

calf pairs, reproduction, feeding or temporary or permanent threshold shifts due to seismic activity may negatively impact GOM sperm whales if disruptions are extended. There are no documented data on auditory-induced physical effects of underwater seismic noise on sperm whales. There is observational evidence that sperm whales may be temporarily displaced to areas near those where seismic operations are underway. However, while MMS believes that sperm whales apparently are not being displaced from the northern Gulf due to seismic surveys, NMFS notes that no data have been provided to support this statement. Nonetheless, it is unknown whether their site fidelity reflects low sensitivity to seismic noise or a high motivation to remain in the area in spite of this noise. Details of such emissions and potential impacts to sperm whales are characterized in NMFS (2002a) and MMS (2002b).

NMFS anticipates an unspecified number of sperm whales within Federal waters of the GOM may be adversely affected by seismic activities, especially in known areas of concentration (primarily off the Mississippi River delta) where cow/calf pairs are frequently sighted (NMFS, 2002a). At this time, there are insufficient data regarding the demography of the Gulf sperm whale stock to estimate the number of takes of sperm whales by age, sex, and reproductive condition. Most animals potentially exposed to seismic noise are expected to be adult females and immature animals, including young calves. It is understood that all animals comprising the Gulf stock (1,213 sperm whales) may be exposed to seismic noise during their lifetimes, and repeated exposure is anticipated, particularly in light of the facts that (a) sperm whales are wide-ranging animals, and (b) acoustic energy may travel great distances, depending on a suite of variables. At present, the means to accurately estimate the anticipated number of exposures for Level A or B Harassment takes of sperm whales as a result of seismic activity are not available.

In the absence of species-specific data on auditory impacts for sperm whales, a received sound pressure level of 180 dB re 1 μ Pa (rms) or greater will be used as an indication of potential concern about temporary and/or permanent hearing impairment (Level A Harassment, as used by NMFS in previous rulemakings).

While a spreading loss equation of 20 log R is recommended by Richardson et al. (1995) for calculating underwater transmission loss in deep water, MMS

believes a spreading loss equation of 15 log R is more appropriate for shallow water such as the GOM. Using a spreading equation (15log(R)), the 180-dB re 1 μ Pa (rms) isopleth in surface and near-surface waters occurs at 295 m (968 ft) from a standard airgun array. Similarly, the 180 dB re 1 μ Pa (rms) isopleth vertically below the seismic source is calculated to be 6,310 m (3.92 mi). By means of a Gulf-wide Notice to Lessees (NTL) for all seismic activities (30 CFR 250.103, August 22, 2002), MMS has implemented a 500-m (1,640-ft) impact zone to minimize possible effects to sperm whales. For typical 2-D and 3-D towed array seismic surveys with estimated source levels of 257 dB re 1 μ Pa (-3 dB rms conversion), a 500-m (1,640-ft) impact zone for a 180 dB isopleth equates to an estimated source level of approximately 232 dB. According to NMFS (2002a), at source levels of 257 dB (rms), the 20 Log(R) model and associated calculation above produce received levels of 203 dB re 1 μ Pa at 500 m (1,640 ft) from the source in subsurface waters (a conservative estimate) and 183 dB in surface waters due to the array effect. Presently, the impact zone of 500 m (1,640 ft) closely approximates the received dB levels in surface waters, but may not accurately reflect the 180 dB isopleth and associated impact zone beneath an array. These disparities between dB measurements for surface and subsurface waters indicate the need for better data to effectively formulate models that can be used to better calculate an impact zone for sperm whales.

In the absence of good sound scientific information for sperm whales in the GOM, a received sound pressure level of 160 dB re 1 μ Pa (rms) will be used in this application as the default indicator of, or for, potential concern to disturb a sperm whale in the wild by causing disruption of behavioral patterns, including but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment, as used previously by NMFS for impulse noise). Using a spherical spreading equation (15log(R)), -20 dB for the array effect, and -3 dB for zero-to-peak to RMS conversion), the 160 dB re 1 μ Pa (rms) isopleth in surface and near-surface waters occurs at 6,309 m (3.92 mi) from the seismic airgun source. Similarly, the 160 dB re 1 μ Pa (rms) isopleth below the seismic source is calculated to extend to the sea floor.

Given that (a) the Level B Harassment impact zone ranges between 6,309 m (3.92 mi) and depth below the vessel (3.92 mi and greater), (b) the Level A Harassment (injury) or mortality impact

zone ranges between 295 m (968 ft) and 6,309 m (3.92 mi), (c) seismic survey operations may be conducted over broad swaths of the Gulf, (d) sperm whales are wide-ranging and inhabit oceanic waters of the northern Gulf, (e) animals may or may not avoid seismic noise sources, and (f) sperm whales may potentially be repeatedly exposed to seismic noise introduced into the GOM, MMS expects that an unspecified number of sperm whales (chiefly adult females and immature animals) may be exposed to levels of 160 dB or greater if they do not avoid exposure by moving away from the noise source. The MMS anticipates new information in the near future from which it will calculate anticipated take numbers for seismic activity. These numbers will be included in MMS' NEPA document and provided to NMFS for rulemaking needs.

NMFS has been determined (NMFS, 2002a) that ramp-up procedures and visual monitoring of an impact zone coupled with passive acoustic monitoring systems will more effectively minimize possible adverse effects to sperm whales than ramp-up and visual observations alone, as currently required by MMS' NTL No. 2002-G07 and Addendum 1. Conservative estimates should be used to calculate impact zones for sperm whales without the array effect until more appropriate models can be formulated from field measurements that effectively minimize the risk of threshold shift to sperm whales. The use of mitigation measures such as visual and acoustic monitoring of adjacent waters (e.g. delineated by the 160 or 180 dB re 1 μ Pa (rms) isopleths), shut-downs, or ramping up seismic airguns are presumably effective techniques that may reduce the potential number of sperm whales taken by harassment as a result of seismic surveys. It is assumed that the likelihood of impacts will be reduced relative to the scope of mitigation measures employed by seismic operators. For example, it is presumed that some animals may experience Level A Harassment if only visual monitoring is employed, and animals do not actively avoid noise or are missed during visual monitoring. Similarly, fewer animals will experience Level A Harassment if visual and effective acoustics monitoring are conducted in conjunction with shut-downs and ramping up. An acoustic model that incorporates acoustic noise propagation, environmental variables, and ecological and behavioral variables known for marine mammals (e.g. sperm whales) would be necessary for the MMS to quantify the anticipated takes