9 April 2012

Mr. P. Michael Payne, Chief
Permits, Conservation, and Education 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 a marine geophysical survey to be conducted in the central Pacific Ocean in May and June 2012. The Commission also has reviewed the National Marine Fisheries Service's 30 March 2012 *Federal Register* notice announcing receipt of the application and proposing to issue the authorization, subject to certain conditions (77 Fed. Reg. 19242).

RECOMMENDATIONS

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

- require the Observatory to re-estimate exclusion and buffer zones for the two-airgun array and associated number of marine mammal takes using operational and site-specific environmental parameters—if the exclusion and buffer zones and number of takes are not re-estimated, require the Observatory to provide a detailed justification for basing the exclusion and buffer zones for the proposed survey in the central Pacific Ocean on modeling that relies on measurements from the Gulf of Mexico;
- (1) use species-specific maximum densities derived by multiplying the best density estimates by a precautionary correction factor and (2) re-estimate the anticipated number of takes using that precautionary approach;
- prohibit a 15-minute pause following the sighting of a mysticete or large odontocete in the exclusion zone and extend that pause to cover the maximum dive times of the species likely to be encountered prior to initiating ramp-up procedures; and
- work with the National Science Foundation to analyze the data collected during ramp-up procedures to help determine the effectiveness of those procedures as a mitigation measure for geophysical surveys.

RATIONALE

The National Science Foundation is funding the Lamont-Doherty Earth Observatory to conduct a geophysical and coring survey in the central Pacific Ocean in the area 0.5 to 8º S latitude

and 156 to 162º W longitude. The Observatory would conduct the survey in waters of the exclusive economic zones of the United States and the Republic of Kiribati. The purpose of the proposed survey is to characterize the sedimentation patterns on the flanks of the Line Islands Ridge and investigate the variation in climate patterns during the late Pleistocene period. The geophysical survey would occur at six different sites in the Line Islands to determine coring locations. The survey would be conducted in waters 1,100 to 5,000 m in depth with approximately 1,400 km of tracklines. It would use the R/V *Langseth* to tow a two-airgun array (nominal source level of 239.8 dB re 1μPa at 1 m (peak-to-peak) with a maximum discharge volume of 210 in^3) at 3 m depth. The *Langseth* also would tow one hydrophone streamer, 2 km in length, during the survey. In addition, the Observatory would operate a 10.5- to 13-kHz multibeam echosounder, a 3.5-kHz sub-bottom profiler, and a 75-kHz acoustic Doppler current profiler continuously throughout the survey, except during coring activities. During those activities, the Observatory would deploy 15 piston cores, 30 gravity cores, and 8 multicores. The cores would range in size from 10 to 90 cm in diameter.

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 16 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.

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 modeling 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 2003 and 2007–2008, the Lamont-Doherty Earth Observatory conducted sound propagation studies using various configurations of airgun arrays from the R/V *Maurice Ewing* (Tolstoy et al. 2004) and R/V *Marcus G. Langseth* (Tolstoy et al. 2009). The Observatory 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 and bathymetry. In addition, Tolstoy et al. (2004) indicated that the Observatory's model overestimates actual received sound levels in deep water (> 1,000 m) and underestimates actual received sound levels in shallow water (< 50 m). 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 proposed survey, the Observatory used its model to estimate exclusion and buffer zones for its two-airgun array. It did not provide details regarding the model and estimation of those zones in either its application or environmental assessment. As a result, the Commission was not able to review and assess the applicability of the model and its associated exclusion and buffer zones. Other Foundation-funded applicants have used operational and site-specific environmental parameters, the Comprehensive Acoustic System Simulation/Gaussian Ray Bundle model, and the Range-dependent Acoustic Model to estimate the extent of those zones. The Commission is unsure why the Observatory did not use the same methods to estimate the exclusion and buffer zones for its study. Thus, it appears that the Observatory's approach is based on (1) a model with uncertain parameters but a known bias as a function of water depth, (2) environmental conditions that are inconsistent with those in the central Pacific Ocean, and (3) sound sources (i.e., 6-, 10-, 12-, and 20-airgun arrays) that are different than the array to be used (i.e., a 2-airgun array).

