2014)	21	< 0.1

Baird's beaked whale	<i>Berardius bairdii</i>	California/ Oregon/ Washington	-/-; N	2,697 (0.6, 1,633, 2014)	16	0
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	California/ Oregon/ Washington	-/-; N	3,044 (0.54, 1,967, 2014)	20	0.1
Hubbs' beaked whale	<i>Mesoplodon carlshubbi</i>					
Stejneger's beaked whale	<i>Mesoplodon stejnegeri</i>					
Family Delphinidae						
Bottlenose dolphin	<i>Tursiops truncatus</i>	California/ Oregon/ Washington offshore	-/-; N	1,924 (0.54, 1,255, 2014)	11	> 1.6
Striped dolphin	<i>Stenella coeruleoalba</i>	California/ Oregon/ Washington	-/-; N	29,211 (0.2, 24,782, 2014)	238	> 0.8
Short-beaked common dolphin	<i>Delphinus delphis</i>	California/ Oregon/ Washington	-/-; N	969,861 (0.17, 839,325, 2014)	8,393	> 40
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	California/ Oregon/ Washington	-/-; N	26,814 (0.28, 21,195, 2014)	191	7.5
Northern right whale dolphin	<i>Lissodelphis borealis</i>	California/ Oregon/ Washington	-/-; N	26,556 (0.44, 18,608, 2014)	179	3.8
Risso's dolphin	<i>Grampus griseus</i>	California/ Oregon/ Washington	-/-; N	6,336 (0.32, 4,817, 2014)	46	> 3.7
False killer whale	<i>Pseudorca crassidens</i>	Hawaii Pelagic	-/-; N	1,540 (0.66, 928, 2010)	9.3	7.6
Killer whale	<i>Orcinus orca</i>	Offshore	-/-; N	240 (0.49, 162, 2014)	1.6	0
		<i>Southern Resident</i>	E/D; Y	83 (N/A, 83, 2016)	0.14	0
		<i>Northern Resident</i>	-/-; N	261 (N/A, 261, 2011)	1.96	0
		West Coast Transient	-/-; N	243 (N/A, 243, 2009)	2.4	0
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	California/ Oregon/ Washington	-/-; N	836 (0.79, 466, 2014)	4.5	1.2

Family Phocoenidae (porpoises)						
<i>Harbor porpoise</i>	<i>Phocoena phocoena</i>	Northern Oregon/Washington Coast	-/-; N	21,487 (0.44, 15,123, 2011)	151	> 3.0
Dall's porpoise	<i>Phocoenoides dalli</i>	California/ Oregon/ Washington	-/-; N	25,750 (0.45, 17,954, 2014)	172	0.3
Order Carnivora – Superfamily Pinnipedia						
Family Otariidae (eared seals and sea lions)						
Northern fur seal	<i>Callorhinus ursinus</i>	Eastern Pacific	- /D; Y	620,660 (0.2, 525,333, 2016)	11,295	457
		California	- /D; N	14,050 (N/A, 7,524, 2013)	451	1.8
<i>California sea lion</i>	<i>Zalophus californianus</i>	U.S.	-/-; N	257,606 (N/A, 233,515, 2014)	14,011	> 197
<i>Steller sea lion</i>	<i>Eumetopias jubatus</i>	Eastern U.S.	-/-; N	41,638 (see SAR, 41,638, 2015)	2,498	108
Guadalupe fur seal	<i>Arctocephalus townsendi</i>	Mexico	T/D; Y	20,000 (N/A, 15,830, 2010)	542	> 3.2
Family Phocidae (earless seals)						
<i>Harbor seal</i>	<i>Phoca vitulina</i>	Oregon/Washington Coastal	-/-; N	Unknown (Unknown, Unknown, 1999)	Undetermined	10.6
Northern elephant seal	<i>Mirounga angustirostris</i>	California Breeding	-/-; N	179,000 (N/A, 81,368, 2010)	4,882	8.8

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. In some cases, CV is not applicable.

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.

NOTE - Italicized species are not expected or authorized to be taken.

All species that could potentially occur in the planned survey areas are included in Table 1. However, the temporal and/or spatial occurrence of gray whales, Southern Resident and Northern Resident killer whales, harbor porpoise, harbor seal, California sea lion, and Steller sea lion is such that take is not expected to occur, and they are not discussed further beyond the explanation provided here. These species are found in the eastern North Pacific, but are generally found in coastal waters and are not expected to occur offshore in the survey area.

A detailed description of the species likely to be affected by L-DEO's planned surveys, 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 (84 FR 26940; June 10, 2019). 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 the NMFS website (<https://www.fisheries.noaa.gov/find-species>) for generalized species accounts.

### *Marine Mammal Hearing*

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al.*, 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential

techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans).

Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 2.

**Table 2. Marine Mammal Hearing Groups (NMFS, 2018).**

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, <i>Kogia</i> , river dolphins, cephalorhynchid, <i>Lagenorhynchus cruciger</i> & <i>L. australis</i> )	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz
* Represents the generalized hearing range for the entire group as a composite ( <i>i.e.</i> , all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall <i>et al.</i> 2007) and PW pinniped (approximation).	

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.*, 2006; Kastelein *et al.*, 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. 26 marine mammal species (23 cetacean

and three pinniped (two otariid and one phocid) species) have the reasonable potential to co-occur with the planned survey activities. Please refer to Table 1. Of the cetacean species that may be present, five are classified as low-frequency cetaceans (*i.e.*, all mysticete species), 15 are classified as mid-frequency cetaceans (*i.e.*, all delphinid and ziphiid species and the sperm whale), and three are classified as high-frequency cetaceans (*i.e.*, harbor porpoise and *Kogia* spp.).

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

The effects of underwater noise from seismic airguns and other associated activities for the Northeast Pacific geophysical surveys have the potential to result in behavioral harassment and a small degree of permanent threshold shift (PTS) in marine mammals in the vicinity of the action area. The **Federal Register** notice for the proposed IHA (84 FR 26940; June 10, 2019) included a discussion of the effects of anthropogenic noise on marine mammals, therefore that information is not repeated here. Please refer to that **Federal Register** notice for that information.

The main impact associated with L-DEO's Northeast Pacific geophysical survey would be temporarily elevated sound levels and the associated direct effects on marine mammals. The project would not result in permanent impacts to habitats used directly by marine mammals, such as haulout sites, but may have potential short-term impacts to food sources such as forage fish or zooplankton during the geophysical survey. These potential effects are discussed in detail in the **Federal Register** notice for the proposed IHA (84 FR 26940; June 10, 2019), therefore that information is not repeated here. Please refer to that **Federal Register** notice for that information.

### **Estimated Take**

This section provides an estimate of the number of incidental takes authorized through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination. Based on input received during the public comment period, minor changes were made to the densities of three species of marine mammals (northern fur seal, Guadalupe fur seal, and northern elephant seal) and the number of Level A takes for sei whales. Takes of these species have been adjusted accordingly, but these changes do not affect any of our findings.

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 cetaceans, otariid pinnipeds, and phocid pinnipeds given very small modeled zones of injury for those species (up to 43.7 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.

