



# MARINE MAMMAL COMMISSION

2 July 2018

Ms. Jolie Harrison, Chief  
Permits and Conservation Division  
Office of Protected Resources  
National Marine Fisheries Service  
1315 East-West Highway  
Silver Spring, MD 20910-3225

Dear Ms. Harrison:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the application submitted by U.S. Geological Survey (USGS) seeking authorization under section 101(a)(5)(D) of the Marine Mammal Protection Act (the MMPA) to take small numbers of marine mammals by harassment. The taking would be incidental to a marine geophysical survey to be conducted in the North Atlantic Ocean in August 2018. The Commission also has reviewed the National Marine Fisheries Service's (NMFS) 31 May 2018 notice announcing receipt of the application and proposing to issue the authorization, subject to certain conditions (83 Fed. Reg. 25268).

## Background

USGS proposes to conduct a geophysical survey in the U.S. exclusive economic zone from Cape Hatteras to south of Hudson Canyon. The purpose of the survey is to investigate lateral and vertical distribution of gas hydrates and shallow natural gas in marine sediments relative to seafloor gas seeps, slope failures, and geological and erosional features. The survey would be conducted along approximately 2,350 km of tracklines in waters estimated to be 100 to 3,700 m in depth. USGS would use the R/V *Hugh R. Sharp (Sharp)* to operate a two- or four-airgun array with a maximum discharge volume of 840 in<sup>3</sup> at a tow depth of 3 m. In addition, the *Sharp* would (1) tow a 750- to 1,300-m hydrophone streamer and (2) use a 38-kHz split-beam echosounder (an EK60), and (3) deploy up to 90 sonobuoys during the survey. The survey is expected to last for up to 22 days<sup>1</sup>.

NMFS preliminarily has determined that, at most, the proposed activities would result in the incidental taking of small numbers of up to 29 species of marine mammals by Level B harassment and that any impact on the affected species would be negligible. NMFS does not anticipate any take of marine mammals by death or serious injury. It also has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on the affected species or stocks. Those measures include (1) using two protected species observers to

---

<sup>1</sup> A 25-percent contingency was added for airgun testing and repeat coverage of any areas where initial data quality is deemed substandard or when partial equipment failure occurs.

monitor the Level A and B harassment zones for 30 minutes before, during, and for 30 minutes after the survey, (2) implementing speed and course alterations, and (3) using shut-down<sup>2</sup> and ramp-up procedures. In addition, USGS would shut down the airguns immediately if a large whale<sup>3</sup> with a calf or an aggregation<sup>4</sup> of large whales is observed regardless of the distance from the *Sharp*. Ramp-up procedures would not be initiated until the animal(s) has not been seen at any distance for 30 minutes. USGS would report any injured or dead marine mammal to NMFS's Office of Protected Resources and the Greater Atlantic Regional or Southeast Stranding Coordinator<sup>5</sup> using its phased approach.

### Flaws in modeling methodologies

USGS used Lamont-Doherty Earth Observatory's (LDEO) model to estimate the extent of the Level A and B harassment zones and the numbers of marine mammal takes. The Commission has raised concerns regarding LDEO's model and has provided extensive comments regarding the inappropriateness of that model<sup>6</sup> for nearly eight years. In more recent years, other stakeholders<sup>7</sup> have expressed similar concerns regarding the inappropriateness of those methods (80 Fed. Reg. 67713). LDEO uses the Nucleus source model and a simple ray trace-based modeling approach<sup>8</sup> that assumes spherical spreading, a constant sound speed, and no bottom interactions for surveys in deep water (Diebold et al. 2010).

