



Marine Mammal Behavioral  
Response to Marine Energy  
Converter Sound

**Brian Polagye**

University of Washington  
bpolagye@uw.edu, 206.543.7544  
February 2017

**Marine Mammal Behavioral Response to Marine Energy Converter Sound:** Marine energy converters unlikely to cause acoustic injury, but may affect behavior. Knowing more about the possibility for behavioral changes could streamline monitoring requirements and methods for pilot and early commercial projects.

**The Challenge:** The behavioral effects of marine energy converter sound are not well-understood. This can lead to monitoring plans poorly suited to specific projects.

**Partners:** SMRU Consulting – marine animal observations and behavioral interpretation.

## Technology Maturity

- Test and demonstrate prototypes
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- Conduct R&D for innovative MHK systems & components
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

## Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- **Support research focused on retiring or mitigating environmental risks and reducing costs**
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

## Market Development

- Support project demonstrations to reduce risk and build investor confidence
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

## Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- Exchange of data information and expertise

## Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- **Support research focused on retiring or mitigating environmental risks and reducing costs**
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

## The Impact

- Quantify the likely behavioral response of cetaceans (harbor porpoises) and pinnipeds (harbor seals) to the signal excess (received level – ambient level) produced by marine energy converter(s).
- Provide guidance for scope and methods of marine animal monitoring around pilot and early commercial projects. Reduce monitoring costs and increase information yields necessary to retire risk.
- A description of observational methods, data reduction techniques, and outcomes (i.e., observed marine mammal behavioral responses – if any – as a function of signal excess around marine energy converter).

## Marine Energy Converter Sound Source(s)

- Generate sound using J11 transducer (U.S. Navy) deployed from moored surface vessel
- Provides control/repeatability for source
  - Modulate sound in relation to measured currents to more accurately simulate a current turbine in a tidal environment



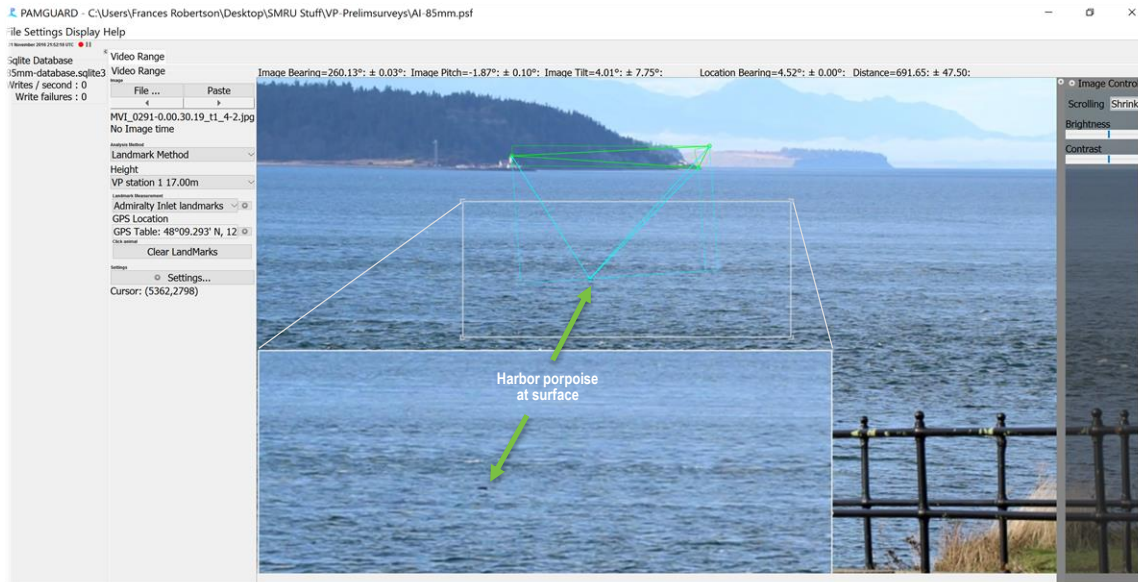
Ocean Renewable Power  
Company RivGen current turbine



