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TITLE: Modeling the aggregated exposure and responses of bowhead whales Balaena mysticetus to multiple sources of anthropogenic underwater sound

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ABSTRACT:

Potential responses of marine mammals to anthropogenic underwater sound are usually assessed by researchers and regulators on the basis of exposure to a single, relatively loud sound source.However, marine mammals typically receive sounds from multiple, dynamic sources.We developed a method to aggregate modeled sounds from multiple sources and estimate the sound levels received by individuals.To illustrate the method, we modeled the sound fields of 9 sources associated with oil development and estimated the sound received over 47 d by a population of 10 000 simulated bowhead whales Balaena mysticetus on their annual migration through the Alaskan Beaufort Sea.Empirical data were sufficient to parameterize simulations of the distribution of individual whales over time and their range of movement patterns.We ran 2 simulations to estimate the sound exposure history and distances traveled by bowhead whales: one in which they could change their movement paths (avert) in response to set levels of sound and one in which they could not avert.When animals could not avert, about 2% of the simulated population was exposed to root mean square (rms) sound pressure levels (SPL) ?180 dB re 1 µPa, a level that regulators in the U.S. often associate with injury.When animals could avert from sound levels that regulators often associate with behavioral disturbance (rms SPL >160 dB re 1 µPa), <1% of the simulated population was exposed to levels associated with injury.Nevertheless, many simulated bowhead whales received sound levels considerably above ambient throughout their migration.Our method enables estimates of the aggregated level of sound to which populations are exposed over extensive areas and time periods.

SOURCE: Endangered species research

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