



BOEM established the Center for Marine Acoustics in 2020 to create a streamlined approach to BOEM's acoustic studies and modeling efforts. Staffed by acoustics and modeling experts, the Center addresses both naturally occurring sounds and those generated by industrial activities that BOEM regulates, including offshore oil and gas, renewable energy and marine minerals. The Center positions BOEM to become a recognized leader on marine acoustics within the federal government and internationally.

Managing 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 offshore energy and marine mineral resources on almost 3.2 billion acres of U.S. federal waters.

With about 200 environmental staff members, including specialists in marine biology, ecology, and oceanography, 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) sound on marine life. BOEM has also played an important role in adaptive management by constantly adjusting to evolving information and needs.

BOEM was one of the earliest federal pioneers in sponsoring research on ocean sounds, beginning in the 1980s. Since 1998, BOEM has invested more than \$95 million in protected species and acoustics-related research by using four general research methods:

- literature reviews, syntheses, and workshops,
- field surveys,
- empirical studies in the laboratory and in the field, and
- 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, and waves. Other sounds are generated by animals that use acoustic signals 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 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 affect 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, the hearing abilities of the species of interest, and the behavioral context in which the animal receives the sound.

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 of 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. With our many federal and academic partners, BOEM has been examining the complex issue of cumulative effects of multiple stressors on marine mammals.

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, for example, an understanding of the transmission of man-made sounds in 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.

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 by supporting workshops and syntheses. They include the following:

- Proceedings of Meetings on Acoustics; Effects of Noise on Marine Life (Open Source) 2010, 2013, 2016, and 2019. In 2020, the Acoustical Society of America published a paper by two BOEM scientists based on their 2019 conference presentation.
- Effects of Sound in the Ocean on Marine Mammals Conference (2018)
- Assessment of cumulative effects of anthropogenic stressors on marine mammals (2017)
- Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities Workshop (2013)

For More Information:

Integrating Science and Policy

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 approach that: (1) identifies information needs during our environmental assessments, then (2) addresses those needs by supporting new scientific research. The results from BOEM studies and other emerging research 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).

- Quieting Technologies for Reducing Noise During Seismic Surveying and Pile Driving Workshop (2014)
- Assessment of cumulative effects of anthropogenic stressors on marine mammals (2017)

For more information on BOEM-funded acoustics research:

- Center for Marine Acoustics - <https://www.boem.gov/center-marine-acoustics>
- Acoustics at BOEM issue of BOEM Ocean Science - <https://www.boem.gov/ocean-science-2019>
- Environmental Studies Program Hub - <https://esp-boem.hub.arcgis.com/>