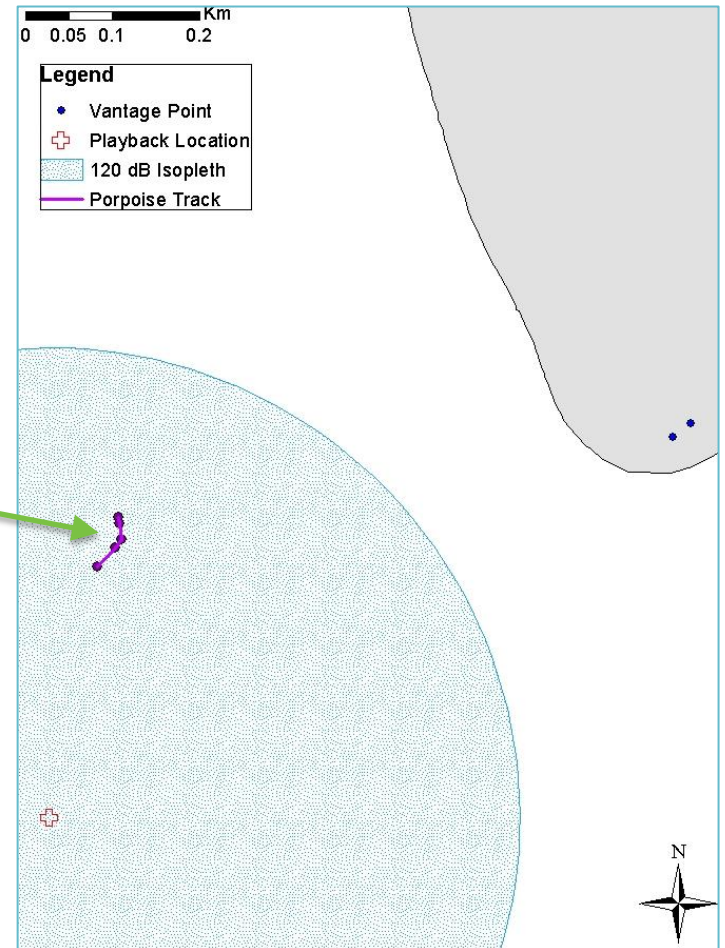
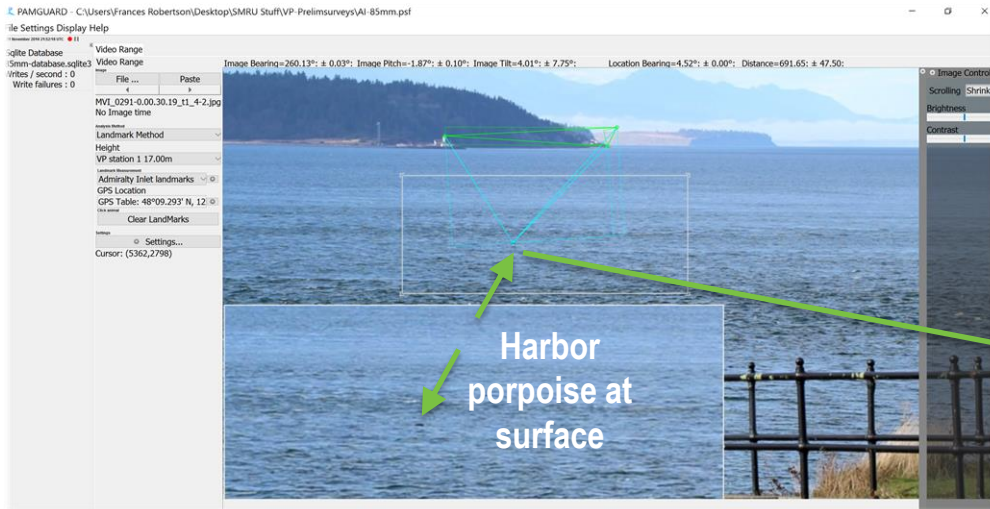
NWEI Azura wave energy  
converter

## Marine Mammal Observations

- Land-based Vantage point survey
- Combined scan sampling and focal follow methodology
  - Photogrammetric method to estimate spatial positions of animals from still images and individual video frames using PAMGUARD landmark module.

