Environmental Studies Program: Ongoing Study

Title	Behavioral effects of sound sources from offshore renewable energy construction on the black sea bass (*Centropristis striata*) and longfin inshore squid (*Doryteuthis pealeii*) (NSL #AT 17-02)
Administered by	Office of Renewable Energy Programs
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Conducting Organizations(s)	National Marine Fisheries Service/Woods Hole Oceanographic Institution
Total BOEM Cost	$1,007,295
Performance Period	FY 2017 – FY 2020
Final Report Due	May 2020
Date Revised	February 5, 2020
PICOC Summary	
Problem	This study will help address questions regarding the impact of noise to commercially important fish such as black sea bass and squid that are found in BOEM offshore renewable energy lease areas all along the Atlantic coast north of Cape Canaveral. BOEM has an obligation to understand how activities that it authorizes may impact commercially and recreationally important fish.
Intervention	The methodology would be controlled exposure studies to evaluate behavioral and physiological effects in a laboratory setting experimentation evaluating behavior and habitat use during sound exposure.
Comparison	Animal behavior will be compared between exposure treatment groups and control groups in the lab.
Outcome	The project will evaluate the behavioral and physiological effects imposed on the economically important black sea bass and the longfin squid in the presence of the reproduced acoustic signal that is expected to occur during the construction and general operation of an offshore wind facility
Context	Atlantic offshore wind energy development.

BOEM Information Need(s): This study will help address questions regarding the impact of noise to commercially important fish such as black sea bass and squid that are found in BOEM offshore renewable energy lease areas all along the Atlantic coast north of Cape Canaveral. BOEM has an obligation to understand how activities that it authorizes may impact commercially and recreationally important fish. In addition to BOEM's regulations under the Outer Continental Shelf Lands Act as amended by the Energy Policy Act of 2005, the information from this study will help in BOEM's environmental assessments under the national Environmental Policy Act and the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

Background: Black sea bass (Centropristis striata) support a valuable commercial and recreational fishery in the North, Mid, and South Atlantic renewable energy planning areas and show an attraction towards certain structurally complex habitats including rocky reefs, cobble and rock fields, stone coral patches, exposed stiff clay, and mussel beds as well as artificial habitat created by marine debris and shipwrecks. Some of these habitats occur within the current renewable energy lease and planning areas either seasonally or year-round depending water temperature. Commercial and recreational fishermen have expressed concern that sound produced during benthic surveys, pile driving and operation of renewable energy facilities may be having negative effects on the behavior of black sea bass, causing changes in catchability and potential long-term sub-lethal behavioral impacts such as flight from disturbed feeding and spawning habitats and disruption of intraspecific communication. Black sea bass are believed to communicate acoustically, especially during spawning behavior, however there is no published literature describing this acoustic behavior or their hearing sensitivities and behavioral responses to natural or anthropogenic sound.

The longfin inshore squid (Doryteuthis pealeii) also has the potential to be impacted by acoustic disturbance from offshore wind development. Longfin squid is a short-lived (~ 1 yr), semelparous cephalopod species. It is migratory, pelagic and a well-established model species for sensory ecology and neurobiological investigations (Hanlon et al, in press). This is the primary commercial cephalopod species of the western north Atlantic at approximately 16.6 mt and $41 million yr-1 since 2000. The species is consumed by a wide range predators and is considered an ecologically key prey item for a variety of marine mammals, seabird and finfish taxa. Fishery stakeholders have expressed concern that summer spawning on the continental shelf could be disrupted by acoustic disturbance from offshore wind construction and operation. Longfin squid are readily accessible in Woods Hole from May-October, allowing for a long experimental season.

Objectives: The objective of this study is to characterize and replicate the acoustic signals from construction and operation of an offshore wind facility and evaluate the effects of noise on commercially and recreationally important fish. Specifically:

- The project must characterize amplitude levels, rise time, duration, repetition rate, and duty cycle of the acoustic signal in terms of sound pressure and particle velocity.

- The project will evaluate the behavioral and physiological effects imposed on the economically important black sea bass and the longfin squid in the presence of the reproduced acoustic signal that is expected to occur during the construction and general operation of an offshore wind facility.

Methods: The methodology would be controlled exposure studies to evaluate behavioral and physiological effects in a laboratory setting experimentation evaluating behavior and habitat use during sound exposure.

Specific Research Question(s): This study will specifically address the behavioral reactions of squid and black sea bass to pile driving noise.

Current Status: The project was awarded in June 2017. Black sea bass and squid collection for initial sound exposure trial (squid) and hearing threshold trial black sea bass) was completed in 2017. Behavioral response experiments squid and black sea bass are contiuing.

Publications Completed:

Jones, Ian & Stanley, Jenni & Mooney, Aran. (2019). Impulsive pile driving noise elicits alarm responses in squid (Doryteuthis pealeii). Marine Pollution Bulletin. 150. 110792. 10.1016/j.marpolbul.2019.110792.

Affiliated WWW Sites: https://www.boem.gov/Renewable-Energy-Ongoing-Studies/; https://www.whoi.edu/press-room/news-release/underwater-pile-driving-noise-causes-alarm-responses-in-squid/

References: N/A