14 May 2012

Mr. P. Michael Payne, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3225

Dear Mr. Payne:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the application submitted by the Lamont-Doherty Earth Observatory seeking authorization under section 101(a)(5)(D) of the Marine Mammal Protection Act to take small numbers of marine mammals by harassment. The taking would be incidental to three marine geophysical surveys to be conducted in the northeast Pacific Ocean from June through July 2012. The Commission also has reviewed the National Marine Fisheries Service's 2 May 2012 *Federal Register* notice announcing receipt of the application and proposing to issue the authorization, subject to certain conditions (77 Fed. Reg. 25966).

RECOMMENDATIONS

The Marine Mammal Commission recommends that the National Marine Fisheries Service—

- require the Observatory to re-estimate the proposed exclusion and buffer zones and associated takes of marine mammals using site-specific information—If the exclusion and buffer zones and numbers of takes are not re-estimated require the Observatory to provide a detailed justification explaining the rationale for (1) basing the exclusion and buffer zones for the proposed survey in the northeast Pacific Ocean on empirical data collected in the Gulf of Mexico or on modeling that relies on measurements from the Gulf of Mexico and (2) using simple ratios to adjust for tow depth and applying median values to estimate propagation in intermediate water depths rather than using empirical measurements;
- require the Observatory to re-estimate the number of takes during the first survey (i.e., Juan de Fuca plate survey) by accounting for two passes over the three long transect lines, which should effectively double the estimated number of takes from a single survey pass of those lines;
- prohibit an 8-minute pause following the sighting of a marine mammal in the exclusion zone and extend that pause to cover the maximum dive times of the species likely to be encountered prior to resuming airgun operations after both power-down and shut-down procedures;
- provide additional justification for its preliminary determination that the proposed monitoring program will be sufficient to detect, with a high level of confidence, all marine mammals within or entering the identified exclusion and buffer zones—such justification should (1) identify those species that it believes can be detected with a high degree of

confidence using visual monitoring only under the expected environmental conditions, (2) describe detection probability as a function of distance from the vessel, (3) describe changes in detection probability under various sea state and weather conditions and light levels, and (4) explain how close to the vessel marine mammals must be for observers to achieve high nighttime detection rates;

- consult with the funding agency (i.e., the National Science Foundation) and individual applicants (e.g., Lamont-Doherty Earth Observatory and the U.S. Geological Survey) to develop, validate, and implement a monitoring program that provides a scientifically sound, reasonably accurate assessment of the types of marine mammal taking and the number of marine mammals taken;
- require the Observatory to (1) report the number of marine mammals that were detected acoustically and for which a power-down or shut-down of the airguns was initiated, (2) specify if such animals also were detected visually, (3) compare the results from the two monitoring methods (visual versus acoustic) to help identify their respective strengths and weaknesses, and (4) use that information to improve mitigation and monitoring methods; and
- work with the National Science Foundation to analyze those data to help determine the effectiveness of ramp-up procedures as a mitigation measure for geophysical surveys.

RATIONALE

The National Science Foundation is funding the Lamont-Doherty Earth Observatory to conduct three geophysical surveys in waters of the northeast Pacific Ocean. The first survey would characterize the evolution and state of hydration of the Juan de Fuca plate at the Cascadia subduction zone. That survey would occur from 11 June – 5 July in the area 43 to 48º N latitude and 124 to 130º E longitude in international waters and waters of the exclusive economic zones of the United States and Canada. It would be conducted in waters from 50 to 3,000 m in depth and would involve approximately 3,051 km of tracklines. The Observatory would use the R/V *Marcus G. Langseth* to tow a 36-airgun array (nominal source levels 236 to 265 dB re 1µPa (peak-to-peak) with a maximum discharge volume of 6,600 in^3) at 9 and 12 m depth. The R/V *Langseth* would tow one 8-km hydrophone streamer during a portion of the survey and would use up to 46 bottom-mounted seismometers for the other portion of the survey. The R/V *Oceanus* would deploy and recover the seismometers during the survey. The Observatory also would operate a 10.5–13 kHz multibeam echosounder and a 3.5 kHz sub-bottom profiler continuously throughout the survey.

The second survey would provide information regarding buried structures in the Cascadia thrust zone. That survey would occur from 5–8 July in the area 43.5 to 47º N latitude and 124 to 125º E longitude in waters of the exclusive economic zone of the United States off Oregon and Washington. It would be conducted in waters from 50 to 1,000 m in depth and would involve approximately 793 km of tracklines. The Observatory would use the *Langseth* to tow the 36-airgun array at 12 m depth and would operate the multibeam echosounder and sub-bottom profiler continuously throughout the survey. The *Oceanus* would deploy and recover 12 seismometers in the water and 48 seismometers would be placed on shore.

