U.S. DEPARTMENT OF
ENERGY

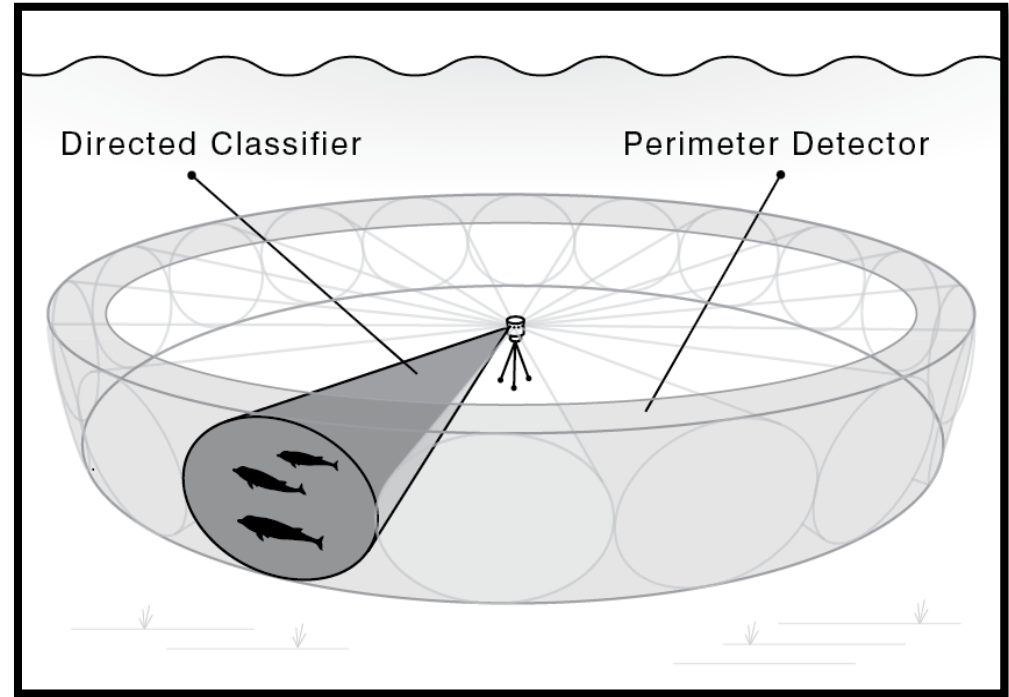*Office of*
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Water Power Technologies Office 2019 Peer Review

Marine and Hydrokinetics Presentation

Long-Range Target Detection and Classification System for Environmental Monitoring at MHK Sites

Directed Classifier   Perimeter Detector

Marine and Hydrokinetics Program

October 9, 2019

James Dawson, **Principal Investigator and Senior Research Scientist**

BioSonics, Inc.

Project Overview

Project Summary

Deliver a practical, robust and cost-effective long range (200 – 300 meters) active acoustic monitoring system, with innovative shaped pulse and Chirp capabilities to suppress off-frequency sound energy within the hearing range of marine mammals, to automatically assess marine life behavior at MHK sites. The one-of-a-kind sonar system successfully integrates a 360-degree Perimeter Detector to automatically detect and geolocate targets at range, and a focused split beam Directed Classifier to track and classify target types.

Project Objective & Impact

MHK developers, regulators and the public need to understand how candidate MHK devices affect the behavior of fish, marine mammals and other marine organisms for project permitting. The long-range target detection and classification system will help answer key questions, with scientific accuracy and at a low cost. This technology helps to further understand potential environmental risk to marine organisms from MHK devices.