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

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

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

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

where  $f$  is the frequency of the sound signal and  $v$  is the speed of the sound in the medium of

interest, one can rewrite the equation for  $D$  as:

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

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

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

If the largest distance to the peak sound pressure level threshold was equal to or less than the longest dimension of the array (*i.e.*, under the array), or within the near-field, then received levels that meet or exceed the threshold in most cases are not expected to occur. This is because within the near-field and within the dimensions of the array, the source levels specified in Table 1 are overestimated and not applicable. In fact, until one reaches a distance of approximately three or four times the near-field distance the average intensity of sound at any given distance from the array is still less than that based on calculations that assume a directional point source (Lurton, 2002). The 6,600 in<sup>3</sup> airgun array used in the 2D survey has an approximate diagonal of 28.8 m, resulting in a near-field distance of 138.7 m at 1 kHz (NSF and USGS, 2011). Field measurements of this array indicate that the source behaves like multiple discrete sources, rather

than a directional point source, beginning at approximately 400 m (deep site) to 1 km (shallow site) from the center of the array (Tolstoy *et al.*, 2009), distances that are actually greater than four times the calculated 140-m near-field distance. Within these distances, the recorded received levels were always lower than would be predicted based on calculations that assume a directional point source, and increasingly so as one moves closer towards the array (Tolstoy *et al.*, 2009). Similarly, the 3,300 in<sup>3</sup> airgun array used in the 3D survey has an approximate diagonal of 17.9 m, resulting in a near-field distance of 53.5 m at 1 kHz (NSF and USGS, 2011). Given this, relying on the calculated distances (138.7 m for the 2D survey and 53.5 m for the 3D survey) as the distances at which we expect to be in the near-field is a conservative approach since even beyond this distance the acoustic modeling still overestimates the actual received level. Within the near-field, in order to explicitly evaluate the likelihood of exceeding any particular acoustic threshold, one would need to consider the exact position of the animal, its relationship to individual array elements, and how the individual acoustic sources propagate and their acoustic fields interact. Given that within the near-field and dimensions of the array source levels would be below those in Table 5, we believe exceedance of the peak pressure threshold would only be possible under highly unlikely circumstances.

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

As described previously, no mortality is anticipated or authorized for this activity. Below we describe how the take is estimated.

Generally speaking, 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) the number of days of activities. We note that while these basic factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.*, previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the authorized take.

#### *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 what the available science indicates 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 Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 micropascal ( $\mu\text{Pa}$ ) (root mean square (rms)) for continuous (*e.g.*, vibratory pile-driving, drilling) and above 160 dB re 1  $\mu\text{Pa}$  (rms) for non-explosive impulsive (*e.g.*, seismic airguns) or intermittent (*e.g.*, scientific sonar) sources. L-DEO's planned activity includes the use of impulsive seismic sources. Therefore, the 160 dB re 1  $\mu\text{Pa}$  (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 (Version 2.0) (Technical Guidance, 2018) 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. L-DEO's planned seismic survey includes the use of impulsive (seismic airguns) sources.

These thresholds are provided in the table below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at <https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance>.

**Table 3. Thresholds identifying the onset of Permanent Threshold Shift.**

Hearing Group	PTS Onset Acoustic Thresholds* (Received Level)	
	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	<i>Cell 1</i> $L_{pk,flat}$ : 219 dB $L_{E,LF,24h}$ : 183 dB	<i>Cell 2</i> $L_{E,LF,24h}$ : 199 dB

<b>Mid-Frequency (MF) Cetaceans</b>	<i>Cell 3</i> $L_{pk,flat}$ : 230 dB $L_{E,MF,24h}$ : 185 dB	<i>Cell 4</i> $L_{E,MF,24h}$ : 198 dB
<b>High-Frequency (HF) Cetaceans</b>	<i>Cell 5</i> $L_{pk,flat}$ : 202 dB $L_{E,HF,24h}$ : 155 dB	<i>Cell 6</i> $L_{E,HF,24h}$ : 173 dB
<b>Phocid Pinnipeds (PW) (Underwater)</b>	<i>Cell 7</i> $L_{pk,flat}$ : 218 dB $L_{E,PW,24h}$ : 185 dB	<i>Cell 8</i> $L_{E,PW,24h}$ : 201 dB
<b>Otariid Pinnipeds (OW) (Underwater)</b>	<i>Cell 9</i> $L_{pk,flat}$ : 232 dB $L_{E,OW,24h}$ : 203 dB	<i>Cell 10</i> $L_{E,OW,24h}$ : 219 dB
<p>* 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.</p> <p><u>Note:</u> Peak sound pressure (<math>L_{pk}</math>) has a reference value of 1 <math>\mu</math>Pa, and cumulative sound exposure level (<math>L_E</math>) has a reference value of 1 <math>\mu</math>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>i.e.</i>, 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.</p>		

### *Ensonified Area*

Here, we describe operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds, which include source levels and transmission loss coefficient.

The planned 3D survey would acquire data with the 18-airgun array with a total discharge of 3,300 in<sup>3</sup> towed at a depth of 10 m. The planned 2D survey would acquire data using 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 18-airgun array, 36-airgun array, and 40-in<sup>3</sup> airgun 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 1600 m), intermediate water depth on the slope (approximately 600–1100 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 Gulf of Mexico 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* 18-airgun array, 36-airgun array, and single 40-in<sup>3</sup> airgun are shown in Table 4.

**Table 4. Predicted Radial Distances from R/V *Langseth* Seismic Sources to Isopleths Corresponding to Level B Harassment Threshold.**

Source and volume	Tow depth (m)	Distance (m) <sup>a</sup>
Single Bolt airgun (40 in <sup>3</sup> )	12	431
2 strings, 18 airguns (3,300 in <sup>3</sup> )	10	3,758
4 strings, 36 airguns (6,600 in <sup>3</sup> )	12	6,733

<sup>a</sup> Distance based on L-DEO model results

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  $SEL_{cum}$  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  $SEL_{cum}$  metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group. In recognition of the fact that the requirement to calculate Level A harassment ensonified areas could be more technically challenging to predict due to the duration component and the use of weighting functions in the new  $SEL_{cum}$  thresholds, NMFS developed an optional User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to facilitate the estimation of take numbers.

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

constructively, as they do for the theoretical farfield signature. The pulses from the different airguns spread out in time such that the source levels observed or modeled are the result of the summation of pulses from a few airguns, not the full array (Tolstoy *et al.* 2009). At larger distances, away from the source array center, sound pressure of all the airguns in the array stack coherently, but not within one time sample, resulting in smaller source levels (a few dB) than the source level derived from the farfield signature. Because the farfield signature does not take into account the 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.

For a more complete explanation of this modeling approach, please see “Appendix A: Determination of Mitigation Zones” in the IHA application.

**Table 5: Modeled Source Levels Based on Modified Farfield Signature for the R/V Langseth 3,300 in<sup>3</sup> Airgun Array, 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)
<b>3,300 in<sup>3</sup> airgun array (Peak <math>SPL_{flat}</math>)</b>	245.29	250.97	243.61	246.00	251.92
<b>3,300 in<sup>3</sup> airgun array (<math>SEL_{cum}</math>)</b>	226.38	226.33	226.66	226.33	227.07
<b>6,600 in<sup>3</sup> airgun array (Peak <math>SPL_{flat}</math>)</b>	252.06	252.65	253.24	252.25	252.52
<b>6,600 in<sup>3</sup> airgun</b>	232.98	232.84	233.10	232.84	232.08

array (SEL <sub>cum</sub> )					
40 in <sup>3</sup> airgun (Peak SPL <sub>flat</sub> )	223.93	224.09	223.92	223.95	223.95
40 in <sup>3</sup> airgun (SEL <sub>cum</sub> )	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 (μPa) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within the User Spreadsheet (*i.e.*, to override the Spreadsheet’s more simple weighting factor adjustment). Using the User Spreadsheet’s “safe distance” methodology for mobile sources (described by Sivle *et al.*, 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation and source velocities and shot intervals specific to each of the three planned surveys provided in the IHA application, potential radial distances to auditory injury zones were then calculated for SEL<sub>cum</sub> 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 18-airgun array, 36-airgun array, and single 40 in<sup>3</sup> airgun for the surveys are shown in Tables A-3, A-6, and A-10 in Appendix A of the IHA application. Outputs from the User Spreadsheets in the form of estimated distances to Level A harassment isopleths for the surveys are shown in Table 6. As described above, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the dual metrics (SEL<sub>cum</sub> and Peak SPL<sub>flat</sub>) is exceeded (*i.e.*, metric resulting in the largest isopleth).