The third survey would assess various characteristics of the Juan de Fuca plate boundary and the overlying crust at the Cascadia subduction margin. That survey would occur from 12–23 July in the area 46.5 to 47.5º N latitude and 124.5 to 126º E longitude in waters of the exclusive economic zone of the United States. It would be conducted in waters from 95 to 2,650 m in depth, and would involve approximately 1,147 km of transect lines. The Observatory would use the *Langseth* to tow the 36-airgun array at 15 m depth and to tow the 8-km hydrophone streamer. It also would operate the multibeam echosounder and sub-bottom profiler continuously throughout the survey.

The Service preliminarily has determined that, at most, the proposed activities would result in a temporary modification in the behavior of small numbers of up to 26 species of marine mammals and that any impact on the affected species would be negligible. The Service does not anticipate any take of marine mammals by death or serious injury. It also believes that the potential for temporary or permanent hearing impairment will be at the least practicable level because of the proposed mitigation and monitoring measures. Those measures include monitoring exclusion and buffer zones and using power-down, shut-down, and ramp-up procedures. In addition, the Observatory would shut-down the airguns immediately if and when a North Pacific right whale is sighted, regardless of the distance from the *Langseth*. Ramp-up procedures would not be initiated until the right whale has not been seen at any distance for 30 minutes. Although the Commission considers the probability of sighting a right whale to be extremely low, it appreciates the extra caution that would be taken by the Observatory to minimize takes by the geophysical survey.

The Commission continues to be concerned about certain aspects of this and similar authorizations for geophysical surveys. These concerns have been raised in past Commission letters (e.g., see the enclosed letter from 27 March 2012) regarding geophysical surveys funded by the National Science Foundation.

Uncertainty in exclusion and buffer zones

Exclusion zones define the area in which marine mammals are close enough to a sound source to be injured (i.e., Level A harassment) or killed by exposure to the sound. Buffer zones delineate the area in which marine mammals are close enough to a sound source to be disturbed to the extent that they change their natural behavior patterns (i.e., Level B harassment). Both zones are established based on the generation and propagation of sound from the source and general assumptions about the responses of marine mammals to sounds at specific sound pressure levels, the latter being based on limited observations of marine mammal responses under known conditions.

In 2007–2008, the Lamont-Doherty Earth Observatory conducted sound propagation studies using airgun arrays from the R/V *Langseth* (Tolstoy et al. 2009) and used results from those studies to create a model of sound propagation for estimating exclusion and buffer zones. However, that model was based on a particular set of environmental conditions, and variation in such conditions is known to affect the manner in which sound propagates through the ocean. Indeed, Tolstoy et al. (2009) not only noted that results vary with environmental conditions but also used that variation as justification for measuring sound propagation at multiple locations. The National

Science Foundation subsequently followed that example in its preparation of a programmatic environmental impact statement for geophysical surveys by modeling sound propagation under various environmental conditions. Furthermore, Tolstoy et al. (2009) acknowledged that sound propagation is not only variable, but also dependent on water depth, bathymetry, and tow depth of the array. Specifically, for the Observatory's model, the applicant has stated that it overestimates actual received sound levels in deep water (>1,000 m) and underestimates actual received sound levels in shallow water (<50 m). The Service also indicated that the Observatory's model does not allow for bottom interactions, which is important for determining sound propagation in shallow and intermediate (100–1,000 m) waters. Such deviations raise questions regarding the efficacy of the model for estimating received sound levels at certain distances and for establishing exclusion and buffer zones.

In preparation for the northeast Pacific Ocean surveys, the Observatory used that model to estimate exclusion and buffer zones for the single mitigation airgun. However, it used empirically measured sound pressure levels from the Gulf of Mexico to establish the exclusion and buffer zones for the 36-airgun array to be used in the northwest Pacific Ocean. The Observatory cited Appendix A of the environmental assessment as providing the basis for its modeling approach, but Appendix A did not discuss modeling of the mitigation airgun or empirical measurements in shallow water (i.e., 100 m for this survey). The Observatory also used values halfway between the empirical shallow and deep water measurements to estimate the received sound pressure levels in intermediate waters rather than using empirical measurements obtained at an intermediate depth for the 36-airgun array, as presented in Appendix A of the environmental assessment. In addition, the Observatory used exclusion and buffer zones for the 36-airgun array that were obtained at a tow depth of 6 m to estimate zones at tow depths of 9, 12, and 15 m using the ratios of the applicable Level A and B harassment zones and depths (see Table 1 of the *Federal Register* notice). However, such adjustments may not be valid because, as the Observatory itself notes, the relationship between tow depth and sound exposure level is not linear (see Figure 6 in Appendix A).