The Commission notes that LDEO's model provides results only for deep water (>1,000 m) and only up to a depth of 2,000 m—the current survey occurs in waters from 100 to 3,700 m in depth. For intermediate water depths (100 to 1,000 m), USGS applied a correction factor of 1.5 to the deep-water results. Environmental conditions in waters off New Jersey (up to 1,500 m in depth) indicate a surface duct at 50 m, in-water refraction, and bathymetry and sediment characteristics that reflect sound in summer. Those parameters were not accounted for in USGS's modeling approach. Many studies, including multiple LDEO-associated studies,<sup>9</sup> have emphasized the importance of incorporating site-specific environmental and operational parameters into estimating Level A and B harassment zones. LDEO's simple model and crude assumptions, that could very well represent underestimated harassment zones in deep water and overestimated harassment zones in intermediate water, are not considered best available science.

These issues have been further complicated with the finalization a few years ago of NMFS's updated acoustic thresholds for permanent threshold shift (i.e., Level A harassment). LDEO continues to claim that its model cannot incorporate more than a single shot and thus cannot

---

<sup>2</sup> Shut downs would not be required for small delphinids (*Delphinus* spp., *Tursiops* spp., *Stenella* spp., *Steno* spp., and *Lagenorhynchus* spp.) that are traveling and voluntarily approaching the source vessel to interact with the vessel and/or airgun array.

<sup>3</sup> A sperm whale or mysticete.

<sup>4</sup> Six or more individuals that do not appear to be traveling and are feeding, socializing, etc.

<sup>5</sup> The Commission informally noted that NMFS did not specify which stranding coordinator should be contacted. NMFS indicated it would clarify which stranding coordinator should be contacted for the specific areas in the final authorization.

<sup>6</sup> Which should be reviewed in conjunction with this letter (see the Commission's [2 May 2016 letter](#)) and are not reiterated herein

<sup>7</sup> Natural Resources Defense Council and Whale and Dolphin Conservation.

<sup>8</sup> Essentially a MATLAB algorithm.

<sup>9</sup> Tolstoy et al. (2004), Tolstoy et al. (2009), Diebold et al. (2010), and Crone et al. (2014).

readily estimate ranges to the cumulative sound exposure level ( $SEL_{cum}$ ) thresholds. In the absence of such a model, LDEO used NMFS's user spreadsheet to estimate the Level A harassment zones<sup>10</sup> for the various functional hearing groups.

To estimate the Level A harassment zones, LDEO computed 'modified' frequency-weighted, farfield source levels. USGS noted that those are more appropriate than the 'actual' farfield source levels<sup>11</sup> because an 'actual' farfield source level "does not take into account the interactions of the two airguns that occur near the source center and is calculated as a point source (single airgun)"<sup>12</sup>. The modified farfield source levels<sup>13</sup> are essentially back-calculated source levels<sup>14</sup> based on the relevant frequency-weighted threshold. The *Federal Register* notice further indicated that, although the array effect is not expected to be as pronounced for the four-airgun array as it would be for a larger airgun array, the modified farfield source level was considered more appropriate than use of the theoretical farfield signature. The Commission is unaware of any other seismic operators using such a circuitous approach to estimate harassment zones. Generally, source levels are inputs to models rather than products of those models, and the sound field from spatially-distributed sources (e.g., airgun arrays) is modeled as sums of point sources, under the assumption that individual airgun pressures do not substantially influence each other. Such an approach is straightforward, easy to implement, and accounts for both the 'near-field' and 'far-field' effects. LDEO also appears to be using both radial distances (i.e., slant ranges) and radii indiscriminately. Radial distances have been used for metrics based on  $SEL_{cum}$  and SPL root-mean-square ( $SPL_{rms}$ ), and radii have been used for metrics based on  $SPL_{peak}$ , which would yield smaller zones. Therefore, the Commission recommends that NMFS require USGS to specify why LDEO is using radial distances for  $SEL_{cum}$  and  $SPL_{rms}$  metrics and radii for  $SPL_{peak}$  metrics.

