

hearing impairment and other physical effects. That information is not repeated here. However, possible effects of the sub-bottom profiler, which was not used in the project described in that notice, are described below. The LDEO application also provides information on what is known about the effects on marine mammals of the types of seismic operations planned by LDEO.

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 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 small numbers of 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 Norwegian Sea Cruise

The estimates of takes by harassment are based on the number of marine mammals that might be found within the 160 dB isopleth radius and potentially disturbed by operations with the 6-airgun array planned for the project. If the 2-GI gun array is used for all or part of the survey, the numbers of marine mammals that might be affected by the proposed seismic survey would be lower than the estimates described below. If only the 2-GI gun array is used, the numbers of animals that would encounter airgun sounds ≥ 160 dB re 1 (rms) would be about one-fifth of the number if only the 6-gun array were used.

Based on summer marine mammal density survey data collected by Sigurjonsson and Gunnlaugsson (1989), 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), except for bottlenose whales. Northern bottlenose whales are migratory and most leave the proposed seismic survey area before the end of June (Benjaminsen 1972; Sigurjonsson and Gunnlaugsson 1990). Therefore, only a few, if any, bottlenose whales may be seen during the seismic survey in the study area during late August to September. For bottlenose whales, LDEO used 0.10x the observed average or maximum density to calculate the numbers that might be exposed to seismic sounds, but even this reduced number is likely a high estimate. For all other species, the average densities were multiplied by the proposed survey effort (3109 km or 1678 n.mi) and twice the 160-dB safety radius around the 6-gun array to estimate the "best estimate" of the numbers of animals 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 LDEO (2003) gives the best 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 Norwegian Sea. Of these, 86 animals would be endangered species, primarily fin (42), humpback (22), and sperm whales (18). Delphinidae would account for 75 percent of the overall estimate for potential taking by harassment, with white-beaked dolphins (298) believed to account for about 90 percent of all delphinids in the area of the proposed seismic survey, and with killer whales (137) and long-finned pilot whales (302) accounting for most of the remaining 10 percent. However, part or all of the survey could be conducted with 2-GI guns. The 160-dB radius for the 2-GI gun array is 520 m (1706 ft) or 19 percent of that of the 6-gun array. Thus, if all surveys were conducted with the 2 GI guns, best estimates of the numbers of animals that would be exposed to seismic sounds ≥ 160 dB would be much less.

As described previously (68 FR 17909), 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 harbor porpoises 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.

Conclusions-Effects on Cetaceans

Strong avoidance reactions by several species of mysticetes to seismic vessels have been observed at ranges up to 6 to 8 km (3.2 to 4.3 nm) and occasionally as far as 20–30 km (10.8–16.2 nm) from the source vessel. Some bowhead whales avoided waters within 30 km (16.2 nm) of the seismic operation. However, reactions at such long distances appear to be atypical of other species of mysticetes, and even for bowheads may only apply during migration.

Odontocete reactions to seismic pulses, or at least those of dolphins, are expected to extend to lesser distances