Project Information

Project Principal Investigator(s)

James J. Dawson, MSc

WPTO Lead

Samantha Eaves

Project Partners/Subs

Airmar Technology Corp.
Dr. Orest Diachok

Project Duration

- Project Start Date: January 1, 2017
- Project End Date: March 31, 2020

Marine and Hydrokinetics (MHK) Program Strategic Approaches

Data Sharing and Analysis

Foundational and Crosscutting R&D	Technology-Specific Design and Validation	Reducing Barriers to Testing

Reducing Barriers to Testing

- Support additional scientific research as needed, focused on retiring or mitigating environmental risks and reducing costs and complexity of environmental monitoring

  The technology will efficiently and unobtrusively assess the impacts of MHK devices on the biological community and is essential to moving to the MHK industry forward.

Project Budget

Project cost performance goals have been achieved with actual costs in line with proposed budget costs.

Total Project Budget – Award Information		
DOE	Cost-share	Total
$750K	$187.5K	$937.5K

FY17	FY18	FY19 (Q1 & Q2 Only)	Total Actual Costs FY17–FY19 Q1 & Q2 (October 2016 – March 2019)
Costed	Costed	Costed	Total
$139.2K	$550.7K	$71.8K	$761.7K

Management and Technical Approach

- Assemble a team of the best researchers in the field; BioSonics, Inc., Airmar Technology Corp., Dr. Orest Diachok (NRL).

- Transition similar technological accomplishments previously achieved by the project team for US Navy waterside security applications to the Marine Hydrokinetic (MHK) application.

- Develop and implement shaped transmit pulse and chirp technology to minimize monitoring system detectability by marine mammals.

- Take an incremental approach by first developing and testing a subsector 120-degree perimeter detection array.

- Work closely with Pacific Northwest National Laboratory's Marine Sciences Lab to field test and optimize the subsector array.

- Apply lessons learned and build out a full prototype system with 360-degree perimeter detector array and slew-to-cue directed classifier.

- Transition previously developed background clutter mapping and biological species classification capabilities to the prototype system.

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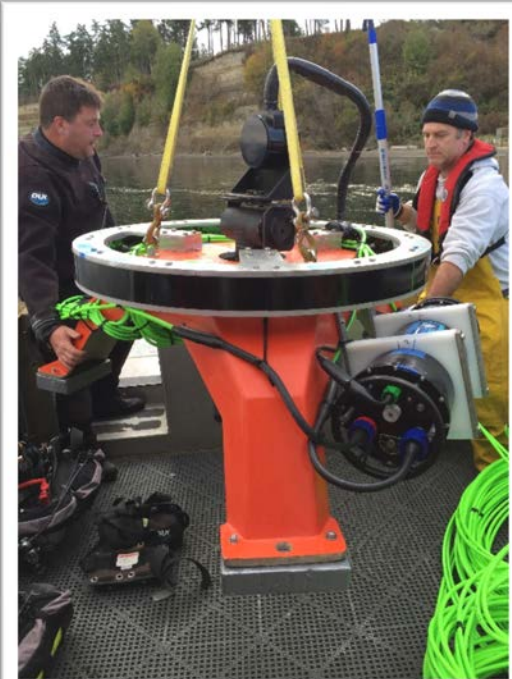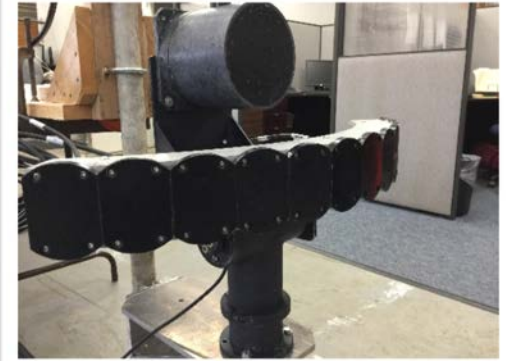
Strategy

- BioSonics team members have attended and presented information on the project at a variety of domestic and international conferences attended by developers, public and private stakeholders, and regulators. Project presentations at technical conferences are the most effective way to engage with members of the MHK community, disseminate information and receive valuable feedback.