LDEO's method did incorporate the spectral aspects of the two- and four-airgun configurations to better refine the frequency-specific weighting function adjustments for the  $SEL_{cum}$  thresholds rather than using NMFS's simple weighting factor adjustment (i.e., 1 kHz for seismic). The Commission supports incorporation of spectral data but wonders why the spectral levels were effectively cut off at 2.5 to 3 kHz, since airguns emit energy above 3 kHz. The Commission suspects that this anomaly occurred because the Nucleus source model only provides data up to 2.5 or 3 kHz, which would affect the estimated ranges to the Level A harassment thresholds for various species (including mid-frequency (MF) and HF<sup>15</sup> cetaceans). Airgun sound in the MF and HF<sup>16</sup>

---

<sup>10</sup> The Level A harassment zone based on peak sound pressure levels ( $SPL_{peak}$ ) for the  $4 \times 105 \text{ in}^3$  array was incorrectly noted for high-frequency (HF) cetaceans in the *Federal Register* notice—it should be 70.79 m. NMFS plans to include that revision in the final authorization. However, this is the second proposed authorization involving LDEO's model for which the Commission noted errors in the  $SPL_{peak}$  zones (see the Commission's [21 May 2018 letter](#)). LDEO also appears to be using indiscriminately both radial distances (i.e., slant ranges) and radii. LDEO should specify why it is using radial distances for metrics based on  $SEL_{cum}$  and SPL root-mean-square and radii for metrics based on  $SPL_{peak}$ , as radii would yield smaller zones.

<sup>11</sup> Deemed a 'theoretical representation of the source level' or a 'theoretical far-field signature' in the application.

<sup>12</sup> Where the effects of the array are the greatest and coherent summation does not occur.

<sup>13</sup> Although USGS did not present both the modified and actual source levels in its application, the University of Hawaii (UH) presented those data in its recent application. UH's source levels were similar for some functional hearing groups but the modified source levels varied from the actual source levels by approximately 3 to 18 dB for other functional hearing groups.

<sup>14</sup> Assuming spherical propagation loss.

<sup>15</sup> Particularly since the Level A harassment threshold is 155 dB re  $1 \mu \text{ Pa}^2\text{-sec}$ .

<sup>16</sup> 1–10 kHz and > 10 kHz, respectively.

range contributes to the overall sound exposure level for those species and should not be assumed to be to zero above 3 kHz. Other source models (including Gundalf Optimizer<sup>17</sup> and JASCO's Airgun Array Source Model<sup>18</sup> (AASM)) provide sound levels into the HF range and could have been used. The Commission recommends that NMFS provide justification for why it believes that LDEO's use of the Nucleus source model, which does not provide data above 2.5 kHz, is appropriate for determining the extents of the Level A harassment zones for MF and HF cetaceans.

The use of truncated spectra and modified farfield source levels further supports the Commission's continued recommendation that NMFS require LDEO, and in turn USGS and other affiliated entities<sup>19</sup>, to revise their source and sound propagation modeling methodologies. The Commission additionally underscores the need for NMFS to hold USGS, LDEO, National Science Foundation (NSF), and affiliated entities to the same standard as other action proponents (e.g., Bureau of Ocean Energy Management, the oil and gas industry, U.S. Navy, U.S. Air Force), as LDEO's model does not represent the best available science. Thus, the Commission again recommends that NMFS require USGS, in collaboration with LDEO, to re-estimate the proposed Level A and B harassment zones and associated takes of marine mammals using (1) both operational (including number/type/spacing of airguns, tow depth, source level/operating pressure, operational volume) and site-specific environmental (including sound speed profiles, bathymetry, and sediment characteristics<sup>20</sup> at a minimum) parameters, (2) a comprehensive source model (i.e., Gundalf Optimizer or AASM) and (3) an appropriate sound propagation model for the proposed incidental harassment authorization. Specifically, the Commission reiterates that LDEO should be using the ray-tracing sound propagation model BELLHOP—which is a free, standard propagation code that readily incorporates all environmental inputs listed herein, rather than the limited, in-house MATLAB code currently in use.