**Table 6. Modeled Radial Distances (m) to Isopleths Corresponding to Level A Harassment Thresholds.**

Source and volume		LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	Otariid pinnipeds
Single Bolt airgun (40 in <sup>3</sup> ) <sup>a</sup>	PTS SEL <sub>cum</sub>	0.5	0	0	0	0
	PTS Peak	1.76	0.51	12.5	1.98	0.4
2 strings, 18 airguns (3300 in <sup>3</sup> )	PTS SEL <sub>cum</sub>	75.6	0	0.3	2.9	0
	PTS Peak	23.2	11.8	118.7	25.1	9.9
4 strings, 36 airguns (6600 in <sup>3</sup> )	PTS SEL <sub>cum</sub>	426.9	0	1.3	13.9	0
	PTS Peak	38.9	13.6	268.3	43.7	10.6

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.

In developing their IHA application, L-DEO utilized estimates of cetacean densities in the survey area synthesized by Barlow (2016). Observations from NMFS Southwest Fisheries Science Center (SWFSC) ship surveys off of Oregon and Washington (up to 556 km from shore) between 1991 and 2014 were pooled. Systematic, offshore, at-sea survey data for pinnipeds are more limited. To calculate pinniped densities in the survey area, L-DEO utilized methods

described in U.S. Navy (2010) which calculated density estimates for pinnipeds off Washington at different times of the year using information on breeding and migration, population estimates from shore counts, and areas used by different species while at sea. The densities calculated by the Navy were updated by L-DEO using stock abundances presented in the latest SARs (*e.g.*, Caretta *et al.*, 2018).

While the IHA application was in review by NMFS, the U.S. Navy published the Marine Species Density Database Phase III for the Northwest Training and Testing (NWTT) Study Area (Navy 2018). The planned geophysical survey area is located near the western boundary of the defined NWTT Offshore Study Area.

For several cetacean species, the Navy updated densities estimated by line-transect surveys or mark-recapture studies (*e.g.*, Barlow 2016). These methods usually produce a single value for density that is an averaged estimate across very large geographical areas, such as waters within the U.S. EEZ off California, Oregon, and Washington (referred to as a “uniform” density estimate). This is the general approach applied in estimating cetacean abundance in the NMFS stock assessment reports. The disadvantage of these methods is that they do not provide information on varied concentrations of species in sub-regions of very large areas, and do not estimate density for other seasons or timeframes that were not surveyed. More recently, a newer method called spatial habitat modeling has been used to estimate cetacean densities that address some of these shortcomings (*e.g.*, Barlow *et al.*, 2009; Becker *et al.*, 2010; 2012a; 2014; Becker *et al.*, 2016; Ferguson *et al.*, 2006; Forney *et al.*, 2012; 2015; Redfern *et al.*, 2006). (Note that spatial habitat models are also referred to as “species distribution models” or “habitat-based density models.”) These models estimate density as a continuous function of habitat variables (*e.g.*, sea surface temperature, seafloor depth) and thus, within the study area that was modeled,

densities can be predicted at all locations where these habitat variables can be measured or estimated. Spatial habitat models therefore allow estimates of cetacean densities on finer scales than traditional line-transect or mark-recapture analyses.

The methods used to estimate pinniped at-sea densities are typically different than those used for cetaceans, because pinnipeds are not limited to the water and spend a significant amount of time on land (*e.g.*, at rookeries). Pinniped abundance is generally estimated via shore counts of animals on land at known haulout sites or by counting number of pups weaned at rookeries and applying a correction factor to estimate the abundance of the population (for example Harvey *et al.*, 1990; Jeffries *et al.*, 2003; Lowry, 2002; Sepulveda *et al.*, 2009). Estimating in-water densities from land-based counts is difficult given the variability in foraging ranges, migration, and haulout behavior between species and within each species, and is driven by factors such as age class, sex class, breeding cycles, and seasonal variation. Data such as age class, sex class, and seasonal variation are often used in conjunction with abundance estimates from known haulout sites to assign an in-water abundance estimate for a given area. The total abundance divided by the area of the region provides a representative in-water density estimate for each species in a different location, which enables analyses of in-water stressors resulting from at-sea Navy testing or training activities. In addition to using shore counts to estimate pinniped density, traditional line-transect derived estimates are also used, particularly in open ocean areas.

Because the Navy's density calculations for many species included spatial habitat modeling and demographic information, we utilized the Navy Marine Species Density Database (NMSDD) to estimate densities and resulting take of marine mammals from the planned geophysical survey. Where available, the appropriate seasonal density estimate from the

NMSDD was used in the estimation here (*i.e.*, summer). For species with a quantitative density range within or around the planned survey area, the maximum presented density was conservatively used. Background information on the density calculations for each species/guild as well as reported sightings in nearby waters are reported here. Density estimates for each species/guild are found in Table 7.

#### Humpback Whale

NMFS SWFSC developed a CCE habitat-based density model for humpback whales which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Six humpback whale sightings (8 animals) were made off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey; all were well inshore of the planned survey area (RPS 2012b). There were 98 humpback whale sightings (213 animals) made during the July 2012 L-DEO seismic survey off southern Washington, northeast of the planned survey area (RPS 2012a), and 11 sightings (23 animals) during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c). No sightings were made near the planned survey area in the 2014 NMFS Southwest Fisheries Science Center (SWFSC) California Current Ecosystem (CCE) vessel survey (Barlow 2016).

#### Minke Whale

Density values for minke whales are available for the SWFSC Oregon/Washington and Northern California offshore strata for summer/fall (Barlow, 2016). Density data are not

available for the NWTT Offshore area northwest of the SWFSC strata, so data from the SWFSC Oregon/Washington stratum were used as representative estimates.

Sightings have been made off Oregon and Washington in shelf and deeper waters (Green *et al.* 1992; Adams *et al.* 2014; Carretta *et al.* 2017). An estimated abundance of 211 minke whales was reported for the Oregon/Washington region based on sightings data from 1991–2005 (Barlow and Forney 2007), whereas a 2008 survey did not record any minke whales while on survey effort (Barlow 2010). The abundance for Oregon/Washington for 2014 was estimated at 507 minke whales (Barlow 2016). There were no sightings of minke whales off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey or during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012b,c). One minke whale was seen during the July 2012 L-DEO seismic survey off southern Washington, north of the planned survey area (RPS 2012a). No sightings of minke whales were made near the planned survey area during the 2014 SWFSC CCE vessel survey (Barlow 2016).

#### Sei Whale

Density values for sei whales are available for the SWFSC Oregon/Washington and Northern California offshore strata for summer/fall (Barlow, 2016). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so data from the SWFSC Oregon/Washington stratum were used as representative estimates.

Sei whales are rare in the waters off California, Oregon, and Washington (Brueggeman *et al.* 1990; Green *et al.* 1992; Barlow 1994, 1997). Only 16 confirmed sightings were reported for California, Oregon, and Washington during extensive surveys from 1991–2014 (Green *et al.* 1992, 1993; Hill and Barlow 1992; Carretta and Forney 1993; Mangels and Gerrodette 1994;

Von Saunder and Barlow 1999; Barlow 2003; Forney 2007; Barlow 2010; Carretta *et al.* 2017). Based on surveys conducted in 1991–2008, the estimated abundance of sei whales off the coasts of Oregon and Washington was 52 (Barlow 2010); for 2014, the abundance estimate was 468 (Barlow 2016). Two sightings of four individuals were made during the June–July 2012 L-DEO Juan de Fuca plate seismic survey off Washington/Oregon (RPS 2012b); these were well inshore of the planned survey area (~125° W). No sei whales were sighted during the July 2012 L-DEO seismic surveys north and south of the planned survey area (RPS 2012a,c).