- BioSonics is a member of the National Hydropower Association's Marine Energy Council, which provides an opportunity through monthly calls and meetings to interact with a diverse MHK community and Federal Agencies.

Recent Highlights

- In July 2019, BioSonics presented the project and results at a Marine Energy Symposium as part of the annual HydroVision International Conference and received unanimous positive support in the need for the technology to advance general development of the MHK industry.

- In December 2019, at the Acoustical Society of America technical conference, BioSonics' CEO, Tim Acker, is an invited speaker, and will present and publish a paper on the project.

Technical Accomplishments

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Prototype System Field Testing

Pacific Northwest National Laboratory Marine Sciences Laboratory - Sequim, Washington

- Successfully operated the prototype system on the seabed in a high energy test site.

- Successfully tracked man-made targets as they were towed through the monitoring site.

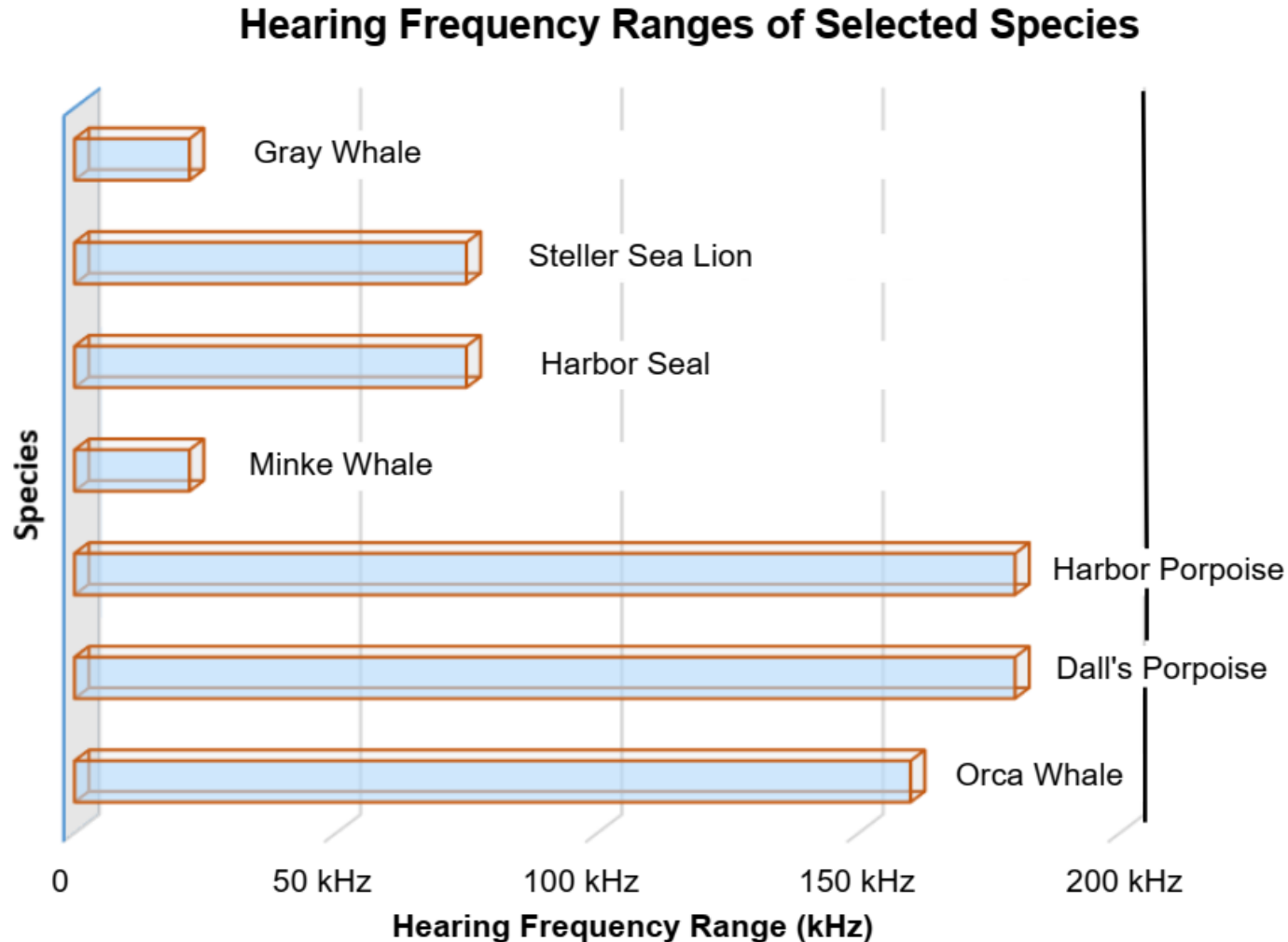- Demonstrated an intuitive real-time user interface displaying tracked targets in real-time
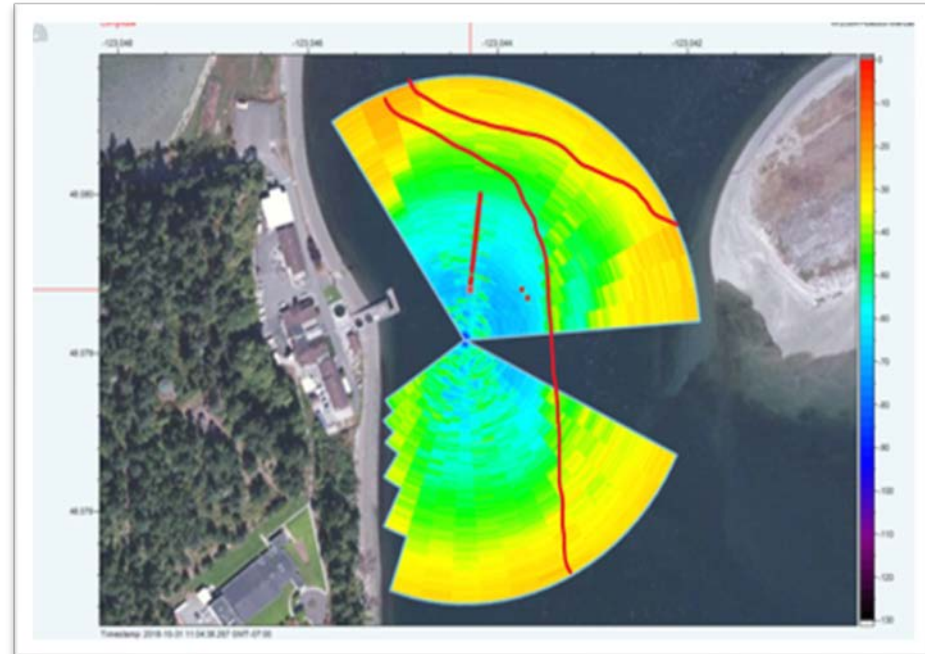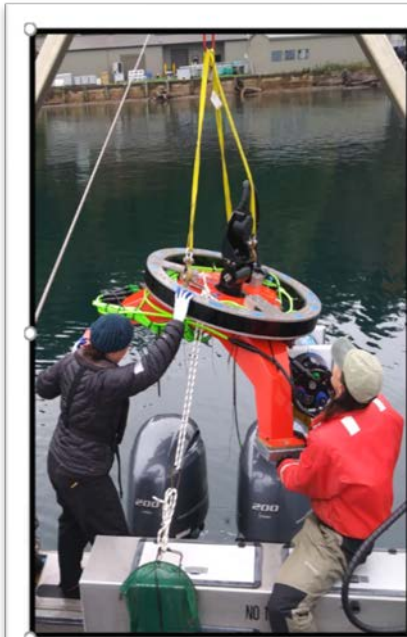
Prototype System Field Testing

