

Minimizing Impacts of Human-generated Sound on Marine Life

A critical part of BOEM's mission is to protect the environment while ensuring the safe development of traditional and renewable offshore energy and marine mineral resources on more than 1.7 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 and evaluate the best available science in all of our management decisions. Through research and environmental reviews, BOEM has played a key role in improving the overall scientific understanding of the potential effects of anthropogenic, or human-generated, sound. BOEM has also played an important role in furthering the concept of adaptive management by implementing a resource and environmental management strategy that constantly adjusts to evolving information and needs. Since 1998, BOEM has invested more than \$50 million on protected species and sound-related research, including marine mammals.

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 sources, such as storms, earthquakes, waves and marine animals that produce and use sound to communicate and learn about their environment. Other sounds come from anthropogenic sources, such as shipping, energy development, military activities, construction, commercial fishing, and recreational activities. When these anthropogenic sounds are unwanted, they are often referred to as 'noise.'

Managing Adaptively

Understanding potential impacts of human-induced sound on marine life is complex. Given some of the uncertainty related to the current scientific understanding of impacts, BOEM's course of action is to implement an adaptive management approach that: (1) uses our environmental assessments to identify information needs, then (2) addresses those needs through scientific research. Research results from BOEM studies, as well as other available research results, are then applied to future reviews of offshore resource development projects.

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

As human presence in the offshore environment has grown, so have the anthropogenic sound 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 mask communication between animals. In more extreme instances, exposures to high levels or extended periods of sound can lead to physiological effects, including

hearing loss and mortality. Research shows that the same level of sound may have different levels of impact on marine life depending where in the ocean the sound occurs. Further, individuals of the same species can react to sound differently in different situations.

Balancing human activities with the protection of marine life can be a difficult task, but BOEM is using the best science available as it approaches all of its management decisions. While debates on best practices remain and opinions on the path forward are diverse, BOEM will continue to implement strict mitigation and monitoring measures to help protect marine life from the impacts of energy and marine mineral-related ocean sounds. BOEM also 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 our understanding expands and the science matures.

BOEM-Funded Sound-Related Research

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). BOEM also funded ground-breaking controlled exposure experiments on behavioral responses of sperm whales to air gun sounds in the Gulf of Mexico and humpback whales in Australia. Present day research focuses on fish bioacoustics; sound field mapping; ambient noise measurements; methods to detect, classify and locate marine life near sound sources; improvements in mitigation; quieting technologies; and effects of sound on prey species. Along with our many federal and academic partners, BOEM has begun to examine the even more complex issue of cumulative effects from chronic exposure to anthropogenic sounds.

Selected Workshops

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, such as:

- Marine Mammals and Sound Workshop
(http://www.nmfs.noaa.gov/pr/pdfs/acoustics/mm_sound_workshop_report.pdf)
- Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities Workshop
(<http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5361.pdf>)
- Cetacean and Sound Mapping Project and Symposium
(<http://cetsound.noaa.gov/report.html>)
- Quieting Technologies for Reducing Noise During Seismic Surveying and Pile Driving Workshop
(<http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5377.pdf>).

[Click here](#) for Select Sound-Related Studies funded and co-funded by BOEM.

updated January 2015