Environmental Studies Program: Deferred Study | FY 2021

Title	Assessing the Impact of Seismic Airguns on Commercially and Recreationally-important Fish
Administered by	Gulf of Mexico OCS Region
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Conducting Organization(S)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2023
Final Report Due	TBD
Date Revised	September 22, 2020
PICOC Summary	Write one or two sentences for each of the following elements, as appropriate.
Problem	Research into impacts to fish and fisheries from seismic surveys is limited, and conclusions are inconsistent. By necessity, our environmental analyses have relied on research with limited applicability and we have not had consistent conclusions about impacts to fish. It is important to obtain more information for species that occur on the U.S. OCS to better inform our analyses and management decisions.
Intervention	Observing the behavior of valuable reef fishes exposed to commercial seismic surveys would enable BOEM to better assess potential effects on biologically important behaviors. Such information would enable BOEM to meet statutory obligations to assess the level of impact and, as appropriate, propose mitigation measures to lessen or avoid such effects.
Comparison	Observe the movements of adult fish and invertebrates in response to a full seismic array.
Outcome	The outcome will address current gaps in our understanding of impacts to a commercially and recreationally-important fish and invertebrate species. While the work would take place in the Pacific Northwest, this research is relevant to other regions.
Context	Pacific NW

BOEM Information Need(s): BOEM is required to consider the impacts of its activities on not just protected and managed species, but all species and ecosystems on the OCS. When it comes to seismic surveys, the most concerning impact-producing factor is noise. Noise can affect

animals in a variety of ways - from physiological damage to stress responses to behavioral changes (Kight and Swaddle 2011). It is not clearly understood how fish (and their respective fisheries) are affected by such noise, particularly whether the effects are short-term or long-term. The fishing community has voiced its concern over pending seismic surveys, as they are unsure whether fish may vacate key fishing grounds or become damaged by the sounds. The International Association for Geophysical Contractors issued a statement assuring that impacts would only be short-term, but cite a lack of adequate research characterizing long-term impacts.

Background: While initial concerns over noise were focused on marine mammals, there is mounting evidence that a wide range of marine taxa are sensitive to sound and could also be affected by anthropogenic noise. Early research on acoustic impacts focused on physiological effects, such as damage to air-filled structures or hearing loss. While such acute responses are indeed possible very close to the sound source, researchers are recognizing that other reactions, like a stress response or change in behavior, are more likely and would be more widespread. Repeated exposures to stressful events or disruption of key behaviors (e.g., feeding) can have negative effects on critical life functions and overall fitness (Wright et al., 2007).

The impacts of airgun noise on fish are potentially significant across all OCS regions. Impacts to fish with swimbladders are expected to be more widespread than those without, since the presence of this air-filled cavity can enable detection of acoustic pressure (a farther-range cue) rather than only particle motion (a shorter-range cue, Popper and Hawkins 2018). Understanding the response of fishes to seismic airguns has important implications for the fishing industry, but research on impacts to commercial catch rates have generally focused on short-term impacts (e.g., hours to days, Hirst and Rodhouse 2000). For example, Lokkeborg and Soldal (1993) found that catch rates of cod decreased near seismic surveys, but returned to pre-shooting levels within about 12 hours, suggesting that cod initially moved away from the survey area but were not permanently displaced. Skalski et al., (1992) showed an immediate significant decline in catch rates in a hook-and-line fishery, but the long-term reaction of rockfish was not measured. Engas et al., (1996) found that the density of cod and haddock decreased after seismic shooting, and while trawl catch rates did not return to pre-shooting levels within five days after acoustic exposure, longline catch efforts did begin to rebound. These studies demonstrate mixed results, and it is important to recognize that longer-term effects (e.g., over weeks to months) have not been measured.

Objectives: The objectives of this study are to:

1. Measure potential changes in behavior (e.g., location, depth, schooling, duration of behavioral change) when free-swimming fish and invertebrates are exposed to seismic airguns, and
2. Frame these results in terms of potential impacts to the fishery.

Methods: This project will leverage an NSF-funded project involving airgun surveys in the Pacific Northwest by taking advantage of a planned survey. In partnership with the NSF, this

study will focus on a reef in the vicinity of this survey scheduled in FY21 to measure the impacts of a full-scale seismic array on reef fish and invertebrates.

An array of Vemco acoustic receivers will be deployed around the research site. Depending on water depth, some of these may be mounted on the bottom while some may need to be mounted on sub-surface buoys mid-way through the water column to maximize potential fish detections. These receivers can record data for approximately six months, so they will be deployed approximately three months before the survey is planned to take place. A passive acoustic recorder will be deployed within the approximate center of the Vemco array to measure the received level of the airguns at the center of the site. Although a single recorder cannot adequately sample the entire area, it can provide a basis of comparison for before-during-after the passage of the survey. A glider with a hydrophone can survey the entire site to help broaden spatial coverage of the sound field.

Four species of fish and invertebrates will be captured and tagged at least 30 days before the planned survey. The targeted species are yellowtail rockfish, black rockfish, China rockfish, and longnose skate. Roughly half of these animals will be tagged with traditional acoustic tags, which transmit their location when they pass within range of one of the receivers. The other half will be tagged with next-generation Vemco tags which transmit the fish's history of acceleration and depth. This information will be critical for understanding fine-scale movements as the survey passes overhead.

As a form of control, observe behavior changes of tagged individuals from a similar-sized ship passing without seismic/airgun noise. This will allow the researchers to tease apart airgun noise-related changes from 'regular' ship presence and noise.

Approximately three months after the survey concludes, the receivers will be retrieved and movement data will be analyzed. Data analysis from the pre-survey period should demonstrate site fidelity (i.e., size of home range) of fish at the site, as well as an analysis of "normal" vertical movements. Approximately three months after the survey concludes, the Vemco receivers should be retrieved and movement data analyzed. Data analysis will focus on individual and population-level movements before, during, and after the passage of the survey.

Specific Research Question(s):

1. Do fish leave the study area when the seismic vessel approaches? If so, how long does it take them to return to the area (if ever)?
2. Do fish exhibit erratic swimming or changes in schooling behavior or depth as the survey passes overhead? If so, how long does it take them to return to natural (pre-seismic) behaviors?

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites: N/A

References:

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