

The *R/V Maurice Ewing* is a suitable platform for marine mammal observations. The observer's eye level will be approximately 11 m (36 ft) above sea level when stationed on the bridge (the highest practical vantage point on the vessel), allowing for good visibility within a 210° arc for each observer. The proposed monitoring plan is summarized later in this document.

Proposed Safety Radii

Received sound levels have been modeled for the 2-GI guns and the 6-airgun arrays. Based on the modeling, estimates of the 190-, 180-, 170-, and 160-dB re 1 μ Pa (rms) distances (safety radii) for these arrays have been provided previously in this document.

Airgun operations will be suspended immediately when cetaceans are seen within or about to enter the appropriate 180-dB (rms) radius, or if pinnipeds are seen within or about to enter the 190-dB (rms) radius. These 180- and 190-dB criteria are consistent with guidelines listed for cetaceans and pinnipeds by NMFS (2000) and other guidance by NMFS.

Mitigation During Operations

The following mitigation measures, as well as marine mammal monitoring, will be adopted during the proposed Storegga slide seismic survey program and the acoustic verification program, provided that doing so will not compromise operational safety requirements: (1) Course alteration; and (2) Shut-down procedures; and (3) Ramp-up procedures.

Course Alteration

If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, alternative ship tracks will be plotted against anticipated mammal locations. The vessel's direct course and/or speed will be changed in a manner that also minimizes the effect to the planned science objectives. The marine mammal activities and movements relative to the seismic vessel will be closely monitored to ensure that the marine mammal does not approach within the safety radius. If the mammal appears likely to enter the safety radius, further mitigative actions will be taken, i.e., either further course alterations or shutdown of the airguns.

Shutdown Procedures

Vessel-based observers will monitor marine mammals near the seismic vessel during daylight and for at least 30 minutes prior to start up during darkness throughout the program. Airgun operations will be suspended

immediately when marine mammals are observed within, or about to enter, designated safety zones. The shutdown procedure should be accomplished within several seconds or one shot period of the determination that a marine mammal is within or about to enter the safety zone. Airgun operations will not resume until the marine mammal is outside the safety radius. Once the safety zone is clear of marine mammals, the observer will advise that seismic surveys can re-commence. The "ramp-up" procedure will then be followed.

Ramp-up Procedure

A "ramp-up" procedure will be followed when the airgun arrays begin operating after a specified-duration period without airgun operations. Under normal operational conditions (vessel speed 4–5 knots), a ramp-up would be required after a "no shooting" period lasting 2 minutes or longer. At 4 knots, the source vessel would travel 247 m (810 ft) during a 2-minute period. If the towing speed is reduced to 3 knots or less, as sometimes required when maneuvering in shallow water, it is proposed that a ramp-up would be required after a "no shooting" period lasting 3 minutes or longer. At towing speeds not exceeding 3 knots, the source vessel would travel no more than 277 m (909 ft) in 3 minutes. These guidelines would require modification if the normal shot interval were more than 2 or 3 min, but that is not expected to occur during the Storegga slide cruise.

Ramp-up will begin with the smallest gun in the 6-gun array (80 in³). Guns will be added in a sequence such that the source level of the array will increase in steps not exceeding 6 dB per 5-minute period over a total duration of approximately 14 min. During the ramp-up procedures, the safety zone for the full gun array will be maintained. Ramp-up will not occur for the 2-GI gun array, since the total air discharge volume for this array is small (210 in³).

Monitoring and Reporting

LDEO proposes to conduct marine mammal monitoring of its 2003 Storegga slide seismic program in the Norwegian Sea and acoustical verification of safety radii, in order to satisfy the anticipated requirements of the IHA.

Vessel-based Visual Monitoring

The observer(s) will systematically scan the area around the vessel with 7 X 50 Fujinon reticle binoculars or with the naked eye during the daytime. At night, night vision equipment will be available (ITT F500 Series Generation 3 binocular image intensifier or

equivalent). Laser rangefinding binoculars (Bushnell Lytespeed 800 laser rangefinder with 4 optics or equivalent) will be available to assist with distance estimation. If a marine mammal is seen well outside the safety radius, the vessel may be maneuvered to avoid having the mammal come within the safety radius (see Mitigation). When mammals are detected within or about to enter the designated safety radii, the airguns will be shut down immediately. The observer(s) will continue to maintain watch to determine when the animal is outside the safety radius. Airgun operations will not resume until the animal is outside the safety radius.

At least one experienced marine mammal observer will be on duty aboard the seismic vessel, as well as a fishery expert (as likely required by the Norwegian Petroleum Directorate (2003)) and possibly one qualified contract biologist. Observers (appointed by LDEO) will complete a one-day training/refresher course on marine mammal monitoring procedures, given by a contract employee experienced in vessel-based seismic monitoring projects.

Observers will be on duty in shifts of duration no longer than 4 hours. Use of two simultaneous observers will increase the proportion of the marine mammals present near the source vessel that are detected. Bridge personnel additional to the dedicated marine mammal observers will also assist in detecting marine mammals and implementing mitigation requirements, and before the start of the seismic survey will be given instruction in how to do so.

Reporting

The vessel-based monitoring will provide data required to estimate the numbers of marine mammals exposed to various received sound levels, to document any apparent disturbance reactions, and thus to estimate the numbers of mammals potentially taken by Level B harassment. It will also provide the information needed in order to shut down the airguns at times when mammals are present in or near the safety zones. When a mammal sighting is made, the following information about the sighting will be recorded: (1) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to seismic vessel (e.g., none, avoidance, approach, paralleling, etc.), and behavioral pace; and (2) time, location, heading, speed, activity of the vessel