#### Fin Whale

NMFS SWFSC developed a CCE habitat-based density model for fin whales which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Fin whales are routinely sighted during surveys off Oregon and Washington (Barlow and Forney 2007; Barlow 2010; Adams *et al.* 2014; Calambokidis *et al.* 2015; Edwards *et al.* 2015; Carretta *et al.* 2017), including in coastal as well as offshore waters. They have also been detected acoustically near the planned study area during June–August (Edwards *et al.* 2015). There is one sighting of a fin whale in the Ocean Biogeographic Information System (OBIS) database within the planned survey area, which was made in August 2005 during the SWFSC Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (CSCAPE) Marine Mammal Survey, and several other sightings in adjacent waters (OBIS 2018). Eight fin whale sightings (19 animals) were made off Washington/Oregon during the June–July 2012 L-DEO

Juan de Fuca plate seismic survey, including two sightings (4 animals) in the vicinity of the planned survey area; sightings were made in waters 2369–3940 m deep (RPS 2012b). Fourteen fin whale sightings (28 animals) were made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). No fin whales were sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c). Fin whales were also seen off southern Oregon during July 2012 in water >2000 m deep during surveys by Adams *et al.* (2014).

#### Blue Whale

NMFS SWFSC developed a CCE habitat-based density model for blue whales which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

The nearest sighting of blue whales is ~55 km to the southwest (OBIS 2018), and there are several other sightings in adjacent waters (Carretta *et al.* 2018; OBIS 2018). Satellite telemetry suggests that blue whales are present in waters offshore of Oregon and Washington during fall and winter (Bailey *et al.* 2009; Hazen *et al.* 2017).

#### Sperm Whale

NMFS SWFSC developed a CCE habitat-based density model for sperm whales which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based

density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

There is one sighting of a sperm whale in the vicinity of the survey area in the OBIS database that was made in July 1996 during the SWFSC ORCAWALE Marine Mammal Survey (OBIS 2018), and several other sightings in adjacent waters (Carretta *et al.* 2018; OBIS 2018). Sperm whale sightings were also made in the vicinity of the planned survey area during the 2014 SWFSC vessel survey (Barlow 2016). A single sperm whale was sighted during the 2009 ETOMO survey, north of the planned survey area (Holst 2017). Sperm whales were detected acoustically in waters near the planned survey area in August 2016 during the SWFSC Passive Acoustics Survey of Cetacean Abundance Levels (PASCAL) study using drifting acoustic recorders (Keating *et al.* 2018).

#### Pygmy and Dwarf Sperm Whales (*Kogia* guild)

*Kogia* species are treated as a guild off the U.S. West Coast (Barlow & Forney, 2007). Barlow (2016) provided stratified density estimates for *Kogia* spp. for waters off California, Oregon, and Washington; these were used for all seasons for both the Northern California and Oregon/Washington strata. In the absence of other data, the Barlow (2016) Oregon/Washington estimate was also used for the area northwest of the SWFSC strata for all seasons.

Pygmy and dwarf sperm whales are rarely sighted off Oregon and Washington, with only one sighting of an unidentified *Kogia* sp. beyond the U.S. EEZ, during the 1991–2014 NOAA vessel surveys (Carretta *et al.* 2017). This sighting was made in October 1993 during the SWFSC PODS Marine Mammal Survey ~150 km to the south of the planned survey area (OBIS 2018). Norman *et al.* (2004) reported eight confirmed stranding records of pygmy sperm whales for Oregon and Washington, five of which occurred during autumn and winter.

## Baird's Beaked Whale

NMFS SWFSC developed a CCE habitat-based density model for Baird's beaked whale which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Green *et al.* (1992) sighted five groups during 75,050 km of aerial survey effort in 1989–1990 off Washington/Oregon spanning coastal to offshore waters: two in slope waters and three in offshore waters. Two groups were sighted during summer/fall 2008 surveys off Washington/Oregon, in waters >2000 m deep (Barlow 2010). Acoustic monitoring offshore Washington detected Baird's beaked whale pulses during January through November 2011, with peaks in February and July (Širović *et al.* 2012b *in* USN 2015). Baird's beaked whales were detected acoustically near the planned survey area in August 2016 during the SWFSC PASCAL study using drifting acoustic recorders (Keating *et al.* 2018). There is one sighting of a Baird's beaked whale near the survey area in the OBIS database that was made in August 2005 during the SWFSC CSCAPE Marine Mammal Survey (OBIS 2018).

## Small Beaked Whale Guild

NMFS has developed habitat-based density models for a small beaked whale guild in the CCE (Becker *et al.*, 2012b; Forney *et al.*, 2012). The small beaked whale guild includes Cuvier's beaked whale and beaked whales of the genus *Mesoplodon*, including Blainville's beaked whale, Hubbs' beaked whale, and Stejneger's beaked whale. NMFS SWFSC developed a CCE habitat-based density model for the small beaked whale guild which provides spatially explicit density

estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Four beaked whale sightings were reported in water depths >2000 m off Oregon/Washington during surveys in 2008 (Barlow 2010). None were seen in 1996 or 2001 (Barlow 2003), and several were recorded from 1991 to 1995 (Barlow 1997). One Cuvier's beaked whale sighting was made east of the planned survey area during 2014 (Barlow 2016). Acoustic monitoring in Washington offshore waters detected Cuvier's beaked whale pulses between January and November 2011 (Širović *et al.* 2012b *in* USN 2015). There is one sighting of a Cuvier's beaked whale near the planned survey area in the OBIS database that was made in July 1996 during the SWFSC ORCAWALE Marine Mammal Survey (OBIS 2018), and several other sightings were made in adjacent waters, primarily to the south and east of the planned survey area (Carretta *et al.* 2018; OBIS 2018). Cuvier's beaked whales were detected acoustically in waters near the planned survey area in August 2016 during the SWFSC PASCAL study using drifting acoustic recorders (Keating *et al.* 2018).

There are no sightings of Blainville's beaked whales near the planned survey area in the OBIS database (OBIS 2018). There is one sighting of an unidentified species of Mesoplodont whale near the survey area in the OBIS database that was made in July 1996 during the SWFSC ORCAWALE Marine Mammal Survey (OBIS 2018). There was one acoustic encounter with Blainville's beaked whales recorded in Quinault Canyon off Washington in waters 1400 m deep during 2011 (Baumann-Pickering *et al.* 2014). Blainville's beaked whales were not detected

acoustically in waters near the planned survey area in August 2016 during the SWFSC PASCAL study using drifting acoustic recorders (Keating *et al.* 2018). Although Blainville's beaked whales could be encountered during the planned survey, an encounter would be unlikely because the planned survey area is beyond the northern limits of this tropical species' usual distribution.

Stejneger's beaked whale calls were detected during acoustic monitoring offshore Washington between January and June 2011, with an absence of calls from mid-July to November 2011 (Širović *et al.* 2012b in USN 2015). Analysis of these data suggest that this species could be more than twice as prevalent in this area than Baird's beaked whale (Baumann-Pickering *et al.* 2014). Stejneger's beaked whales were also detected acoustically in waters near the planned survey area in August 2016 during the SWFSC PASCAL study using drifting acoustic recorders (Keating *et al.* 2018). There are no sightings of Stejneger's beaked whales near the planned survey area in the OBIS database (OBIS 2018). There is one sighting of an unidentified species of *Mesoplodont* beaked whale near the survey area in the OBIS database that was made during July 1996 during the SWFSC ORCAWALE Marine Mammal Survey (OBIS 2018).