Furthermore, USGS will be deploying up to 90 sonobuoys in water depths greater than 1,000 m to provide velocity control and possibly wide-angle reflections along the highest-priority transects. Those sonobuoys<sup>21</sup> also would provide in-situ data on the extents of the various harassment zones. In addition, the hydrophone streamer would be equipped with Soundguard software, which can record signals from 64 Hz to 50 kHz. NMFS has been including in numerous authorizations the requirement that sound source verification studies (SSVs) be conducted for a myriad of activities, including seismic surveys, high-resolution geophysical surveys, confined underwater blasting, and various construction-related activities. SSVs have been required when action proponents use proxy source levels, as well as proxy sound propagation assumptions. Given the shortcomings noted for LDEO's source and sound propagation modeling and the requirement that other action proponents are obliged to fulfill, the Commission recommends that NMFS require USGS to archive, analyze, and compare the in-situ data collected by the sonobuoys and hydrophone streamer to LDEO's modeling results for the extents of the Level A and B harassment

---

<sup>17</sup> <https://www.gundalf.com/environmental/>

<sup>18</sup> [http://www.nmfs.noaa.gov/pr/permits/incidental/oilgas/boem\\_2016rule\\_app\\_appendix.pdf](http://www.nmfs.noaa.gov/pr/permits/incidental/oilgas/boem_2016rule_app_appendix.pdf)

<sup>19</sup> Including the Scripps Institution of Oceanography (SIO).

<sup>20</sup> Those data can be obtained from the National Geophysical Data Center, Leviticus, and the U.S. Navy Oceanographic and Atmospheric Master Library's databases including Generalized Digital Environmental Model, Digital Bathymetric Database Variable-Resolution, Surface Marine Gridded Climatology.

<sup>21</sup> USGS indicated that the sonobuoys, although uncalibrated, would provide data primarily between 10 and 400 Hz (but up to 1 kHz), which is the frequency range where most of the energy is centered.

zones based on the various airgun configurations and water depths to be surveyed and provide the data and results to NMFS.

### **Take estimates in general**

In 2014 NMFS revised the manner in which takes were estimated for seismic surveys. Historically, action proponents used simple area x density methods that vastly underestimated the numbers of marine mammals that could be taken during a seismic survey, or any other activity with a moving sound source. NMFS's revised method has included determining the ensonified area to be surveyed in a given location based on the line-kilometers<sup>22</sup> that could be surveyed over a given number of days<sup>23</sup>, which is then to be multiplied by site- and species-specific densities and the number of days during which those activities could occur in that location. All site- or location-specific takes are then to be summed to determine the total numbers of takes to be authorized for the activity as a whole.

USGS did not follow that approach. USGS specified that it did not calculate the numbers of takes as a function of time, but rather calculated them based on the area ensonified within the Level B harassment zones along all the exemplary tracks adjacent to all of the exemplary lines and interseismic linking lines. USGS further stipulated that its approach is more precise than that often used by applicants since it relies completely on the marine mammal density grids and “shooting through” specific locations<sup>24</sup>, but is a departure from the “daily ensonified method” that is typically used. The Commission doesn't disagree. Many action proponents that conduct seismic surveys rely on site-specific marine mammal densities and the associated ensonified areas within each location as refined in GIS. However, the action proponents also account for the time spent conducting the survey in each location, which USGS apparently did not do.

USGS indicated that the method used to estimate the numbers of takes was appropriate and conservative. USGS stated that the calculated number of days to complete all of the tracklines is 25 days, but the airguns would only be in operation for 19 days. Assuming 2,350 line-kilometers are to be surveyed, only 94 km would be surveyed on each of the 25 days. USGS also indicated that it would only use the airguns on 50 percent of the interseismic linking lines but assumed 100-percent use of the airguns for those lines. Assuming an additional 750 km<sup>25</sup> were added to the line-kilometers to account for those interseismic linking lines, 124 km would be surveyed on each of the 25 days. That would equate to the survey vessel traveling at less than 3 knots. The *Sharp* would be traveling at 4 knots and would cover more area (83 Fed. Reg. 25270).

