The influence of acoustic emissions for underwater data transmission on the displacement of harbor porpoises (*Phocoena phocoena*) in a floating pen and harbor seals in a pool

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Abstract

To prevent grounding of ships and collisions between ships in shallow coastal waters, an underwater data collection and communication network is currently under development: Acoustic Communication network for Monitoring of underwater Environment in coastal areas (ACME). Marine mammals might be affected by ACME sounds since they use sounds of similar frequencies (around 12 kHz) for communication, orientation, and prey location. If marine mammals tend to avoid the vicinity of the transmitters, they may be kept away from ecologically important areas by ACME sounds. The most abundant marine mammal species that may be affected in the North Sea are the harbor porpoise and the harbor seal. Therefore, as part of an environmental impact assessment program, two captive harbour porpoises and nine harbour seals were subjected to four sounds, three of which may be used in the underwater acoustic data communication network. The effect of each sound was judged by comparing the animals' positions and respiration rates during test periods with those during baseline periods. Each of the four sounds could be made deterrent by increasing the amplitude of the sound. Both the porpoises and the seals reacted by swimming away from the sound source. The porpoises increasing their respiration rate slightly, but the seals' respiration rate remained the same. From the sound pressure level distribution in the enclosures, and the distribution of the animals during test sessions, discomfort sound pressure level threshold were determined for each sound. The acoustic discomfort threshold is defined as the boundary SPL between the areas that the animals generally occupied during the transmission of the sounds and areas that they generally did not enter during transmission. In combination with information on sound propagation in the areas where the communication system may be deployed, the extent of the 'discomfort zone' can be estimated for several source levels. The discomfort zone is defined as the area around a sound source that animals are expected to avoid. Based on these results, source levels can be selected that have an acceptable effect on harbor porpoises and harbor seals in particular areas. The source level of the communication system should be adapted to each area (taking into account bounding conditions created by narrow channels, sound propagation variability due to environmental factors, and the importance of an area to the affected species). The discomfort zone should not prevent porpoises and seals from spending sufficient time in ecologically important areas (for instance resting, breeding, suckling, and feeding areas), or routes towards these areas.