

portable high-resolution seismic system, were described in an earlier **Federal Register** notice on April 11, 2003 (68 FR 17773). The current LDEO Mid-Atlantic application also provides information on what is known about the effects on marine mammals of the types of seismic operations planned by LDEO.

#### *Possible Effects of the Sub-bottom Profiler Signals*

Sound levels have not been measured for the sub-bottom profiler used by the *Maurice Ewing*, but Burgess and Lawson (2000) measured the sounds propagating more or less horizontally from a similar unit with similar source output (205 dB re 1  $\mu$ Pa-m). The 160 and 180 dB re 1  $\mu$ Pa (rms) radii, in the horizontal direction, were estimated to be near 20 m (66 ft) and 8 m (26 ft), respectively, from the source, as measured in 13 m (43 ft) water depth. The corresponding distances for an animal in the beam below the transducer would be greater, on the order of 180 m (591 ft) and 18 m (59 ft), assuming spherical spreading.

The sub-bottom profiler on the *Maurice Ewing* has a maximum source level of 204 dB re 1  $\mu$ Pa-m. Thus the received level would be expected to decrease to 160 and 180 dB at about 160 m (525 ft) and 16 m (52 ft) below the transducer, respectively (assuming spherical spreading). Corresponding distances in the horizontal plane would be lower, given the directionality of this source (30° beamwidth) and the measurements of Burgess and Lawson (2000).

#### *Masking by Sub-bottom Profiler Signals*

There is little chance that marine mammal communications will be masked appreciably by the sub-bottom profiler signals given its relatively low power output, the low duty cycle, directionality, and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of baleen whales, the sonar signals do not overlap with the predominant frequencies in the animals' calls, which would avoid significant masking.

#### *Behavioral Responses Resulting from Sub-bottom Profiler Signals*

Marine mammal behavioral reactions to pulsed sound sources and responses to the sub-bottom profiler are likely to be similar to those of other pulsed sources at the same received levels. However, the pulsed signals from the sub-bottom profiler are much weaker than those from the airgun array and the multi-beam sonar. Therefore behavioral responses rising to Level B harassment are not expected unless marine mammals are very close to the source,

e.g. within about 160 m (525 ft) below the vessel, or a lesser distance to the side. Because simple momentary behavioral reactions that are within normal behavioral patterns for that species are not considered to be a taking, the very brief exposure of cetaceans to signals from the sub-bottom profiler is unlikely to result in a "take" by harassment.

#### *Hearing Impairment and Other Physical Effects*

Source levels of the sub-bottom profiler are much lower than those of the airguns and the multi-beam sonar that will be used during the planned project. Furthermore, received levels of pulsed sounds that are necessary to cause temporary or permanent hearing impairment in marine mammals appear to be higher than 180 dB. Thus, it is unlikely that the sub-bottom profiler produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is briefly in a position immediately adjacent to the source.

Furthermore, the sub-bottom profiler is usually operated simultaneously with other higher-power acoustic sources. Many marine mammals will move away in response to the approaching higher-power sources before the mammals would be close enough to be affected by the less intense sounds from the sub-bottom profiler. In the event that mammals do not avoid the approaching vessel and its various sound sources, mitigation measures that would be applied to minimize effects of the higher-power sources (discussed later in this document) would further reduce or eliminate any minor effects of the sub-bottom profiler.

#### *Estimates of Take by Harassment for the two Mid-Atlantic Cruises*

As described previously (68 FR 17909, April 14 2003), animals subjected to sound levels  $\leq 160$  dB may alter their behavior or distribution, and therefore might be considered to be taken by Level B harassment. However, the 160-dB criterion is based on studies of baleen whales (mysticetes), which are low frequency hearing specialists. In contrast, odontocete hearing at low frequencies is relatively insensitive, and dolphins and pilot whales generally appear to be more tolerant of strong sounds than are most baleen whales. Delphinidae have their best hearing in the higher frequencies and are unlikely to be as sensitive as the mysticete whales to the low frequency of the airgun array. Therefore, LDEO believes they are less likely to experience Level B harassment at 160 dB, and a more

likely threshold for onset of Level B harassment in response to seismic sounds is at about 170 dB.

The estimates of takes by harassment are based on the number of marine mammals that may be exposed to seismic sounds  $\geq 160$  dB re 1  $\mu$ Pa (rms) by operations with the 20-airgun array and the 2 GI guns, during the TAG and ADWBC cruises, respectively. Based on marine mammal density sightings and effort data collected during a survey of offshore waters northeast of the Azores by Lens (1991), LDEO used their estimates of marine mammal density to compute the best (and maximum) estimates of the number of marine mammals that may be exposed to received levels  $\geq 160$ -dB re 1  $\mu$ Pa (rms) (NMFS' current criterion for onset of Level B harassment). The best estimates of densities were then multiplied by the linear extent of the proposed survey effort and by twice the 160 dB radius around the applicable airgun array. The proposed survey effort is 185 km (100 n.mi.) for the TAG cruise, and 4329 km (2340 n.mi.) for the ADWBC cruise. The 160-dB radius for the TAG cruise (20-airgun array) is 9000 m (29,529 ft), whereas that for the ADWBC cruise (2 GI guns) is 510 m (1673 ft). For large cetaceans, LDEO used 0.5x the densities seen during the Lens (1991) survey to calculate the numbers that might be exposed to seismic sounds, but even this reduced number is likely a high estimate, because the proposed survey areas are likely less productive, so feeding aggregations similar to those seen by Lens (1991) are not likely to be seen. In particular, the two areas where the proposed surveys will be conducted are farther offshore and likely in less productive waters than the area surveys northeast of the Azores (Lens 1991). Thus, densities are likely to be much lower in the two proposed survey areas than in the Lens (1991) survey area.

Based on this method, tables 3 and 4 of LDEO's application give the best estimates, as well as maximum estimates, of densities for each species or species group of cetacean in the proposed seismic survey areas during the TAG and ADWBC cruises, respectively, that might be exposed to received levels  $\geq 160$  dB re 1  $\mu$ Pa (rms), and thus potentially taken by Level B harassment, during seismic surveys in the proposed study areas of the Mid-Atlantic Ocean. During the TAG cruise, 38 of the marine mammals exposed to sounds  $\geq 160$  dB re 1  $\mu$ Pa (rms) would be endangered species, primarily fin (18) and sperm whales (15). During the ADWBC cruise, 49 of the marine mammals exposed to sounds  $\geq 160$  dB re 1  $\mu$ Pa (rms) would be endangered