

# Underwater Noise

## RELEVANCE TO MARINE RENEWABLE ENERGY

Animals use sound in the marine environment like humans and animals use light (sight) on land. Underwater sound allows animals to communicate, navigate, interact, forage, and avoid predation. The extent to which marine animals detect and produce sound varies by species and may range across frequencies and sound levels. Marine animals are already subject to sources of anthropogenic noise under water; the addition of sound from marine renewable energy (MRE) devices could induce stress, behavioral changes (such as avoidance), a range of physical injuries, and a temporary or permanent reduction in hearing ability that can mask other sounds. The propagation of sound from MRE devices dissipates with distance from the device, depending on specific ocean conditions and the level of sound generated by each device. Construction activities at sea can create loud underwater noise, while noise from operational MRE devices is much quieter.



## STATUS OF KNOWLEDGE

Assessing the potential effects of underwater noise from MRE devices on marine animals requires that we understand the noise environment into which the devices are placed, be able to measure the underwater noise from the device, and relate that sound to changes in animal behavior.



In the region of an MRE device, ambient noise consists of a combination of natural sounds such as animal vocalizations, tidal currents, wave sounds, wind, other weather conditions, as well as noise from anthropogenic sources such as shipping, boating, and other industrial activities. Although source measurements are widely used during oceanographic surveys to localize noise, they have not yet been used to distinguish between the background ambient noise and MRE device noise. Generally, MRE device noise appears to be lower than that of other anthropogenic sources and/or natural sounds. In particular, areas with fast-moving tidal currents generate high levels of noise that interfere with the noise measurement of MRE devices.

Measuring the frequency and levels at which key marine species receive sound is an important step in understanding the effects MRE devices may have on marine animals. In the United States, there are regulatory action levels and guidance for protecting marine mammals and fish from underwater noise.

The MRE community benefits from an internationally accepted standard for measuring underwater noise from MRE devices, including instrument calibration, measurement methods, methods for data processing, and uniform presentation of results.

Several studies have attempted to link the behavioral responses of various species to MRE device noise. Documenting changes in animal behavior requires a combination of human observers and measurements by underwater cameras, listening devices, and sonar. Establishing a link between MRE device noise and animal behavior has been difficult even for more established industries such as oil and gas, or offshore wind, as well as for the noise effects of vessel traffic, and sound from seismic surveys, which use an underwater air gun and produce higher amplitude sounds than operational MRE devices. A handful of studies have concluded that MRE devices are unlikely to cause behavioral effects in marine animals at long distances, but some suggest the possibility of behavioral responses at close range.

To date, there is no evidence that operational noise from MRE devices harms marine animals physically or behaviorally.

Computer models are used to predict the propagation of sound under water and potential effects on the environment and marine animals.

## REMAINING UNCERTAINTIES

Additional quantitative information is needed to explain the direct and indirect effects of noise from MRE devices on marine animals. The limited number of devices in the water, variations among the types of wave and tidal devices, and the difficulty in quantifying animal behavioral responses continue to make this a significant challenge. Similarly, the ability to distinguish between MRE device noise and ambient noise is needed to determine the true acoustic characteristics of devices over a range of depths and distances from the device. It is also important to relate MRE underwater noise levels to changes in animal behavior, yet we have little understanding of what constitutes normal behavior in many marine animals, and behavioral changes may be caused by other underwater stimuli.

## RECOMMENDATIONS

To understand the potential effects of MRE underwater noise on marine animals, it is important to be able to accurately measure the noise from a range of MRE device types and distinguish that noise from the ambient sound. Of equal importance is the need for a method to relate specific marine animal behavioral responses to the range of frequencies and sound levels from single MRE devices. Once these relationships are established for one or small numbers of MRE devices, computer models can help predict how the underwater noise from larger arrays of devices may affect marine animals. With this information, it will be possible to understand the likely effects as the MRE industry moves toward commercial deployment.

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### REPORT AND MORE INFORMATION

OES-Environmental 2020 State of the Science full report and executive summary available at:  
<https://tethys.pnnl.gov/publications/state-of-the-science-2020>

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Go to <https://tethys.pnnl.gov> for a robust collection of papers, reports, archived presentations, and other media about environmental effects of MRE development.