Consequently, the exclusion and buffer zones were based on (1) a model with known biases as a function of water depth, (2) environmental conditions that are inconsistent with those in the northeast Pacific Ocean, and (3) sound sources that are different from those that are to be used (i.e., the 36-airgun array vs. the single mitigation airgun). These problems might be less significant if mitigation and monitoring measures for this type of activity were known to be highly effective, but as is well known, and as is described later in this letter, that is not the case.

On numerous occasions the Commission has recommended that the Service or the Observatory estimate exclusion and buffer zones using either empirical measurements from the particular survey site or a model that takes into account the conditions in the proposed survey area. The model should incorporate operational parameters (e.g., tow depth, source level, and number of active airguns) and site-specific environmental parameters (e.g., sound speed profiles, surface ducts, bathymetry, water depth, and wind speed). To address these shortcomings, the Marine Mammal Commission recommends that the National Marine Fisheries Service require the Observatory to re-estimate the proposed exclusion and buffer zones and associated takes of marine mammals using site-specific information. If the exclusion and buffer zones and numbers of takes are not re-

estimated, the Marine Mammal Commission recommends that the Service require the Observatory to provide a detailed justification explaining the rationale for (1) basing the exclusion and buffer zones for the proposed survey in the northeast Pacific Ocean on empirical data collected in the Gulf of Mexico or on modeling that relies on measurements from the Gulf of Mexico and (2) using simple ratios to adjust for tow depth and applying median values to estimate propagation in intermediate water depths rather than using empirical measurements.

Underestimating the numbers of takes

The Observatory estimated the number of takes expected to result from the proposed surveys using the sizes of the buffer zones and associated ensonified areas, coupled with estimates of marine mammal densities. To be precautionary, it also increased the sizes of the ensonified areas by 25 percent. However, during the first survey, the Observatory would repeat three long transect lines with multiple days between passes, and it assumed that a marine mammal taken during the first pass and then again during the second pass need only be counted once. The Commission does not agree with this reasoning for several reasons. First, marine mammals that remain in the survey area and are harassed during both passes are taken twice; the second harassment, or take, is not a continuation of the first. On both survey passes those animals may be startled, may abandon habitat, or may even be injured. Second, the marine mammals present in the survey area may change if the affected species are migrating or altering their distribution for other reasons. The available information is not sufficient to make the case that the individual marine mammals taken during the second pass will be the same individuals that were taken during the first pass. Marine mammals are highly mobile animals that often move into and out of an area quickly. For those reasons, the Marine Mammal Commission recommends that the National Marine Fisheries Service require the Observatory to re-estimate the number of takes during the first survey (i.e., Juan de Fuca plate survey) by accounting for two passes over the three long transect lines, which should effectively double the estimated number of takes from a single survey pass of those lines.

Mitigation and monitoring measures

The *Federal Register* notice states that the Observatory will monitor the area near the survey vessel for at least 30 minutes prior to the initiation of and during airgun operations. The notice also states that when airguns have been powered down because a marine mammal has been detected near or within a proposed exclusion zone, airgun activity will not resume until the marine mammal is outside the exclusion zone (i.e., the animal is observed to have left the exclusion zone or has not been seen or otherwise detected within the exclusion zone for 15 minutes in the case of small odontocetes and pinnipeds and 30 minutes in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales) or the vessel has transited beyond the original 180-dB re 1 μPa exclusion zone after an 8-minute period. That 8-minute period is based on the time it would take the *Langseth*, traveling at 8.5 km/hour, to move beyond the smallest 180-db re 1 μPa exclusion zone (i.e, 940 m for the 36-airgun array being towed at 9 m depth in waters greater than 1,000 m). However, using the same rationale, the waiting period would be more than 19 minutes for the vessel, traveling at the same speed, to move beyond the largest 180-dB re 1 μPa exclusion zone (i.e., 2,750 m for the 36-airgun array being towed at 15 m depth in waters less than

100 m). Given these extremes, the Commission does not concur with the Service's approach, which is the least protective. In addition, the Service indicated that implementing ramp-up procedures for the full array after an extended power down would not meaningfully increase the effectiveness of observing marine mammals approaching or entering the exclusion zone and would not further minimize the potential for take because the vessel would have transited more than the 940 m in 8 minutes. Here, again, the Commission disagrees with the Service's reasoning. The primary purpose of ramp-up procedures is not to increase the observer effectiveness, but rather give any marine mammals in the area an opportunity to move away from the airgun array before its impulses may harm them. In addition, the utility of ramp-up procedures is not diminished because the ship has moved away from the location where marine mammals were first sighted. Those marine mammals may be moving in the same direction as the vessel or the vessel may encounter additional marine mammals.