Baird's beaked whale is sometimes seen close to shore where deep water approaches the coast, but its primary habitat is over or near the continental slope and oceanic seamounts (Jefferson *et al.* 2015). Along the U.S. West Coast, Baird's beaked whales have been sighted primarily along the continental slope (Green *et al.* 1992; Becker *et al.* 2012; Carretta *et al.* 2018) from late spring to early fall (Green *et al.* 1992). The whales move out from those areas in winter (Reyes 1991). In the eastern North Pacific Ocean, Baird's beaked whales apparently spend the winter and spring far offshore, and in June, they move onto the continental slope, where peak numbers occur during September and October. Green *et al.* (1992) noted that Baird's beaked

whales on the U.S. West Coast were most abundant in the summer, and were not sighted in the fall or winter. MacLeod *et al.* (2006) reported numerous sightings and strandings of *Berardius* spp. off the U.S. West Coast.

#### Bottlenose Dolphin

During surveys off the U.S. West Coast, offshore bottlenose dolphins were generally found at distances greater than 1.86 miles (3 km) from the coast and were most abundant off southern California (Barlow, 2010, 2016). Based on sighting data collected by SWFSC during systematic surveys in the Northeast Pacific between 1986 and 2005, there were few sightings of offshore bottlenose dolphins north of about 40° N (Hamilton *et al.*, 2009). NMFS SWFSC developed a CCE habitat-based density model for bottlenose dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Bottlenose dolphins occur frequently off the coast of California, and sightings have been made as far north as 41°N, but few records exist for Oregon/Washington (Carretta *et al.* 2017). Three sightings and one stranding of bottlenose dolphins have been documented in Puget Sound since 2004 (Cascadia Research 2011 *in* USN 2015). It is possible that offshore bottlenose dolphins may range as far north as the planned survey area during warm-water periods (Carretta *et al.* 2017). Adams *et al.* (2014) made one sighting off Washington during September 2012. There are no sightings of bottlenose dolphins near the planned survey area in the OBIS database (OBIS 2018).

## Striped Dolphin

Striped dolphin encounters increase in deep, relatively warmer waters off the U.S. West Coast, and their abundance decreases north of about 42°N (Barlow *et al.*, 2009; Becker *et al.*, 2012b; Becker *et al.*, 2016; Forney *et al.*, 2012). Although striped dolphins typically do not occur north of California, there are a few sighting records off Oregon and Washington (Barlow, 2003, 2010; Von Sauner & Barlow, 1999), and multiple sightings in 2014 when water temperatures were anomalously warm (Barlow, 2016). NMFS SWFSC developed a CCE habitat-based density model for striped dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Striped dolphins regularly occur off California (Becker *et al.* 2012), where they have been seen as far as the ~300 n.mi. limit during the NOAA Fisheries vessel surveys (Carretta *et al.* 2017). Strandings have occurred along the coasts of Oregon and Washington (Carretta *et al.* 2016). During surveys off the U.S. West Coast in 2014, striped dolphins were seen as far north as 44° N (Barlow 2016).

## Short-beaked Common Dolphin

Short-beaked common dolphins are found off the U.S. West Coast throughout the year, distributed between the coast and at least 345 miles (556 km) from shore (Barlow, 2010; Becker *et al.*, 2017; Carretta *et al.*, 2017b). The short-beaked common dolphin is the most abundant cetacean species off California (Barlow, 2016; Carretta *et al.*, 2017b; Forney *et al.*, 1995);

however, their abundance decreases dramatically north of about 40° N (Barlow *et al.*, 2009; Becker *et al.*, 2012c; Becker *et al.*, 2016; Forney *et al.*, 2012). Short-beaked common dolphins are occasionally sighted in waters off Oregon and Washington, and one group of approximately 40 short-beaked common dolphins was sighted off northern Washington in 2005 at about 48° N (Forney, 2007), and multiple groups were sighted as far north as 44° N during anomalously warm conditions in 2014 (Barlow, 2016). NMFS SWFSC developed a CCE habitat-based density model for short-beaked common dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

There are no sightings of short-beaked dolphins near the planned survey area in the OBIS database (OBIS 2018).

#### Pacific White-sided Dolphin

Pacific white-sided dolphins occur year-round in the offshore region of the NWTT Study Area, with increased abundance in the summer/fall (Barlow, 2010; Forney & Barlow, 1998; Oleson *et al.*, 2009). NMFS SWFSC developed a CCE habitat-based density model for Pacific white-sided dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were

interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Fifteen Pacific white-sided dolphin sightings (231 animals) were made off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey; none were near the planned survey area (RPS 2012b). There were fifteen Pacific white-sided dolphin sightings (462 animals) made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c). One group of 10 Pacific white-sided dolphins was sighted during the 2009 ETOMO survey north of the planned survey area (Holst 2017).

#### Northern Right Whale Dolphin

Survey data suggest that, at least in the eastern North Pacific, seasonal inshore-offshore and north-south movements are related to prey availability, with peak abundance in the Southern California Bight during winter and distribution shifting northward into Oregon and Washington as water temperatures increase during late spring and summer (Barlow, 1995; Becker *et al.*, 2014; Forney *et al.*, 1995; Forney & Barlow, 1998; Leatherwood & Walker, 1979). NMFS SWFSC developed a CCE habitat-based density model for northern right whale dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Seven northern right whale dolphin sightings (231 animals) were made off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey; none were seen near the planned survey area (RPS 2012b). There were eight northern right whale dolphin sightings (278 animals) made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c).

#### Risso's Dolphin

NMFS SWFSC developed a CCE habitat-based density model for Risso's dolphins which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Two sightings of 38 individuals were recorded off Washington from August 2004 to September 2008 (Olson *et al.* 2009). Risso's dolphins were sighted off Oregon, in June and October 2011 (Adams *et al.* 2014). There were three Risso's dolphin sightings (31 animals) made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c), or off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey (RPS 2012b).

#### False Killer Whale

False killer whales were not included in the NMSDD, as they are very rarely encountered in the northeast Pacific. Density estimates for false killer whales were also not presented in Barlow (2016), as no sightings occurred during surveys conducted between 1986 and 2008 (Ferguson and Barlow 2001, 2003; Forney 2007; Barlow 2003, 2010). One sighting was made off of southern California during 2014 (Barlow 2016). There are no sightings of false killer whales near the survey area in the OBIS database (OBIS 2018).

#### Killer Whale

Due to the difficulties associated with reliably distinguishing the different stocks of killer whales from at-sea sightings, density estimates for the Offshore region of the NWTT Study Area are presented for the species as a whole (*i.e.*, includes the Offshore, West Coast Transient, Northern Resident, and Southern Resident stocks). Density values for killer whales are available for the SWFSC Oregon/Washington and Northern California offshore strata for summer/fall (Barlow, 2016). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so data from the SWFSC Oregon/Washington stratum were used as representative estimates. These values were used to represent density year-round.

Eleven sightings of ~536 individuals were reported off Oregon/Washington during the 2008 SWFSC vessel survey (Barlow 2010). Killer whales were sighted offshore Washington during surveys from August 2004 to September 2008 (Oleson *et al.* 2009). Keating *et al.* (2015) analyzed cetacean whistles from recordings made during 2000–2012; several killer whale acoustic detections were made offshore Washington.

#### Short-finned Pilot Whale

Along the U.S. West Coast, short-finned pilot whales were once common south of Point Conception, California (Carretta *et al.*, 2017b; Reilly & Shane, 1986), but now sightings off the

U.S. West Coast are infrequent and typically occur during warm water years (Carretta *et al.*, 2017b). Stranding records for this species from Oregon and Washington waters are considered to be beyond the normal range of this species rather than an extension of its range (Norman *et al.*, 2004). Density values for short-finned pilot whales are available for the SWFSC Oregon/Washington and Northern California strata for summer/fall (Barlow, 2016). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so data from the SWFSC Oregon/Washington stratum were used as representative estimates. These values were used to represent density year-round.