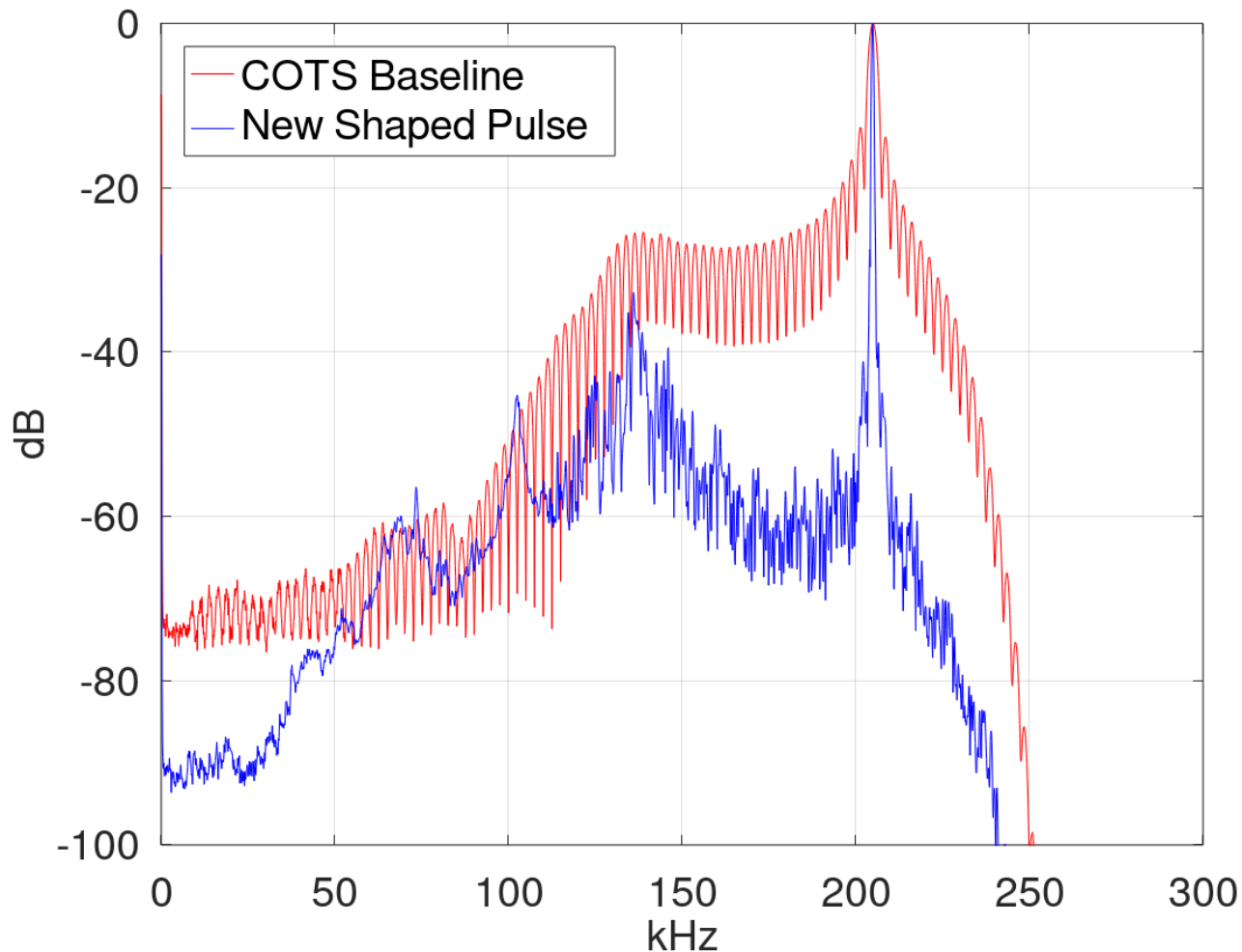**Pacific Northwest National Laboratory Marine Sciences Laboratory - Sequim, Washington**

