Title	Algorithm development to optimize localization accuracy of towed passive acoustic monitoring arrays used during offshore renewable energy activities
Administered by	Office of Renewable Energy Programs
BOEM Contact(s)	Desray Reeb; desray.reeb@boem.gov
Procurement Type(s)	Competitive
Approx. Cost	$150 (in thousands)
Performance Period	FY 2019–2020
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PICOC Summary	
Problem	There are no data readily available that assess the localization accuracy of towed PAM array configurations.
Intervention	The algorithms used to calculate localization need to be improved.
Comparison	New methodologies will be compared to old methodologies.
Outcome	Improved mitigation for marine mammal species.
Context	North, Mid-, and South Atlantic

BOEM Information Need(s): BOEM Office of Renewable Energy is required by the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act to assess the potential and apply appropriate mitigation for the protection of marine mammals. Passive Acoustic Monitoring (PAM) has become a widely-used mitigation in order to detect marine mammal species and ensure they remain outside of protective exclusion zones during the use of active sound sources, in order to prevent injury to these protected species. To date there are no data readily available that assess the localization accuracy of towed PAM array configurations. BOEM therefore has no way of determining how effective the localizing abilities of the arrays proposed by developers for mitigation purposes are for the various types of calls produced by the marine mammal species that occur in the Atlantic. Determining effective mitigations that balance protection of marine mammals with the development of offshore renewable energy requires an understanding of the localizing accuracy of towed PAM arrays.

Background: PAM is a growing technology that is already used world-wide to detect vocalizing marine mammals in order to mitigate for potential acoustic impacts to these protected species. Since PAM is not affected by visibility constraints, this mitigation technique can be used at night and in bad weather when visual observations are not possible. Developers in the renewable energy industry have requested and have been approved to conduct 24-hour high resolution geophysical surveys. Twenty-four hour operations are important to the industry considering the tremendous mobilization and

operational costs associated with these surveys. Towed PAM is one of the mitigations proposed to be used during night time operations to not only detect vocalizing marine mammals, but to help ensure that animals remain outside of the exclusion zone. In order to do this the towed PAM array must be able to localize on the position of the marine mammal in order to determine the distance that the marine mammal is from the sound source. This would enable the PAM operator to determine the proper mitigation action required, for example, to shut down the sound source or not. Currently there is no readily available data that assess the accuracy of the localization abilities of towed PAM arrays. The Joint Industry Programme on E&P Sound and Marine Life recently put out a request for proposals that will investigate and develop improvements for the application of towed PAM for real-time monitoring of marine mammals at sea in 2015. However, this request has specific application to the towed PAM arrays used in the oil and gas industry, which are significantly different to the towed PAM arrays used to support offshore renewable energy and marine minerals activities. In addition, this study complements BSEE's current efforts to develop ANSI standards for towed PAM systems for marine mammals for use throughout BOEM's programs.

Objectives: The first objective of this study is to examine and understand the critical parameters for designing a towed PAM array. The second objective is to develop an algorithm and identify the metrics (for example, frequency content, system configuration, system deployment configuration, trade-offs i.e. localization accuracy vs. area covered for a limited number of sensors) which will affect optimization of the localization abilities of various towed PAM array designs for various protected marine mammal species..

Methods: Establish and verify an algorithm which specifies the physical parameters of a towed PAM array (for example, array length, hydrophone spacing, number of hydrophones etc.) that will facilitate the optimization and selection of an appropriate towed PAM array configuration for marine mammal mitigation purposes. The algorithm should incorporate the characteristics of multiple marine mammal species vocalizations, including, but not limited to, frequency, source level, repetition rate and directionality, as well as array operational parameters including, but not limited to, tow depth, speed, and water depth.

Specific Research Question: How do we improve towed PAM measurements?