In short, the Commission believes that the Service's rationale is incorrect on both biological and physical grounds. The Service's approach appears to require a 15- or 30-minute pause in activity if an animal enters an exclusion zone but, in effect, that pause is not observed based on the notion that the sound source is moving. That approach does not make sense if the position of the marine mammal is not known. That is, the key consideration driving this measure is the relative positions of the animal and the sound source. Their relative positions over time are best estimated as a function of their positions when the marine mammal was first sighted plus the speed and heading of the vessel and the speed and heading of the marine mammal. If the vessel and marine mammal are moving in opposite directions, then the marine mammal may leave the exclusion zone relatively quickly. However, if they are moving in the same direction, then the marine mammal may remain in the exclusion zone for a prolonged period. In fact, Miller et al. (2009) determined that sperm whales continued on their course of travel during exposure to airgun sounds. None of those sperm whales diverted to avoid seismic activity at distances of 1–13 km from the vessel, and most whales traveled on a parallel course. Therefore, unless the marine mammal is sighted leaving or outside the exclusion zone, it does not make sense to allow the survey to resume after a shorter period of time because (1) the animal spends much of its time underwater where it is not visible, (2) it may change its heading and speed in response to the vessel, and (3) it is not possible to determine the animal's position relative to the vessel or sound source after the initial sighting unless it surfaces again and is observed.

Indeed, the efficacy of this measure depends largely on observations of the marine mammal at the surface. That being the case, the dive time of the possibly affected marine mammals is a central consideration in developing mitigation measures. For small cetaceans, the Commission has recommended a pause time of at least 15 minutes because their dive times are shorter and generally fall within that limit. For some mysticetes and large cetaceans, the proposed 30-minute pause may be inadequate, sometimes markedly so. Sperm whales and beaked whales, in particular, may remain submerged for periods far exceeding 30 minutes. Blainville's beaked whales dive to considerable depths (> 1,400 m) and can remain submerged for nearly an hour (Baird et al. 2006, Tyack et al. 2006). In addition, observers may not detect marine mammals each time they return to the surface, especially cryptic species such as beaked whales, which are difficult to detect even under ideal conditions. Barlow (1999) found that "[a]ccounting for both submerged animals and animals that are otherwise missed by the observers in excellent survey conditions, only 23 percent of Cuvier's beaked

whales and 45 percent of *Mesoplodon* beaked whales are estimated to be seen on ship surveys if they are located directly on the survey trackline." Thus, at least for certain species, visual monitoring alone is not adequate to detect all marine mammals within the exclusion and buffer zones. Therefore, the Marine Mammal Commission again recommends that the National Marine Fisheries Service prohibit an 8-minute pause following the sighting of a marine mammal in the exclusion zone and extend that pause to cover the maximum dive times of the species likely to be encountered prior to resuming airgun operations after both power-down and shut-down procedures.

In addition, as discussed in the Commission's previous letters commenting on similar activities by this and other applicants, visual monitoring is not effective during periods of bad weather or at night, especially when the radius of the exclusion zone is approximately 2,750 m in width. Although the *Federal Register* notice states that on average observers can monitor to the horizon (i.e, 10 km), it is unclear how the Observatory expects to see cryptic species (i.e., beaked whales and harbor porpoise) and smaller pinnipeds (i.e., harbor seals) at those distances even in good weather during daylight hours. Furthermore, the Observatory used Barlow (2010) as the basis for the majority of the density estimates. Those data yielded effective strip widths (i.e., based on truncation distances of 2 or 4 km and the mean probability of detection within that distance) ranging from 0.97–3.47 km depending on the species. Those distances are much less than the Observatory's assumed sighting distance of 10 km. Therefore, the Marine Mammal Commission recommends that, prior to issuing the requested authorization, the National Marine Fisheries Service provide additional justification for its preliminary determination that the proposed monitoring program will be sufficient to detect, with a high level of confidence, all marine mammals within or entering the identified exclusion and buffer zones. At a minimum, such justification should (1) identify those species that it believes can be detected with a high degree of confidence using visual monitoring only under the expected environmental conditions, (2) describe detection probability as a function of distance from the vessel, (3) describe changes in detection probability under various sea state and weather conditions and light levels, and (4) explain how close to the vessel marine mammals must be for observers to achieve high nighttime detection rates. If such information is not available, the Service and the applicant should conduct the studies needed to describe the efficacy of existing monitoring methods and develop alternative or supplemental methods to address current shortcomings.