Suppression of Low Frequency Sound Energy Within the Hearing Range of Marine Mammals

Hearing Frequency Ranges of Selected Species
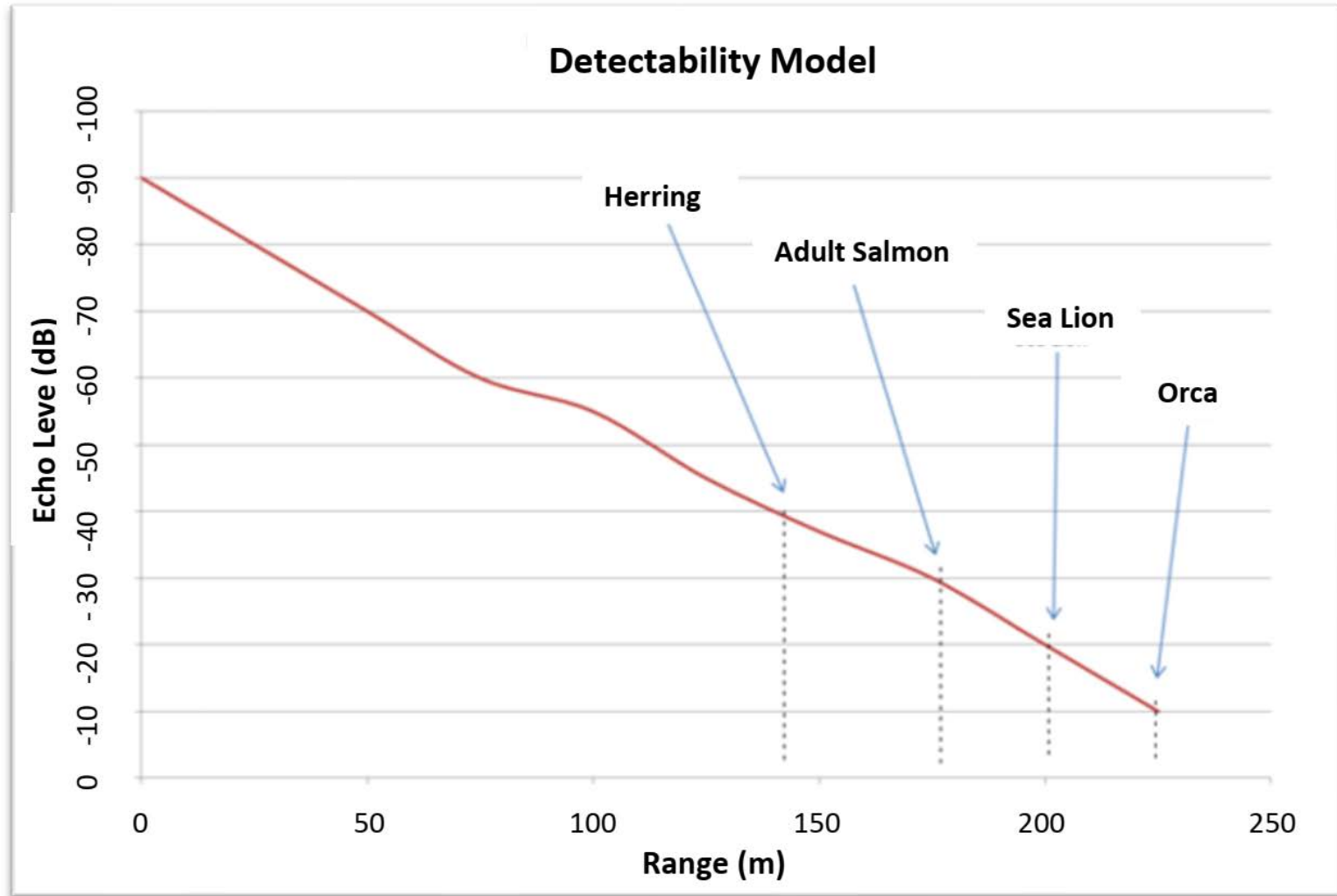
Deceased Low Frequency Sound, in the Hearing Range of Marine Mammals, by a Factor of 10