USGS further stated that it assumed ‘double ensonification’ by estimating the numbers of Level B harassment takes based on the extent of the entire zone without subtracting the Level A harassment zone<sup>26</sup>. That point is moot since *Kogia* spp. are the only species for which takes could

---

<sup>22</sup> And relevant Level B harassment radii.

<sup>23</sup> Which generally has been based on a 5-knot survey speed, see 83 Fed. Reg. 18683 as just one example.

<sup>24</sup> USGS defined 11 different locations for its proposed survey based on the 11 transect lines.

<sup>25</sup> USGS did not specify how many line-kilometers would comprise the interseismic linking lines, but 750 km includes surveying the exemplary lines in 100–1,000 m of water and 50 percent of interseismic linking lines (Table 1 of the *Federal Register*). Lesser line-kilometers for the interseismic linking lines would yield an even smaller area to be surveyed and a slower speed.

<sup>26</sup> Level A harassment takes were not estimated or proposed to be authorized.

have been calculated based on the size of the Level A harassment zones and those still will equate to less than 1 take<sup>27</sup>. In addition, USGS noted that the 25-percent correction factor<sup>28</sup> will ensure that the take estimates are as conservative as possible. That is only true if USGS does not have to conduct airgun testing or repeat tracklines if data are substandard or partial equipment failure occurs. Furthermore, USGS's application indicated that the 25 days of activities included the 25-percent contingency, yet it indicated otherwise in response to Commission questions. For all of these reasons, it is unclear how 'conservative' the takes truly are.

Since USGS did not provide the line-kilometers assumed to be surveyed in each of the 11 locations, associated ensonified areas, or site-specific densities, the numbers of takes cannot be reviewed for appropriateness or even basic mathematical accuracy<sup>29</sup>. USGS's approach for enumerating takes is neither consistent with the approaches of other applicants that use moving sound sources nor transparent. Accordingly, the Commission recommends that NMFS ensure that USGS calculated the numbers of takes appropriately based on the line-kilometers to be surveyed in each of the 11 locations and the number of days it would take to survey each location, the associated ensonified areas, and site-specific densities—species-specific takes from each of the 11 locations should be summed to yield the total numbers of takes for each species. Furthermore, the Commission recommends that NMFS require USGS to provide in all future applications all relevant information regarding line-kilometers to be surveyed and days necessary to survey each location based on a presumed survey speed, associated ensonified areas, site-specific densities, and any other assumptions (including the assumed 25-percent contingency).

### **Rounding of take estimates**

The method used to estimate the numbers of takes during the proposed activities, which summed fractions of takes for each species across project days, does not account for and negates the intent of NMFS's 24-hour reset policy. As the Commission has indicated in previous letters regarding this matter<sup>30</sup>, the issue at hand involves policy rather than mathematical accuracy. The Commission understands that NMFS has nearly completed revising its draft criteria and plans to share them with the Commission in the near term. The Commission recommends that NMFS provide those criteria without further delay.

### **Use of the echosounder**

Action proponents that conduct research-related seismic surveys, including LDEO, SIO, and other NSF-affiliated entities, refrain from using echosounders and subbottom profiles during transit. A number of years ago, it was brought to NMFS's attention that those sources—that were not being used as navigational aids—were active from the time the vessel left port until it returned, which was unnecessary. From that time onward, LDEO, SIO, and other NSF-affiliated entities have not used echosounders or subbottom profilers during transits (see SIO's recent application for

---

<sup>27</sup> Similarly Level A harassment takes would be less than 0.1 for low-frequency cetaceans and are non-existent for mid-frequency cetaceans.

<sup>28</sup> That accounts for airgun testing and repeat coverage of any areas where initial data quality is deemed substandard.

<sup>29</sup> The Commission further notes that, based on rounding errors, the takes of Risso's dolphins, sperm whales, Clymene dolphins, and striped dolphins were incorrectly rounded down. NMFS plans to increase the numbers of takes for each species by 1.

<sup>30</sup> See the Commission's [29 November 2016 letter](#) detailing this issue.

its Mid-Atlantic Ridge survey as an example). USGS, however, plans to use the echosounder during transits to and from the survey area.

