

Environmental Studies Program: Studies Development Plan | FY 2020–2022

Title	Fish Auditory Thresholds—Part 2 Field Component
Administered by	Office of Renewable Energy Programs
BOEM Contact(s)	Brian Hooker (brian.hooker@boem.gov)
Procurement Type(s)	Interagency agreement with the National Oceanic & Atmospheric Administration (NOAA); Cooperative Agreement
Performance Period	FY 2020–2022
Date Revised	February 22, 2018
PICOC Summary	Write one or two sentences for each of the following elements, as appropriate.
<i><u>Problem</u></i>	There are several commercially and recreationally important fish that co-occur with proposed wind energy facilities. This study is principally addressing fisheries resource impacts from acoustic disturbance during offshore wind energy development. The temporary and longer-term physical and physiological impact of fish during and shortly after offshore construction activities is currently not well understood.
<i><u>Intervention</u></i>	This study would evaluate the physical and physiological impact to fish and/or mollusks during construction of an offshore wind energy facility.
<i><u>Comparison</u></i>	This second phase project will compare controlled (lab) studies to field trials in regards to both the acoustic environment (ambient vs. disrupted) and fish injury and/or behavior.
<i><u>Outcome</u></i>	The outcome will be a better understanding of the physical, physiological, and behavioral impacts to fish associated with offshore wind construction activity.
<i><u>Context</u></i>	The principal target for the investigation is commercially important fish in the North and Mid-Atlantic Planning Areas, principally black sea bass and longfin squid. The percussive action of pile driving offshore wind foundations has the potential to induce physical or behavior impact to fish. This study will evaluate that potential in a field setting.

BOEM Information Need(s): The information from this study will help in BOEM’s noise impact assessments to commercial fish species and their associated fishing industries under the National Environmental Policy Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

Background: Auditory thresholds for some commercial fish species have been established, while for some species such as black sea bass data are lacking. Black sea bass in particular support valuable commercial fisheries in the North, Mid, and South Atlantic Planning Areas. Black sea bass show affinity for certain habitats within the wind energy lease areas and are thus not a temporary resident of these lease areas (Guida *et al.*, 2017). In addition, black sea bass produce sounds, such as grunts and thumps, which have been associated with feeding and escape. This species is known to utilize mid-frequency acoustic signals (100–1000 Hz) which may be used to communicate during spawning and feeding but their sensitivities to anthropogenic sounds such as pile driving noise, and their behavioral responses to them, is not understood.

Commercial and recreational fishermen have expressed concern that noise produced during sub-bottom surveys, pile driving, and operation of renewable energy facilities may have a negative effect on the behavior of black sea bass, potentially affecting a range of factors from catchability to long-term reproductive success. Sounds that are produced through offshore wind development could lead to acute or chronic sub-lethal effects due to the overlap in frequency between their hearing/communication range and direct particle motion generated by these anthropogenic sounds (Hawkins and Popper 2017). Black sea bass will be the first species tested because they are known to use acoustic cues to communicate and because their habitats overlap within renewable energy lease areas. If feasible, other species, such as squid, identified as a *priority* in Normandeau 2012 (BOEM Contract #M11PC00031), may be evaluated.

This study is divided into two parts. Part one is a laboratory study awarded in 2017 as an interagency agreement with NOAA's Northeast Fisheries Science Center; this profile describes part two, which is the companion field study. The Part 1 study, which will fully conclude in 2020, has demonstrated clear behavioral reactions to the playback of pile driving sound to black sea bass and squid and further established auditory evoked potentials for black sea bass. It is necessary to compare these lab based results with those in the field.

Objectives: The objective of this study is to understand black sea bass, and potentially other species' physical, behavioral, and physiological effects when exposed to anthropogenic sounds associated with offshore wind construction and operation. Thresholds for different effect levels (*e.g.*, injurious vs. behavioral) may be established.

Methods: Field studies would evaluate behavioral and physiological effects, as well as potential changes in habitat use during sound exposure. The exact methodology will be influenced by the results of phase one of the study. However, the likely methodology could include the following: mesocosm observations, videography, Adaptive Resolution Imaging Sonar (ARIS)/Dual-frequency Identification Sonar (DIDSON) (*e.g.*, ARIS Explorer 1200) monitoring applications, or other appropriate monitoring technologies such as active acoustic tags and passive receivers.

Specific Research Question(s):

1. How does sound generated during offshore wind construction affect important fish species like black sea bass and squid?
2. At what amplitude does pile driving or other project sounds induce a behavioral response?
3. At what amplitude do these sounds lead to physical or physiological damage internal and/or external organs of the subject fish?

References:

Normandeau Associates, Inc. 2012. Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-

Generating Activities. A Workshop Report for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M11PC00031. 72 pp. plus Appendices.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, E. Estela-Gomez. 2017. Habitat Mapping and Assessment of Northeast Wind Energy Areas. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. 312 p.

Hawkins, A. D., and Popper, A. N. 2017. A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES Journal of Marine Science, Volume 74, Issue 3, March-April 2017, Pages 635–651, <https://doi.org/10.1093/icesjms/fsw205>.