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 exclusion and buffer zones for the two-airgun array and associated number of marine mammal takes using operational and site-specific environmental parameters. If the exclusion and buffer zones and number of takes are not re-estimated, the Marine Mammal Commission recommends that the Service require the Observatory to provide a detailed justification for basing the exclusion and buffer zones for the proposed survey in the central Pacific Ocean on modeling that relies on measurements from the Gulf of Mexico. The Commission would like an opportunity to evaluate the detailed justification prior to issuance of the authorization.

Uncertainty in take estimates

The Observatory estimated the number of takes expected to result from the proposed survey using the size of the buffer zones and associated ensonified areas, coupled with estimates of marine mammal densities from a previous marine mammal survey. To be precautionary, it increased by 25 percent the size of the area it expects to be ensonified to a level sufficient to result in harassment. The Observatory's application and the Service's *Federal Register* notice indicated uncertainty in the representativeness of the density data and, thus, the assumptions used to calculate takes. That

uncertainty was based on limited survey effort in the survey area and densities from some species originating from offshore Hawaiian waters, which are more than 1,400 km from the survey area. However, the Observatory and the Service did not address the uncertainty inherent in the density data from temporal differences (i.e., some data were collected in the mid-1980s and none of the data were collected in May or June when the survey would occur). In previous incidental harassment authorizations (e.g., the U.S. Geological Survey's proposed geophysical survey in the central Gulf of Alaska; 76 Fed. Reg. 18187), the Service used maximum densities to estimate the number of takes because of similar uncertainties regarding density data with respect to space and time. In the cases where only one density estimate was available (as is the case for this proposed incidental harassment authorization), the Service has calculated maximum densities for marine mammals by multiplying the best density estimate by 1.5 (e.g., 76 Fed. Reg.18185, 76 Fed. Reg. 26276). Given the similar nature and considerable uncertainty in density estimates for marine mammals in the proposed survey area and the need to ensure adequate protection, the Marine Mammal Commission recommends that the National Marine Fisheries Service (1) use species-specific maximum densities derived by multiplying the best density estimates by a precautionary correction factor and (2) re-estimate the anticipated number of takes using that precautionary approach.

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 airgun operations. The notice also states that when airguns have been powered down or shut 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, killer, and beaked whales). However, the *Federal Register* notice also states that ramp-up procedures would occur after only 15 minutes based on the use of a comparable period in previous incidental harassment authorizations.

After further review of the ramp-up measure, the Commission believes that it does not make sense biologically or physically. On its face, the power-down and shut-down mitigation measure has required a 15- or 30-minute pause in activity if an animal enters an exclusion zone. However, the related ramp-up measure has allowed the applicant to resume the survey after a shorter period of time based on the movement of the vessel and sound source. 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 a 15-minute pause following the sighting of a mysticete or large odontocete in the exclusion zone and extend that pause to cover the maximum dive times of the species likely to be encountered prior to initiating ramp-up procedures.

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. Further, 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 the data collected during ramp-up procedures to help determine the effectiveness of those 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.

Melon-headed and beaked whales

A resident population of melon-headed whales may occur at Palmyra Atoll, which is part of the Line Islands. Those animals have been observed resting in the Atoll's shallow waters during the day and moving offshore to waters 1,300 m in depth to forage at night (Brownell et al. 2009). Although the acoustic footprint of the geophysical survey may not overlap with the known range of those animals, little is known about their range. And, because this is potentially a separate population of melon-headed whales, the Commission believes that the Observatory should be advised to exercise caution should those whales be encountered. If those whales are encountered near Palmyra Atoll, the Observatory should record and report on any observations it makes.

