

finned pilot whale (*Globicephala macrorhynchus*), North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), Bryde's whale (*Balaenoptera edeni*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), and the blue whale (*Balaenoptera musculus*). Another three species are known to occur just outside of the study area and are not likely to be seen within the study area - the northern bottlenose whale (*Hyperoodon ampullatus* (not usually found south of Nova Scotia)),

the white-beaked dolphin (*Lagenorhynchus albirostris* (does not normally occur south of Cape Cod)), and Fraser's dolphin (*Lagenodelphis hosei* (usually found further south)). Pinnipeds are unlikely to be seen in the study area although vagrants of grey (*Halichoerus grypus*) and hooded (*Cystophora cristata*) seals could occur. Additional information on most of these species is contained in Caretta et al. (2001, 2002) which is available at: http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars.html.

Potential Effects on Marine Mammals

The sound pressure fields for the standard and augmented 20-gun arrays have been modeled by LDEO, in relation to distance and direction from the airguns. As determined by the models, the pressure fields are similar for both the 8575 in³ and the 11,000 in³ arrays. Table 1 in the application (LDEO Bermuda 2003) shows the maximum distances from both 20-airgun array configurations where sound levels of ≥ 190 , 180, 170, and 160 dB re 1 μ Pa (rms) are predicted to be received:

20-Airgun Array Volume	Predicted RMS Radii in meters/ft			
	190 dB	180 dB	170 dB	160 dB
8575 in ³	275/902	900/2953	2600/8531	9000/29,529
11,000 in ³	300/984	925/3035	2900/9515	9200/30,185

An earlier notice of an LDEO application and proposed IHA was published in the **Federal Register** on April 14, 2003 (68 FR 17909). That notice described, in detail, the characteristics of the *Ewing's* acoustic sources and, in general, the anticipated effects on marine mammals including masking, disturbance, and potential hearing impairment and other physical effects. That information is not repeated here. In addition, details on acoustic sources from, and possible effects of, the sub-bottom profiler, which was not used in the project described in the April 14, 2003, notice, were described on July 28, 2003 (68 FR 44294). The subject LDEO Bermuda application also provides information on what is known about the effects on marine mammals of the types of seismic operations planned by LDEO.

Estimates of Take by Harassment for the Bermuda Cruise

As described previously (68 FR 17909, April 14 2003), animals subjected to sound levels ≥ 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. 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, they are less likely to experience Level B harassment at 160 dB. 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 might be exposed to seismic sounds ≥ 160 dB re 1 μ Pa (rms) by operations with the 20-airgun array planned for the project. Taken from year-round marine mammal density aerial survey data that has been summarized by geographic location and calendar season (CETAP 1982), LDEO used densities for the "Entire Atlantic Stratum" during the autumn period to estimate the numbers of marine mammals that are likely to be present in the proposed survey area near Bermuda. These densities are probably overestimates of the numbers that are likely to be present, because much of the proposed seismic survey area is farther from shore, in greater water depths, and in generally much less productive waters. Because the CETAP (1982) surveys were conducted from an airplane, few beaked whales were seen or identified, and densities of beaked whales were estimated to be zero during the autumn surveys. More than likely there are small numbers of beaked whales in the proposed survey area throughout the year, so LDEO used the mean density for the entire year to estimate the densities of beaked whales that might be present.

Except for beaked whales, LDEO used its best estimate of density to compute a best estimate of the number of marine mammals that may be exposed to seismic sounds ≥ 160 dB re 1 μ Pa (rms) (NMFS' current criterion for onset of Level B harassment). The best density estimates were multiplied by the linear extent of the proposed survey (1200 km or 648 n.mi. for each of the 8575 and approximately 11,000 in³ arrays) and by twice the 160-dB safety radius around

the applicable 20-airgun arrays to estimate the "best estimate" of the numbers of animals of each species that might be exposed to sound levels ≥ 160 dB re 1 μ Pa (rms) during the proposed seismic survey program.

Based on this method, Table 3 in the LDEO application gives the best estimates, as well as maximum estimates, of densities for each species or species group of marine mammal that might be exposed to received levels ≥ 160 dB re 1 μ Pa (rms), and thus potentially taken by Level B harassment during seismic surveys in the proposed study area of the Northwest Atlantic Ocean near Bermuda. It is assumed that the 20-airgun array would be used for all surveys but that air volume would be 8575 in³ for half of the survey and approximately 11,000 in³ for half of the survey.

Delphinidae would account for 94 percent of the overall estimate for potential taking by harassment (i.e., 10,292 of 10,910), with short-beaked common dolphins (3941) and pilot whales (3345) believed to account for about 71 percent of all delphinids in the area of the proposed seismic survey, and with smaller numbers of bottlenose dolphins (1871), Risso's dolphins (858), and striped dolphins (277) accounting for most of the remaining 29 percent. While there is no agreement regarding any alternative "take" criterion for dolphins exposed to airgun pulses, if only those dolphins exposed to ≥ 170 dB re 1 μ Pa (rms) were to be affected sufficiently to be considered taken by Level B harassment, then the best estimate for common dolphins would be 1191 rather than 3941 during the Bermuda Rise cruise, and for pilot whales it would be 1011 instead of