

radii that are quite variable, while some baleen whales show considerable tolerance of seismic pulses. Whales are often reported to show no overt reactions to airgun pulses at distances beyond a few kilometers, even though the pulses remain well above ambient noise levels out to much longer distances. However, recent studies of humpback and especially bowhead whales show that reactions, including avoidance, sometimes extend to greater distances than documented earlier, possibly even exceeding the distances at which boat-based observers can see whales. 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 n.mi.) and occasionally as far as 20–30 km (10.8–16.2 n.mi.) from the source vessel. Some bowhead whales avoided waters within 30 km (16.2 n.mi.) 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 than those of mysticetes. Odontocete low-frequency hearing is less sensitive than that of mysticetes, and dolphins are often seen from seismic vessels, occasionally even at close distances. In fact, there are documented instances of dolphins approaching active seismic vessels. However, dolphins as well as some other types of odontocetes sometimes show avoidance responses and/or other changes in behavior when near operating seismic vessels. In the cases of mysticetes, these reactions are expected to involve small numbers of individual cetaceans because few mysticetes occur in the area where seismic surveys are proposed.

For most species, including endangered sperm and blue whales, the total estimated “take by harassment” by species presented in Table 3 of the application (Scripps 2003) represents less than 1.0 percent of the eastern tropical Pacific population of any of these species. For the remaining three cetacean species, the total estimated “take by harassment” are 1.8 percent of the estimated pygmy sperm whale population in and adjacent to the study area, 6.2 percent of the dwarf sperm whale population, and 1.8 percent of endangered humpback whales would receive seismic sounds ≤ 160 dB. Although the absolute numbers of odontocetes that may be harassed by the proposed activities may be large, the population sizes of the main species are also large; therefore, the numbers

potentially affected are small relative to the population sizes.

Taking account of the mitigation measures that are planned, effects on cetaceans are generally expected to be limited to avoidance of the area around the seismic operation and short-term changes in behavior, falling within the MMPA definition of “Level B harassment.” Based on the relatively low numbers of marine mammals that will be exposed at levels ≤ 160 dB and the expected impacts at these levels, NMFS has preliminarily determined that this action will have a negligible impact on the affected species or stocks of cetaceans.

Conclusions-effects on Pinnipeds

Responses of pinnipeds to acoustic disturbance are variable, but usually quite limited. Early observations provided considerable evidence that pinnipeds are often quite tolerant of strong pulsed sounds. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior. These studies show that pinnipeds frequently do not avoid the area within a few hundred meters of an operating airgun array. Even so, results from initial telemetry studies suggest that avoidance and other behavioral reactions may be stronger than has been evident from visual studies.

Very few, if any, pinnipeds are expected to be encountered during the proposed seismic survey in the ETP, and it is therefore unlikely that the seismic vessel will encounter significant numbers of any of the four pinniped species that live, for at least part of the year, in the area of proposed seismic profiling.

If pinnipeds are encountered, the proposed seismic activities would have, at most, a short-term effect on their behavior and no long-term impacts on individual seals or their populations. Effects are expected to be limited to short-term and localized behavioral changes falling within the MMPA definition of Level B harassment. Therefore, NMFS’ preliminary determination is that impacts will be negligible.

Mitigation

For the proposed seismic operations in the ETP, SIO will use 2-GI guns with a total volume of 90 in³ (1475 cc). These airguns will be spread out horizontally, so that the energy from the array will be directed mostly downward. The following mitigation measures, as well as marine mammal monitoring, will be

adopted during the proposed ETP seismic survey program.

Shutdown Procedures

SIO proposes to shut down seismic sources whenever marine mammals are observed close enough to the vessel that they are at risk of exposure to sound levels greater than 180 dB (rms), where there is a possibility of Level A harassment. Airgun operations will be suspended immediately when marine mammals are observed within, or about to enter, this designated safety zone. Current NMFS guidance dictates that cetaceans and pinnipeds should not be exposed to impulsive sounds exceeding 180 and 190 dB rms (the level for the potential for Level A harassment), respectively. SIO will adopt a 180-dB threshold for all marine mammals because pinnipeds have less developed (or less documented) avoidance behaviors, and because of the low likelihood that pinnipeds will be encountered.

SIO has adopted conservative methods in defining safety zone calculations using (i) a 9-dB difference between p-p and rms, and (ii) spherical spreading of the sound, even though it is clear that at the low acoustic frequencies which dominate SIO’s airgun output, the generated sound pulses have considerable directivity, favoring downward propagation over horizontal propagation (because in the near-horizontal direction the direct gun pulse is closely followed by the opposite-phased bounce off the sea surface, if the source is within an acoustic wavelength of the surface; this effect can reduce the effective near-horizontal output by as much as 10 dB). Because the actual seismic source is a distributed sound source rather than a single point source, the highest sound levels measurable at any location in the water will be less than the nominal source level.

As described earlier, the pair of simultaneously fired airguns would have a p-p amplitude of 236 dB re 1 μ Pa. Converting to a rms dB using the 9 dB difference between p-p and rms for a sine wave yields an output level of 227 dB rms. Therefore, SIO’s modeled results for the 2-gun array indicate that, assuming spherical spreading, the paired guns would produce sound levels of 180 dB re 1 μ Pa (rms) at a range of about 225 m (738 ft); i.e., the radius around the 2-gun array where the received level would be 180 dB re 1 μ Pa (rms), is estimated to be 225 m (738 ft). The effect of using a conservative calculation, which yields this safety zone for 180 dB rms sound, is to build a safety factor into the airgun