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

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| Title | A Database and Acoustic Reference Catalog of Marine Fish Sounds—Atlantic Pilot |
| Administered by | Office of Renewable Energy Programs |
| BOEM Contact(s) | Brian Hooker (brian.hooker@boem.gov) |
| Procurement Type(s) | Cooperative Agreement/National Ocean Partnership Program/Interagency Agreement |
| Performance Period | FY 2020–2021 |
| Date Revised | February 23, 2019 |
| PICOC Summary | Write one or two sentences for each of the following elements, as appropriate. |
| _Problem_ | Passive acoustic monitoring datasets detect a variety of marine species, but identifying each species or group of vocalizers requires audio profiles of each species.  This study would address the problem of disparate datasets and a framework for cataloging acoustically active fish for analysis in passive acoustic monitoring datasets. |
| _Intervention_ | This study would develop an acoustic catalog of fish sounds to identify various fish species recorded in passive acoustic data in a more efficient and accurate way. |
| _Comparison_ | N/A |
| _Outcome_ | The outcome will be a better understanding of passive acoustic monitoring data, as well as marine species distributions. |
| _Context_ | BOEM currently collects passive acoustic data for a variety of research and monitoring needs.  Unfortunately the data is only used for detecting a few marine mammals when it could be used for detecting sound-producing fish as well. |

**BOEM Information Need(s):**  BOEM needs to understand potential behavioral, physical, and physiological impacts to fish from offshore wind construction.  One means of accomplishing this is by establishing a library of fish sounds to allow for analysis of existing sub-marine acoustic recordings and developing fish-specific acoustic detectors to monitor movement and identify important habitat areas via a non-invasive means.  Currently there are many databases with underwater recordings that have not been analyzed outside a few focal species.  This would allow that data to be analyzed more fully.  This information will elucidate some marine fish distribution and behavior, which is integral to understanding potential impacts from BOEM activities, as analyzed (or required) under the National Environmental Policy Act (NEPA) and Magnuson-Stevens Fishery Management Conservation and Management Act compliance.

**Background:**  Ocean passive acoustic recording has primarily focused on marine mammals, due to their broadly protected status.  Acoustic recording has effectively monitored fish populations as well as the sounds of various marine habitats however, because the sounds of many species of fish have not been documented, much of the sounds in these recordings remain a mystery.  Many long-term marine acoustic recordings have recorded sounds that are likely produced by fishes, but the species

identity is unclear. As many as 50–70% of the fish species along the U.S. Atlantic Coast are potentially capable of producing sounds, but only a small number have been well documented. This means that a large portion of existing (and future) passive acoustic monitoring (PAM) recordings are not being used to their full potential, representing a substantial lost opportunity.

Many fish species produce species-specific acoustic calls in courtship and aggression that are strongly tied to seasonal patterns of movement and reproduction. Tracking these sounds provides the ability to remotely monitor changes in their normal behaviors allows them to serve as bioindicators of anthropogenic impacts and environmental changes. Understanding (1) which species of fishes are producing sounds and (2) the time of year and context in which they vocalize, allows for passive recordings of fish to serve as a mechanism for detecting changes in marine ecosystems. In addition, the information gleaned from other PAM data (that may be targeted at other species or habitats) will become much more useful with proper knowledge of the types of fish that are vocalizing. Fish acoustic behavior is strongly affected by anthropogenic noise, including seismic air guns and ship traffic. Additionally, the frequency range of ship propeller noise overlaps with the fundamental frequency component of many fish sounds (and likewise, hearing), creating a masking effect of fish calls. Once a baseline pattern of fish calling is established, effects of increased ship traffic or ordinance deployment on fish behavior and the environment may be more accurately and efficiently evaluated.

Much of the foundational work in understanding the sounds produced by fishes was published in 1970 by Marie Poland Fish and William H. Mowbray in Sounds of Western North Atlantic Fishes. Despite being over 40 years old, and the sounds recorded under laboratory conditions on analog equipment, this work is still largely the key reference in the field of fish acoustics. An updated, publicly available compendium of fish sound identification and reference would allow the public and private research community to use fish sounds to further understand the context of their acoustic recordings and examine the dynamics of fish populations across broad spatial scale. Sounds identified over the course of the project would be described in peer-reviewed publications, as well as made freely available as an online multi-media reference through Cornell University's Macaulay Library of Natural Sounds. At present, the Macaulay Library has a limited number of fish recordings (http://macaulaylibrary.org/browse/taxa/actinopterygii), but these sounds represent only a small fraction of the acoustically active species found along the Atlantic Coast. Our goal is to develop this approach along the U.S. Atlantic Coast, given the known species occurrence, previous acoustic work, and energy development potential, but similar approaches could also be applied to other areas under BOEM or National Oceanic & Atmospheric Administration (NOAA) jurisdiction.

**Objectives:** Identify the species-specific sounds produced by focal fish species along the U.S. Atlantic Coast. The species of interest would be targeted on the basis of their known or hypothesized degree of acoustic activity (*e.g.*, drumfish, toadfish), geographical occurrence, economic value (*e.g.*, cod, haddock), or population vulnerability (*e.g.*, sturgeon).

**Methods:** A team of fish sound experts would be assembled to query the research community for which species have been recorded, because many fish species' sounds exist in personal research collections. The list of acoustically active or hypothesized focal Atlantic fish species would be identified, and additional sounds would be captured through a combination of *in situ* observations or captive recordings in different locations. Recording efforts would focus on known spawning or aggregation sites of different species, and local marine laboratories with appropriate facilities for recording fish in captivity. All sounds would be digitally recorded and maintained in an online data catalog to maintain high-quality audio standards. Sounds from different behavioral contexts (spawning, aggregation, feeding) would also be collected and identified.

**Specific Research Question(s):** How can sound-producing fish be better identified and evaluated by existing and new passive acoustic datasets in areas of offshore wind construction and operation?

**References:**

Lobel, P. S., I. M. Kaatz, and A. N. Rice. 2010. Acoustical behavior of coral reef fishes. Pages 307–386 in K. S. Cole, editor. Reproduction and Sexuality in Marine Fishes: Evolutionary Patterns & Innovations. Elsevier Academic Press, San Diego.