Few sightings were made off California/ Oregon/Washington in 1984–1992 (Green *et al.* 1992; Carretta and Forney 1993; Barlow 1997), and sightings remain rare (Barlow 1997; Buchanan *et al.* 2001; Barlow 2010). No short-finned pilot whales were seen during surveys off Oregon and Washington in 1989–1990, 1992, 1996, and 2001 (Barlow 2003). A few sightings were made off California during surveys in 1991–2014 (Barlow 2010). Carretta *et al.* (2017) reported one sighting off Oregon during 1991–2008. Several stranding events in Oregon/southern Washington have been recorded over the past few decades, including in March 1996, June 1998, and August 2002 (Norman *et al.* 2004).

#### Dall's Porpoise

NMFS SWFSC developed a CCE habitat-based density model for Dall's porpoise which provides spatially explicit density estimates off the U.S. West Coast for summer and fall based on survey data collected between 1991 and 2014 (Becker *et al.*, *in prep*). Density data are not available for the NWTT Offshore area northwest of the SWFSC strata, so the habitat-based density values in the northernmost pixels adjoining this region were interpolated based on the nearest-neighbor approach to provide representative density estimates for this area.

Oleson *et al.* (2009) reported 44 sightings of 206 individuals off Washington during surveys from August 2004 to September 2008. Dall's porpoise were seen in the waters off Oregon during summer, fall, and winter surveys in 2011 and 2012 (Adams *et al.* 2014). Nineteen Dall's porpoise sightings (144 animals) were made off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey; none were in near the planned survey area (RPS 2012b). There were 16 Dall's porpoise sightings (54 animals) made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c). Dall's porpoise was the most frequently sighted marine mammal species (5 sightings of 28 animals) during the 2009 ETOMO survey north of the planned survey area (Holst 2017).

#### Northern Fur Seal

The Navy estimated the abundance of northern fur seals from the Eastern Pacific stock and the California breeding stock that could occur in the NWTT Offshore Study Area by determining the percentage of time tagged animals spent within the Study Area and applying that percentage to the population to calculate an abundance for adult females, juveniles, and pups independently on a monthly basis. Adult males are not expected to occur within the Offshore Study Area and the planned survey area during the planned geophysical survey as they spend the summer ashore at breeding areas in the Bering Sea and San Miguel Island (Caretta *et al.*, 2017b). Using the monthly abundances of fur seals within the Offshore Study Area, the Navy created strata to estimate the density of fur seals within three strata: 22 km to 70 km from shore, 70 km to 130 km from shore, and 130 km to 463 km from shore (the western Study Area boundary). L-DEO's planned survey is 423 km from shore at the closest point. Based on satellite tag data and

historic sealing records (Olesiuk 2012; Kajimura 1984), the Navy assumed 25 percent of the population present within the overall Offshore Study Area may be within the 130 km to 463 km stratum.

During the public comment period, the Commission noted that the Navy's density estimates for northern fur seals did not include abundance data collected from Bogoslof Island in 2015. Incorporating the 2015 Bogoslof counts yielded an increased abundance estimate, and thus an increased density of northern fur seals. The density estimate increased from 0.0103 animals/km<sup>2</sup> to 0.01065 animals/km<sup>2</sup>. As a result, the estimated take of northern fur seals increased from 194 takes by Level B harassment to 201. No Level A take of northern fur seals is anticipated nor authorized.

Thirty-one northern fur seal sightings (63 animals) were made off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey north of the planned survey area (RPS 2012b). There were six sightings (6 animals) made during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c).

#### Guadalupe Fur Seal

As with northern fur seals, adult male Guadalupe fur seals are expected to be ashore at breeding areas over the summer, and are not expected to be present during the planned geophysical survey (Caretta *et al.*, 2017b; Norris 2017b). Additionally, breeding females are unlikely to be present within the Offshore Study Area as they remain ashore to nurse their pups through the fall and winter, making only short foraging trips from rookeries (Gallo-Reynoso *et al.*, 2008; Norris 2017b; Yochem *et al.*, 1987). To estimate the total abundance of Guadalupe fur

seals, the Navy adjusted the population reported in the 2016 SAR (Caretta *et al.*, 2017b) of 20,000 seals by applying the average annual growth rate of 7.64 percent over the seven years between 2010 and 2017. The resulting 2017 projected abundance was 33,485 fur seals. Using the reported composition of the breeding population of Guadalupe fur seals (Gallo-Reynoso 1994) and satellite telemetry data (Norris 2017b), the Navy established seasonal and demographic abundances of fur seals expected to occur within the Offshore Study Area.

The distribution of Guadalupe fur seals in the Offshore Study Area was stratified by distance from shore (or water depth) to reflect their preferred pelagic habitat (Norris, 2017a). Ten percent of fur seals in the Study Area are expected to use waters over the continental shelf (approximated as waters with depths between 10 and 200 m). A depth of 10 m is used as the shoreward extent of the shelf (rather than extending to shore), because Guadalupe fur seals in the Offshore Study Area are not expected to haul out and would not be likely to come close to shore. All fur seals (*i.e.*, 100 percent) would use waters off the shelf (beyond the 200-m isobath) out to 300 km from shore, and 25 of percent of fur seals would be expected to use waters between 300 and 700 km from shore (including the planned geophysical survey area). The second stratum (200 m to 300 km from shore) is the preferred habitat where Guadalupe fur seals are most likely to occur most of the time. Individuals may spend a portion of their time over the continental shelf or farther than 300 km from shore, necessitating a density estimate for those areas, but all Guadalupe fur seals would be expected to be in the central stratum most of the time, which is the reason 100 percent is used in the density estimate for the central stratum (Norris, 2017a). Spatial areas for the three strata were estimated in a GIS and used to calculate the densities.

During the public comment period, the Commission noted that the Navy density estimate for Guadalupe fur seals projected the abundance through 2017, while L-DEO's survey will occur

in 2019. The Commission recommended calculating the abundance estimate in 2019 using the annual growth rate above. This calculation yielded an increased density estimate of Guadalupe fur seals, from 0.0029 animals/km<sup>2</sup> to 0.00343 animals/km<sup>2</sup>. As such, the take estimate increased from 55 takes by Level B harassment to 65. No Level A take of Guadalupe fur seals is anticipated or authorized.

Guadalupe fur seals have not previously been observed in the planned survey area, nor on previous L-DEO surveys off Washington and Oregon.

#### Northern Elephant Seal

The most recent surveys supporting the abundance estimate for northern elephant seals were conducted in 2010 (Caretta *et al.*, 2017b). By applying the average growth rate of 3.8 percent per year for the California breeding stock over the seven years from 2010 to 2017, the Navy calculated a projected 2017 abundance estimate of 232,399 elephant seals (Caretta *et al.*, 2017b; Lowry *et al.*, 2014). Male and female distributions at sea differ both seasonally and spatially. Pup counts reported by Lowry *et al.*, (2014) and life tables compiled by Condit *et al.*, (2014) were used to determine the proportion of males and females in the population, which was estimated to be 56 percent female and 44 percent male. Females are assumed to be at sea 100 percent of the time within their seasonal distribution area in fall and summer (Robinson *et al.*, 2012). Males are at sea approximately 90 percent of the time in fall and spring, remain ashore through the entire winter, and spend one month ashore to molt in the summer (*i.e.*, are at sea 66 percent of the summer). Monthly distribution maps produced by Robinson *et al.* (2012) showing the extent of foraging areas used by satellite tagged female elephant seals were used to estimate the spatial areas to calculate densities. Although the distributions were based on tagged female seals, Le Boeuf *et al.* (2000) and Simmons *et al.* (2007) reported similar tracks by males over

broad spatial scales. The spatial areas representing each monthly distribution were calculating using GIS and then averaged to produce seasonally variable areas and resulting densities.