Furthermore, the applicant indicates that it will be able to assess possible impacts by comparing estimated marine mammal abundance during periods when the airguns are not firing (i.e., baseline conditions) with periods when they are, but the efficacy of this approach depends, in part, on the length of the periods when the airguns are silent. If firing of the airguns causes marine mammals to depart an area and/or alter their behavior, a comparison after the airguns are silenced would be meaningful only if it involved sufficient time for the disturbed marine mammals to return to their normal distribution and/or behavior. If the time for such a return to normalcy exceeds the period that the airguns are silent, then any comparison would be largely meaningless as an indicator of the impact of seismic disturbance. Put frankly, the Commission does not believe that the proposed monitoring method is a scientifically sound way of assessing impacts on behavior or distribution. The Marine Mammal Protection Act requires that the National Marine Fisheries Service (for the Secretary of Commerce) put forth "requirements pertaining to the monitoring and reporting

of such taking." Although the Act is not explicit on this point, the Commission believes that Congress's intent was that those monitoring and reporting methods be scientifically sound and yield sufficient information to confirm that the authorized taking is having only negligible impacts on the affected species and stocks. That is, the monitoring and reporting requirements should provide a reasonably accurate assessment of the types of taking and the number of animals taken by the proposed activity. Therefore, the Marine Mammal Commission recommends that the National Marine Fisheries Service consult with the funding agency (i.e., the National Science Foundation) and individual applicants (e.g., Lamont-Doherty Earth Observatory and the U.S. Geological Survey) to develop, validate, and implement a monitoring program that provides a scientifically sound, reasonably accurate assessment of the types of marine mammal taking and the number of marine mammals taken. Without such a system in place, the Commission does not see how the Service can continue to assume that this type of survey is having no more than a negligible impact on marine mammal populations.

The *Federal Register* notice states that the applicant also would conduct vessel-based passive acoustic monitoring to augment visual monitoring during daytime operations and at night to help detect, locate, and identify marine mammals that may be present. The Commission supports the use of passive acoustic monitoring for this purpose but also considers it important to keep in mind the limitations of such monitoring. As the Commission has noted in previous correspondence, and as the Service acknowledges, passive acoustic monitoring is effective only when marine mammals vocalize. In addition, the effectiveness of passive acoustic monitoring will depend on the operator's ability to locate a vocalizing cetacean and determine whether it is within the power-down or shut-down radius or in a position such that the ship's movement will place it within the power-down or shut-down radius. Therefore, the Marine Mammal Commission recommends that the National Marine Fisheries Service require the Observatory to (1) report the number of marine mammals that were detected acoustically and for which a power-down or shut-down of the airguns was initiated, (2) specify if such animals also were detected visually, (3) compare the results from the two monitoring methods (visual versus acoustic) to help identify their respective strengths and weaknesses, and (4) use that information to improve mitigation and monitoring methods.

Effectiveness of ramp-up procedures

Although the effectiveness of ramp-up procedures has yet to be verified empirically, the Service would continue to require the Observatory to monitor, document, and report observations during all ramp-up procedures. Such data will provide a stronger scientific basis for determining the effectiveness of, and deciding when to implement, this particular mitigation measure. The National Science Foundation has indicated that monitoring data from past surveys are being compiled into a single database. The Commission supports that effort by the Foundation. After the data are compiled and quality control measures have been completed, the Marine Mammal Commission recommends that the National Marine Fisheries Service work with the National Science Foundation to analyze those data to help determine the effectiveness of ramp-up procedures as a mitigation measure for geophysical surveys. International researchers also are trying to determine the impacts of seismic airguns and the effectiveness of ramp-up procedures, primarily on humpback whales, during specific life history stages. However, the results of those studies are not expected for three to

five years and even then, their applicability to other species may be limited. In the interim, the Commission continues to believe that the Service should continue to require data collection and analysis to assess the effectiveness of ramp-up procedures, given that those procedures are considered a substantial component of the mitigation measures.

Please contact me if you have questions about the Commission's recommendations or rationale.

Sincerely,

Timothy J. Ragen, Ph.D.
Executive Director

Enclosure

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