

smallest gun in the 6-gun array (80 in3), and 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. Under normal operational conditions (vessel speed 4–5 knots), a ramp-up will 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, ramp-up will 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. 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).

Course Alteration

If a marine mammal is detected outside the safety radius and, based on its position and 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. The Ewing is required to adopt this mitigation measure during the Norwegian Sea seismic survey program provided that doing so will not compromise operational safety requirements.

Marine Mammal Monitoring

LDEO will conduct marine mammal monitoring during its seismic program in the Norwegian Sea in order to verify that the taking of marine mammals, by harassment, incidental to conducting the seismic survey will have a negligible impact on marine mammal stocks and to ensure that these harassment takings are at the lowest level practicable. Up to three vessel-based observers will be stationed on the *R/V Maurice Ewing*

during seismic operations in the Storegga slide area. Vessel-based observers will monitor for marine mammals near the seismic source vessel for at least 30 minutes prior to and during all daylight ramp-up and airgun operations, and for at least 30 minutes before and during any nighttime startups of the airguns. At least one experienced marine mammal observer will be on duty aboard the seismic vessel, as well as a fisheries expert (as likely required by the Norwegian Petroleum Directorate (2003)) and possibly one qualified contract biologist. Observers (appointed by LDEO) will complete a training/refresher course on marine mammal monitoring procedures, given by a contract employee experienced in vessel-based seismic monitoring projects. The *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. Airgun operations will be suspended when marine mammals are observed within, or about to enter, designated safety zones. 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. 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.

Observers will be on duty in shifts of duration no longer than 4 hours. Use of two simultaneous observers whenever possible will decrease the potential that marine mammals near the source vessel will be missed. Bridge personnel will also assist in detecting marine mammals and implementing mitigation requirements, and before the start of the seismic survey will be given proper instruction for observing and reporting marine mammals and sea turtles.

Observers will not normally be on duty during ongoing seismic operations at night; bridge personnel will watch for marine mammals during this period and will immediately call for the airguns to be shut-down or powered-down if marine mammals are observed in or about to enter the safety radii. A marine mammal observer will be on “standby” at night, in case bridge personnel see a marine mammal. If the airguns are started up at night, two marine mammal observers will monitor for marine mammals near the source vessel for 30 minutes prior to start up using night-vision devices. An image-intensifier

night-vision device (NVD) will be available for use at night, although NMFS notes that past experience has shown that NVDs are of limited value for this purpose. If the complete safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime, ramp-up may not commence unless the seismic source has maintained an SPL of at least 180 dB during the interruption of seismic survey operations.

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.

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. Results from the vessel-based observations will provide (1) the basis for real-time mitigation (airgun power-down); (2) information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS; (3) data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted; (4) information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity; and (5) data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Reporting

When a marine 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 (shooting or not), sea state, visibility,