Similar to the Guadalupe fur seal above, the Commission suggested using the population growth rate above to calculate the abundance of northern elephant seals in 2019. The resulting density estimate of northern elephant seals increased from 0.0309 animals/km<sup>2</sup> to 0.03333 animals/km<sup>2</sup>. As such, the estimated take by Level B harassment increased from 583 to 629 animals. Take of northern elephant seals by Level A harassment is not anticipated or authorized.

Off Washington, most elephant seal sightings at sea were made during June, July, and September; off Oregon, sightings were recorded from November through May (Bonnell *et al.* 1992). Several seals were seen off Oregon during summer, fall, and winter surveys in 2011 and 2012 (Adams *et al.* 2014). Northern elephant seals were also taken as bycatch off Oregon in the west coast groundfish fishery during 2002–2009 (Jannot *et al.* 2011). Northern elephant seals were sighted five times (5 animals) during the July 2012 L-DEO seismic surveys off southern Washington, northeast of the planned survey area (RPS 2012a). This species was not sighted during the July 2012 L-DEO seismic survey off Oregon, southeast of the planned survey area (RPS 2012c), or off Washington/Oregon during the June–July 2012 L-DEO Juan de Fuca plate seismic survey that included the planned survey area (RPS 2012b). One northern elephant seal was sighted during the 2009 ETOMO survey north of the planned survey area (Holst 2017).

**Table 7. Marine Mammal Density Values in the Survey Area.**

Species	Reported Density (#/km <sup>2</sup> ) <sup>a</sup>
<b>LF Cetaceans</b>	
Humpback whale	0.001829
Minke whale	0.0013
Sei whale	0.0004

Fin whale	0.004249
Blue whale	0.001096
<b>MF Cetaceans</b>	
Sperm whale	0.002561
Cuvier's and Mesoplodont beaked whales	0.007304
Baird's beaked whale	0.00082
Bottlenose dolphin	0.000003
Striped dolphin	0.009329
Short-beaked common dolphin	0.124891
Pacific white-sided dolphin	0.017426
Northern right-whale dolphin	0.039962
Risso's dolphin	0.007008
False killer whale	N/A
Killer whale	0.00092 <sup>b</sup>
Short-finned pilot whale	0.00025
<b>HF Cetaceans</b>	
Kogia spp.	0.00163
Dall's porpoise	0.043951
<b>Otariids</b>	
Northern fur seal	0.01065 <sup>b, c</sup>
Guadalupe fur seal	0.00343 <sup>c</sup>
<b>Phocids</b>	
Northern elephant seal	0.03333 <sup>c</sup>

<sup>a</sup> Navy 2018

<sup>b</sup> No stock-specific densities are available so densities are presumed equal for all stocks present

<sup>c</sup> Density estimate increased from that presented in **Federal Register** notice of proposed IHA (84 FR 26940; June 10, 2019)

### *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 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 and Level B harassment thresholds. The area estimated to be ensounded in a single day of the survey is then calculated (Table 8), based on the areas predicted to be ensounded around the array and representative trackline distances traveled per day. This number is then multiplied by the number of survey days. The product is then multiplied by 1.25 to account for the additional 25 percent contingency. This results in an estimate of the total areas (km<sup>2</sup>) expected to be ensounded to the Level A and Level B harassment thresholds.

**Table 8. Areas (km<sup>2</sup>) Estimated to be Ensonified to Level A and Level B Harassment Thresholds, per Day.**

Survey	Criteria	Relevant Isopleth (m)	Daily Ensonified Area (km <sup>2</sup> )	Total Survey Days	25% Increase	Total Ensonified Area (km <sup>2</sup> )
2-D Survey	Level B Harassment					
	160-dB	6733	1346.90	3	1.25	5050.86
	Level A Harassment					
	LF Cetaceans	426.9	158.67	3	1.25	595.01
	HF Cetaceans	268.3	99.77	3	1.25	374.12
	Phocids	43.7	16.26	3	1.25	60.96
	MF Cetaceans	13.6	5.06	3	1.25	18.97
3-D Survey	Level B Harassment					
	160-dB	3758	690.52	16	1.25	13810.40
	Level A Harassment					
	LF Cetaceans	118.7	47.39	16	1.25	947.74
	HF Cetaceans	75.6	30.13	16	1.25	602.59
	Phocids	25.1	9.98	16	1.25	199.59
	MF Cetaceans	11.2	4.45	16	1.25	89.01
Otariids	9.9	3.93	16	1.25	78.67	

The marine mammals predicted to occur within these respective areas, based on estimated densities, are assumed to be incidentally taken. For species where take by Level A harassment has been requested, the calculated Level A takes have been subtracted from the total exposures within the Level B harassment zone. During the public comment period, the Commission noted that the typical group size for sei whales is two animals (Barlow 2016) and

recommended increasing the Level A take to two animals and reducing the Level B takes to six animals. NMFS agreed and has made that change. Authorized takes for the planned survey are shown in Table 9.

**Table 9. Estimated Level A and Level B Exposures, and Percentage of Stock Exposed.**

Species	Stock	Level B	Level A	Total Take	Percent of Stock
<b>LF Cetaceans</b>					
Humpback whale	California/Oregon/Washington	32	3	35	1.21
Minke whale	California/Oregon/Washington	23	2	25	3.93
Sei whale	Eastern North Pacific	6	2	8	1.54
Fin whale	California/Oregon/Washington	74	7	81	0.90
Blue whale	Eastern North Pacific	19	2	21	1.28
<b>MF Cetaceans</b>					
Sperm whale	California/Oregon/Washington	48	0	48	2.40
Cuvier's and Mesoplodont beaked whales	California/Oregon/Washington	138	0	138	2.18 <sup>a</sup>
Baird's beaked whale	California/Oregon/Washington	15	0	15	0.56
Bottlenose dolphin	California/Oregon/Washington	13 <sup>b</sup>	0	13 <sup>b</sup>	0.68
Striped dolphin	California/Oregon/Washington	176	0	176	0.60
Short-beaked common dolphin	California/Oregon/Washington	2356	0	2356	0.24
Pacific white-sided dolphin	California/Oregon/Washington	329	0	329	1.23
Northern right-whale dolphin	California/Oregon/Washington	754	0	754	2.82
Risso's dolphin	California/Oregon/Washington	132	0	132	2.08
False killer whale	Hawaii Pelagic	5 <sup>b</sup>	0	5 <sup>b</sup>	0.32
Killer whale	Offshore	17	0	17	5.67 <sup>c</sup>
	West Coast				7.00 <sup>c</sup>

	Transient				
Short-finned pilot whale	California/Oregon/Washington	18 <sup>b</sup>	0	18 <sup>b</sup>	2.15
<b>HF Cetaceans</b>					
Kogia spp.	California/Oregon/Washington	29	2	31	0.71
Dall's porpoise	California/Oregon/Washington	786	43	829	3.05
<b>Otariids</b>					
Northern fur seal	Eastern Pacific	201	0	201	0.03 <sup>c</sup>
	California				1.43 <sup>c</sup>
Guadalupe fur seal	Mexico	65	0	65	0.33
<b>Phocids</b>					
Northern elephant seal	California Breeding	629	0	629	0.35

<sup>a</sup> Combined stock abundances for Cuvier's beaked whales and Mesoplodont guild.

<sup>b</sup> Calculated take increased to mean group size (Barlow 2016).

<sup>c</sup> Where multiple stocks are affected, for the purposes of calculating the percentage of stock affected, takes are analyzed as if all takes occurred within each stock.

It should be noted that the authorized take numbers shown in Table 9 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 takes by Level A harassment. 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.

Note that due to the different density estimates used, and in consideration of the near-field soundscape of the airgun array, we have authorized a different number of incidental takes than the number of incidental takes requested by L-DEO (see Table 6 in the IHA application).