In addition, it is possible that a little known species or stock of beaked whale occurs in waters around Palmyra Atoll. Baumann-Pickering (2009) determined that vocalizations from some beaked whales in that area are acoustically distinct from other species of beaked whales (Zimmer et al. 2005, Johnson et al. 2006) and from an unknown beaked whale at Cross Seamount in Hawaii (McDonald et al. 2009). It is likely that the beaked whales at the Atoll are of the genus *Mesoplodon* (Baumann-Pickering 2009) and could be *Mesoplodon hotaula* based on genetic analysis of skulls from stranded animals (Dalebout, unpublished results). Skull samples from the Atoll are identical genetically to a stranded specimen from Sri Lanka (Dalebout, unpublished results), which was described initially as *M. hotaula* by Deraniyagala (1963a, 1963b). Additionally, *M. hotaula* was considered synonymous with *M. gingkodens* (Moore and Gilmore 1965) due to similarities in the skulls. Baumann-Pickering (2009) indicated that biopsy samples and additional photographs of males with their distinct dentition should be obtained to determine the precise species of beaked whale at the Atoll. Although the information regarding this beaked whale species or stock may not be sufficient to warrant official listing in the proposed incidental harassment authorization, the Observatory should use caution when in the presence of beaked whales and report any observations it makes. If the survey causes the death of a melon-headed whale or a beaked whale, collection of the specimen could contribute significantly to our understanding of those species.

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

Sincerely,

Timothy J. Ragen, Ph.D.
Executive Director

Enclosure

References

Baird, R.W., D.L. Webster, D.J. McSweeney, A.D. Ligon, G.S. Schorr, and J. Barlow. 2006. Diving behavior and ecology of Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales in Hawaii. Canadian Journal of Zoology 84(8):1120–1128.

Barlow, J. 1999. Trackline detection probability for long-diving whales. Pages 209–221 *in* G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds.), Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam, The Netherlands.

Baumann-Pickering, S. 2009. Species identification and measurement of activity in odontocete species of Palmyra Atoll by acoustic monitoring. Ph.D. Thesis, Eberhard Karls University, Tübingen, Germany. 101pp.

Brownell, R.L., K. Ralls, S. Baumann-Pickering, and M.M. Poole. 2009. Behavior of melon-headed whales, *Peponocephala electra*, near oceanic islands. Marine Mammal Science 25(3):639– 658.

Deraniyagala, P.E.P. 1963a. A new beaked whale from Ceylon. Government Information Bulletin, Ceylon Today 12(3):2, 13–14.

Deraniyagala, P.E.P. 1963b. Mass mortality of the new subspecies of little piked whale *Balaenoptera acutorostrarta thalmaha* and a new beaked whale *Mesoplodon hotaula* from Ceylon. Spolia Zeylanica 30(1):79–84.

Johnson, M., P.T. Madsen, W.M.X. Zimmer, N. Aguilar de Soto, and P.L. Tyack. 2006. Foraging Blainville's beaked whales (*Mesoplodon densirostris*) produce distinct click types matched to different phases of echolocation. Journal of Experimental Biology 209:5038–5050.

McDonald, M.A., J.A. Hildebrand, S.M. Wiggins, D.W. Johnston, and J.J. Polovina. 2009. An acoustic survey of beaked whales at Cross Seamount near Hawaii. Journal of the Acoustic Society of America 125(5):624–627.

Miller, P.J.O., M.P. Johnson, P.T. Madsen, N. Biassoni, and P.L. Tyack. 2009. Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. Deep-Sea Research I 56(7): 1168–1181.

Moore, J.C. and R.M. Gilmore. 1965. A beaked whale new to the western hemisphere. Nature 205: 1239–1240.

Tolstoy, M., J. Diebold, S.C. Webb, D.R. Bohenstiehl, 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. Bohenstiehl, 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.

Tyack, P.L., M. Johnson, N. Aguilar Soto, A. Sturlese, and P.T. Madsen. 2006. Extreme diving of beaked whales. Journal of Experimental Biology 209(21):4238–4253.

Zimmer, W.M.X., M. Johnson, P.T. Madsen, and P.L. Tyack. 2005. Echolocation clicks of free-ranging Cuvier's beaked whales (*Ziphius cavirostris*). Journal of the Acoustic Society of America 117:3191–3927.