Detectability Model to estimate the ranges at which specific species can be detected

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Background Clutter Removal and Target Classification Algorithms Have Been Implemented; Critical to Maximizing Probability of Biological Detections and Minimizing Nuisance Alarms
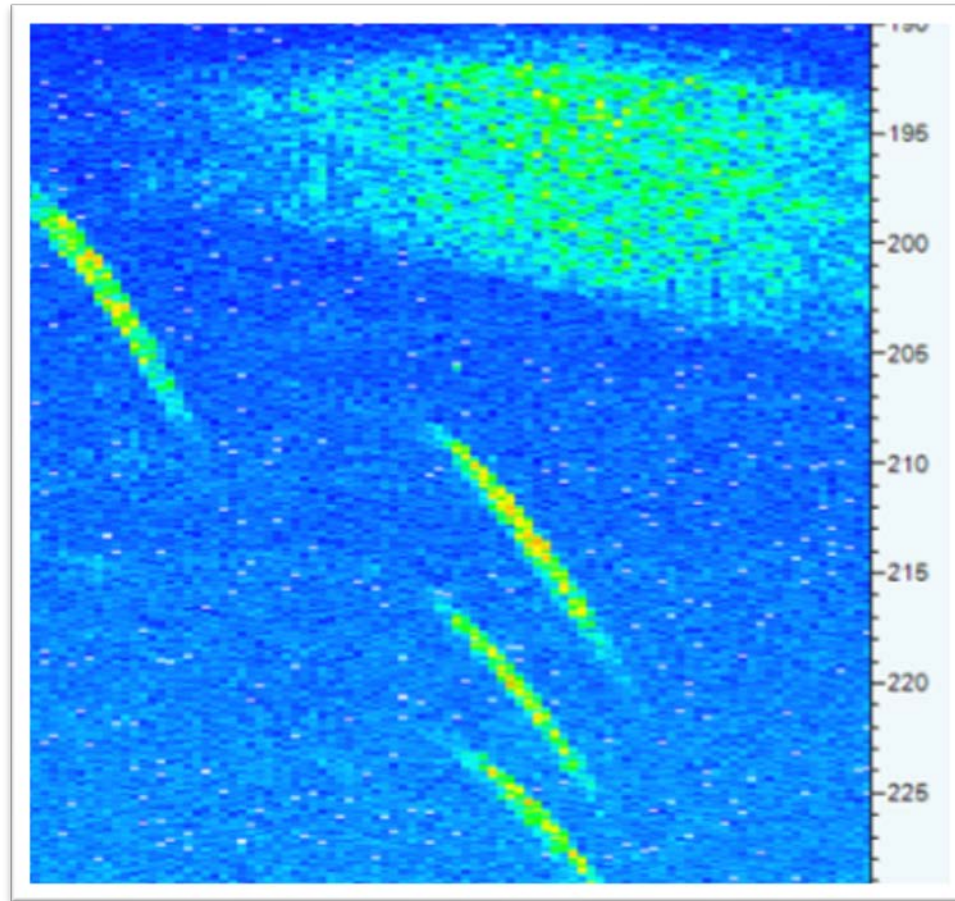
Orca and Herring Classification

Future Work

Deployment at Wave Energy Test Site (WETS) Hawaii – 2020
Monitor biological activity during deployment of a Wave Energy Convertor (WEC)

