

## **Managing Impacts of Human-generated Noise on Marine Life**

A critical part of BOEM's mission is to protect the environment while ensuring the safe development of offshore energy and marine mineral resources on more than 2.3 billion acres of U.S. federal waters. With about 200 environmental staff members, including specialists in marine biology, ecology, and acoustics, BOEM works tirelessly to produce, evaluate and incorporate the best available science in all of our management decisions. By driving original research to fill knowledge gaps and by overseeing environmental reviews, BOEM has played a key role in improving the overall scientific understanding of the potential effects of anthropogenic (human-generated) noise on marine life. BOEM has also played an important role in adaptive management by constantly adjusting to evolving information and needs.

Since 1998, BOEM has invested more than \$75 million on protected species and acoustics-related research by using four general research methods: 1) literature reviews, syntheses, and workshops; 2) field surveys; 3) empirical studies in the laboratory and in the field; and 4) sound source verification and modeling.

### **The Context for Understanding Sound in the Marine Environment**

Once considered silent, the seas are now known to be alive with sounds. Some sounds are from natural, non-biological sources such as storms, earthquakes, waves. Other sounds are generated by animals that use sound to communicate and to navigate within their environment. Finally, human activities such as shipping, energy development, military operations, construction, commercial fishing, and recreation introduce sounds into the marine environment. When these

### **Managing Adaptively**

Understanding the potential impacts of anthropogenic (human-induced) noise on marine life is complex. Given the uncertainty regarding the current scientific understanding of impacts, BOEM's strategy is to implement an adaptive management approach that: (1) identifies information needs during our environmental assessments, then (2) addresses those needs by supporting new scientific research. The results from these BOEM studies, as well as other emerging research findings, are applied to future reviews of offshore resource development projects.

Decisions can then align with BOEM's environmental stewardship responsibilities and requirements under a suite of environmental laws (e.g., National Environmental Policy Act, Endangered Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act).

anthropogenic sounds are unwanted, they are generally referred to as noise.

As human presence in the offshore environment has grown, so have the anthropogenic noise levels. Current science shows us that some of these sounds may adversely impact marine life in certain situations. Some sounds can interrupt important biological behaviors (courtship, nursing, feeding and migration) and can interfere with communication between animals. In more extreme instances,

exposures to sounds at high levels or for extended periods of time can lead to physiological effects, including hearing loss and mortality. The impacts to marine life are challenging to predict because they depend upon the acoustic qualities of the sound source, the oceanographic conditions in which the sound is produced, and the behavioral context in which the animal receives the sound.

Balancing human activities with the protection of marine life can be a difficult task, but as BOEM approaches its management decisions, it uses the best science available. This includes applying an understanding of different types of [geological and geophysical surveys](#) to our decision-making process. While debates on best mitigation practices remain, and opinions on the path forward are diverse, BOEM continues to implement strict mitigation and monitoring measures to help minimize potential impacts on marine species. BOEM remains steadfastly committed to funding and supporting the science needed to better understand anthropogenic sounds and their impacts on marine life. BOEM is also dedicated to using adaptive management for this complicated issue, so that our approaches evolve as the science matures and as our understanding expands.

## BOEM-Funded Acoustics Research

Present-day research funded by BOEM covers a range of topics, including: bioacoustics of fish and marine mammals; measuring source levels and propagation from anthropogenic sound sources; ambient noise measurements; methods to detect, classify, and locate marine life; measuring hearing thresholds of key marine species; observing behavioral responses to anthropogenic sound sources; and improving mitigation methods. Along with our many federal and academic partners, BOEM has been examining the complex issue of cumulative effects of multiple stressors on marine mammals.

BOEM was one of the earliest federal pioneers in sponsoring research on ocean sounds. BOEM's first sound-related studies began in the early 1980s and explored effects of industrial sounds on large whale species in the Pacific Ocean. Similar studies involving seals and sea lions began in the late 1980s. During the 1990s, BOEM co-funded early scientific reviews on sound by the National Academy of Sciences and the 1995 book *Marine Mammals and Noise* (W. John Richardson, et al., Academic Press, 579 pp).

## Selected Workshops and Syntheses

BOEM also partners with diverse stakeholders to share information and ideas on science needs as well as best management practices, often in the form of workshops and syntheses, such as:

- A Risk Assessment Framework to Assess the Biological Significance of Noise Exposure on Marine Mammals (2018)
- [Assessment of cumulative effects of anthropogenic stressors on marine mammals](#) (2017)
- Effects of Noise on Marine Life conferences ([Proceedings](#) (Open Source) for 2010, 2013, and 2016)
- Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities [Workshop](#) (2013)
- Quieting Technologies for Reducing Noise During Seismic Surveying and Pile Driving [Workshop](#) (2014)
- Cetacean and Sound Mapping [Project and Symposium](#) (2012)

[Click here](#) to access a wide range of BOEM's ongoing and completed environmental research.

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## About the Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) promotes economic development, energy independence, and environmental protection through responsible, science-based management of offshore conventional and renewable energy, and marine mineral resources.

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