### **Mitigation**

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

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

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

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

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 required 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 is required to implement mitigation measures for marine mammals. Mitigation measures that would 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.

#### *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 m exclusion zone, out to a radius of 1,000 m from the edges of the airgun array (500–1,000 m). 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.

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 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 (visual and acoustic but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO.

#### *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.

Passive acoustic monitoring (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, is 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 (if on duty) 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 two hours without acoustic monitoring during daylight hours 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 four hours in any 24-hour period.

### *Establishment of Exclusion and Buffer Zones*

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. 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  $SEL_{cum}$  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.

An extended EZ of 1,500 m must be enforced for all beaked whales, and dwarf and pygmy sperm whales.

### *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 pinnipeds, and 30 minutes for all mysticetes and all other odontocetes, including sperm whales, pygmy sperm whales, dwarf sperm whales, beaked whales, pilot whales, and Risso's dolphins);

- 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; and

- 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) and (1) a marine mammal appears within or enters the applicable exclusion zone and/or (2) a marine mammal (other than delphinids, see below) is detected acoustically and localized within the applicable exclusion zone, the acoustic source will be shut down. 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 whales, pygmy sperm whales, dwarf sperm whales, pilot whales, beaked whales, and Risso's dolphins.

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 applies solely to specific genera of small dolphins — *Tursiops*, *Delphinus*, *Stenella*, *Lagenorhynchus*, and *Lissodelphis*. The acoustic source must 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.

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 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.

Powerdown conditions shall be maintained until the marine mammal(s) of the above listed genera are no longer observed within the exclusion zone, following which full-power operations may be resumed without ramp-up. Additionally, visual PSOs may elect to waive the powerdown requirement if the small dolphin(s) 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. 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 pinnipeds, and 30 minutes for mysticetes and all other odontocetes, including sperm whales, pygmy sperm whales, dwarf sperm whales, beaked whales, pilot whales, and Risso's dolphins, with no further observation of the marine mammal(s).

The following shutdown requirements have been added to the final IHA as they were not included in the proposed IHA:

- L-DEO must implement shutdown if a marine mammal species for which take was not authorized, or a species for which authorization was granted but the takes have been met, approaches the Level A or Level B harassment zones;
- L-DEO must implement shutdown if any large whale (defined as a sperm whale or any mysticete species) with a calf (defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult) or an aggregation of six or more large whales is observed at any distance; and
- L-DEO must implement shutdown if a North Pacific right whale is observed at any distance.

#### *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; and

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 required 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); and
- 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.

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; and

- 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;
- Date and participants of PSO briefings;
- Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;

- Vessel location (latitude/longitude) when survey effort 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); and
- Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

### *Reporting*

A report would be submitted to NMFS within 90 days after the end of the cruise. The report would describe the operations that were conducted and sightings of marine mammals near the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report would summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report would also include estimates of the number and nature of exposures that occurred above the harassment threshold based on PSO observations and including an estimate of those that were not detected, in consideration of both the characteristics and behaviors of the species of marine mammals that affect detectability, as well as the environmental factors that affect detectability.

L-DEO is required to 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 draft report shall 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 shall be provided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates shall be referenced to the WGS84 geographic coordinate system. In addition to the report, all raw observational data shall 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*

In the event that personnel involved in survey activities covered by the authorization discover an injured or dead marine mammal, the L-DEO shall report the incident to the Office of Protected Resources (OPR), NMFS and to the NMFS West Coast 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’s implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, our analysis applies to all species listed in Tables 7 and 9, given that NMFS expects the anticipated effects of the planned geophysical 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 survey, even in the absence of mitigation. Thus the authorization does not authorize any mortality. As discussed in the *Potential Effects* section, non-auditory physical effects, stranding, and vessel strike are not expected to occur.

We have authorized a limited number of instances of Level A harassment of seven species and Level B harassment of 26 marine mammal species. However, we believe that any PTS incurred in marine mammals as a result of the planned activity would be in the form of only a small degree of PTS, 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). Also, as described above, we expect that marine mammals would be likely to move away from a sound source that represents an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice of the *Langseth's* approach due to the vessel's relatively low speed when conducting seismic surveys. We expect that the majority of takes would be in the form of short-term Level B behavioral harassment in the form of temporary avoidance of the area or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al.*, 2007).

Potential impacts to marine mammal habitat were discussed previously in this document (see *Potential Effects of the Specified Activity on Marine Mammals and their Habitat*). Marine

mammal habitat may be impacted by elevated sound levels, but these impacts would be temporary. 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 (~19 days) and temporary nature of the disturbance, 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 seven percent of all species). Additionally, the acoustic "footprint" of the planned survey 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 planned geophysical survey occurs outside of the U.S. EEZ and outside of any established Biologically Important Areas or critical habitat.

The required mitigation measures are expected to reduce the number and/or severity of takes by allowing for detection of marine mammals in the vicinity of the vessel by visual and acoustic observers, and by minimizing the severity of any potential exposures via 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 required 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, and Central America DPS humpback whales, and the threatened Mexico DPS humpback whale and Guadalupe fur seal. We have authorized very small numbers of takes for these species relative to their population sizes. Given the low probability of fitness impacts to any individual, combined with the small portion of any of these stocks impacted, 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 planned surveys 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 propose to authorize take are considered “depleted” or “strategic” by NMFS under the MMPA.

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 the authorized take to impact annual rates of recruitment or survival.

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

No mortality is anticipated or authorized;

- The planned activity is temporary and of relatively short duration (19 days);

- The anticipated impacts of the planned 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 very small in number. 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 planned 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 planned survey would be temporary and spatially limited; and
- The required mitigation measures, including visual and acoustic monitoring, power-downs, and shutdowns, are expected to minimize potential impacts to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the 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 Sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness

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

Table 9 provides the authorized numbers of take by Level A and Level B harassment, which are used here for purposes of the small numbers analysis. The numbers of marine mammals that we have authorized to be taken by Level A and Level B harassment would be considered small relative to the relevant populations (less than seven percent for all species and stocks) for the species for which abundance estimates are available.

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 or stocks.

### **Unmitigable Adverse Impact Analysis and Determination**

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

### **National Environmental Policy Act**

In compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), as implemented by the regulations published by the Council on Environmental Quality (40 CFR parts 1500-1508), the NSF prepared an Environmental Analysis (EA) to consider the direct,

indirect, and cumulative effects to the human environment from this marine geophysical survey in the Northeast Pacific. NSF's EA was made available to the public for review and comment in relation to its suitability for adoption by NMFS in order to assess the impacts to the human environment of issuance of an IHA to L-DEO. In compliance with NEPA and the CEQ regulations, as well as NOAA Administrative Order 216-6, NMFS has reviewed the NSF's EA, determined it to be sufficient, and adopted that EA and signed a Finding of No Significant Impact (FONSI) on July 10, 2019

### **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 Office of Protected Resources Interagency Cooperation Division issued a Biological Opinion on July 10, 2019, under section 7 of the ESA, on the issuance of an IHA to L-DEO under section 101(a)(5)(D) of the MMPA by the NMFS Permits and Conservation Division. The Biological Opinion concluded that the proposed action is not likely to jeopardize the continued existence of sei whale, fin whale, blue whale, sperm whale, humpback whale (Central America DPS and Mexico DPS), and Guadalupe fur seal, and is not likely to destroy or modify critical habitat of listed species because no critical habitat exists for these species in the action area.

## **Authorization**

NMFS has issued an IHA to L-DEO for the potential harassment of small numbers of 26 marine mammal species incidental to a marine geophysical survey in the Northeast Pacific, provided the previously mentioned mitigation, monitoring, and reporting are incorporated.

Dated: July 17, 2019.

**Donna S. Wieting,**

*Director, Office of Protected Resources,*

*National Marine Fisheries Service.*

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