Oscilla Energy - WEC

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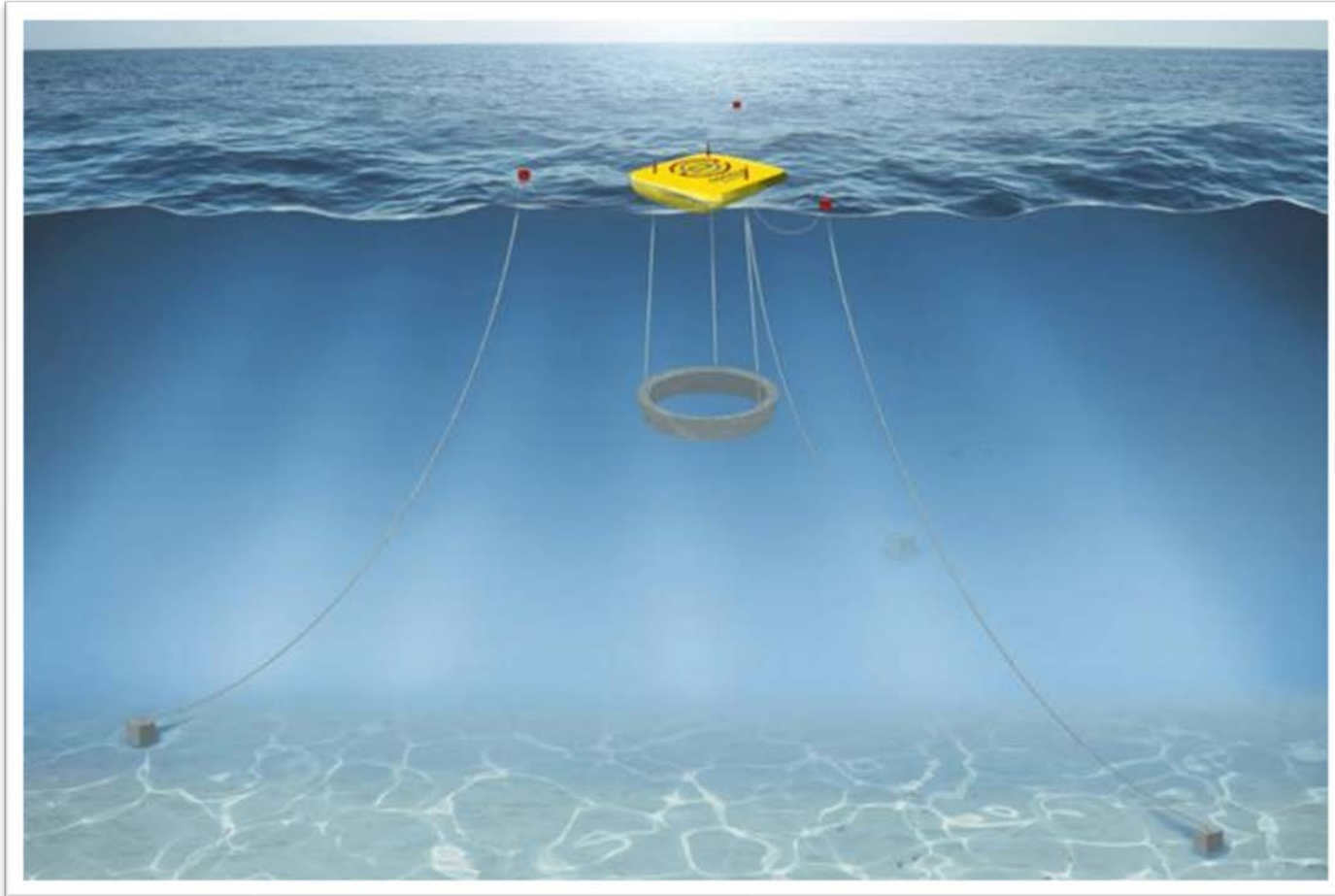
Deployment at Wave Energy Test Site (WETS) Hawaii – 2020

Focus on documenting marine mammal behavior and WEC device interactions

Marine Corps Base, Oahu - WETS