The Commission questioned why the echosounder needed to be used, since NMFS clarified that the device would be used to detect methane gas hydrates rather than as a navigational aid. USGS initially responded that the echosounder needed to be calibrated in 30 m of water. When the Commission further questioned why the echosounder couldn't be deactivated when it wasn't being calibrated during the remainder of the transits and when in deeper water, NMFS responded that data would be collected at shallower depths as well. Those responses do not comport.

Calibrating a source is not the same as collecting actual gas hydrate data<sup>31</sup>. If gas hydrate data are being collected with the echosounder during transits to and from the survey area, then it is unclear why Level B harassment takes were not requested by USGS during that portion of the activity. Level B harassment takes are not generally requested during seismic surveys, because the Level B harassment zone associated with an echosounder or subbottom profiler is subsumed by the Level B harassment zone of the airgun array. However, Level B harassment takes have been authorized multiple times in the past when only an echosounder was used, including for the same EK60 echosounder that USGS plans to use in this instance (see Table 6 in 81 Fed. Reg. 53076 as one example<sup>32</sup>). USGS noted in its application that Cholewiak et al. (2017) observed a reduced number of beaked whale sightings and vocalizations during surveys that used the EK60 and could detect the EK60 transmissions at depths of 800 m 1.3 km from the source. USGS also acknowledged that there is a possibility of some odontocetes exhibiting a behavioral response to EK60 transmissions, despite the fact that the modeled Level B harassment zones are small.

The Commission sees this issue quite simply. Echosounders, subbottom profilers, and other sources that are intended to image the ocean bottom and not serve as navigational tools should not be active except when necessary. In this instance, that would be limited to the airgun survey and during calibration. If USGS intends to use the echosounder to collect gas hydrate data during transit to the survey area before the survey begins and from the survey area when it ends, then it needs to obtain authorization for taking during those activities as well. Therefore, the Commission recommends that NMFS condition the authorization to limit USGS's use of the echosounder during transits to and from the survey area except during calibration (apparently in water depths of 30 m or less). If USGS intends to use the echosounder to collect gas hydrate data during transits to and from the area, the Commission recommends that NMFS advise USGS that it needs to obtain additional authorization to take marine mammals during such activities.

---

<sup>31</sup> Furthermore, the use of the echosounder in water depths greater than 30 m was not addressed.

<sup>32</sup> This source also is similar to or the same as those used during high-resolution geophysical surveys.

The Commission looks forward to working with NMFS on the various issues raised in this and past letters. Please contact me if you have questions concerning the Commission's recommendations.

Sincerely,



Peter O. Thomas, Ph.D.,  
Executive Director

## References

- Cholewiak, D., A. Izzi, D. Palka, P. Corkeron, and S. Van Parijs. 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. *Royal Society Open Science* 4:170940. doi:10.1098/rsos.170940.
- Crone, T.J., M. Tolstoy, and H. Carton. 2014. Estimating shallow water sound power levels and mitigation radii for the *R/V Marcus G. Langseth* using an 8 km long MCS streamer. *Geochemistry, Geophysics, Geosystems* 15, doi:10.1002/2014GC005420.
- Diebold, J.B., M. Tolstoy, L. Doermann, S.L. Nooner, S.C. Webb, and T.J. Crone. 2010. *R/V Marcus G. Langseth* seismic source: Modeling and calibration. *Geochemistry, Geophysics, Geosystems* 11(12):Q12012. doi:10.1029/2010GC003216.
- Tolstoy, M., J. Diebold, S.C. Webb, D.R. Bohnstiehl, E. Chapp, R.C. Holmes, and M. Rawson. 2004. Broadband calibration of the *R/V Ewing* seismic sources. *Geophysical Research Letters* 31:L14310. doi:10.1029/2004GL020234.
- Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of *R/V Marcus G. Langseth* four-string seismic sources. *Geochemistry, Geophysics, Geosystems* 10:Q08011. doi:10.1029/2009GC002451.