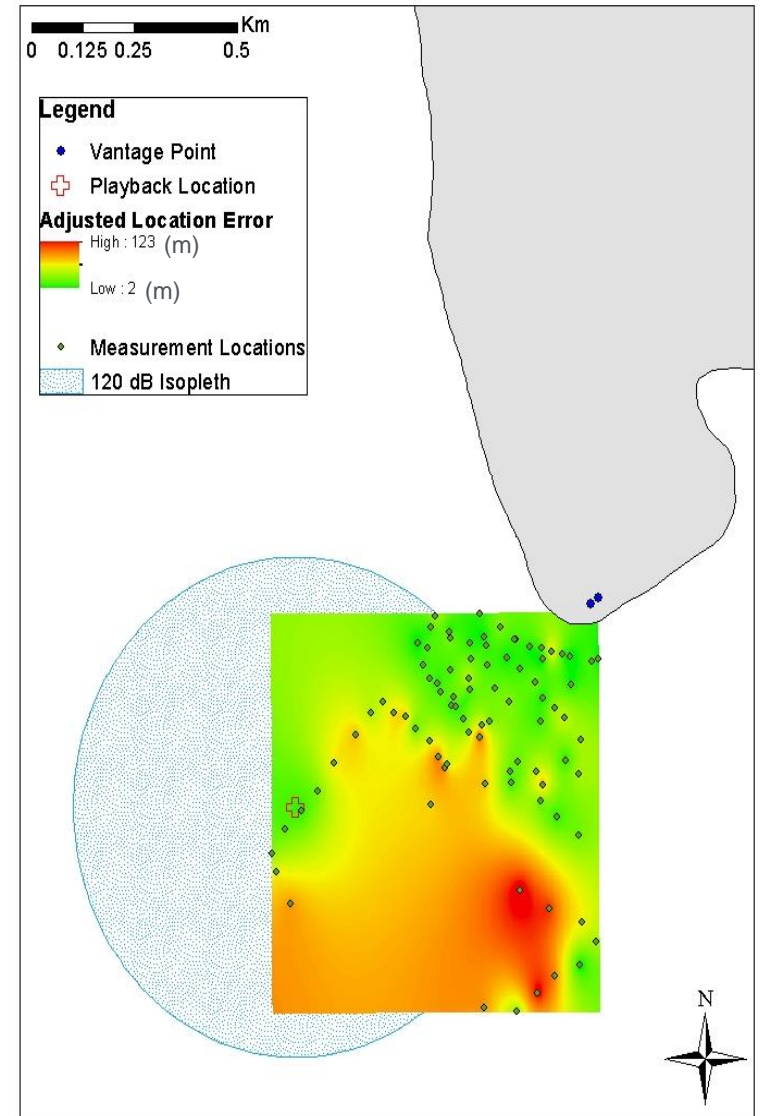


## Marine Mammal Observations



## Location Accuracy Experiment

- Collected 87 known locations throughout study area
- Compared known locations to estimated photo-geo referenced locations (PAMGUARD)
- Location error increases with distance, but also in specific directions due to poor landmarks
- Informs procedures for error minimization in BP 2





- Completed preliminary surveys to verify method for observations of marine mammals
- Selected marine energy converter sound sources
- Received J11 transducer from U.S. Navy equipment
- On track for National Marine Fisheries Service authorization by end of Q1 FY2017

**On track for Go/No-Go decision in Q2 FY2017**

- Project awarded in 2013, with expected completion in 2015
- *Original scope*: Study the behavioral effects of tidal turbine sound on marine mammals in conjunction with Snohomish PUD/OpenHydro demonstration project (project cancelled)
- *Re-scope 1*: Conduct project in Ramsey Sound, UK around Tidal Energy, Ltd., demonstration project (company is now in bankruptcy proceedings – briefly operated turbine)
- *Re-scope 2*: Conduct project in Admiralty Inlet, USA, playing back marine energy converter sound as a repeatable, controllable source at a well-characterized location

## Budget History

FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$0	\$0	\$0	\$0	\$0	\$0

- Expenditures began in October 2016, as a consequence of re-scoping
- ~20% of project funds will have been expended by Go/No-Go decision

## Partners, Subcontractors, and Collaborators:

- University of Washington
  - Dr. Brian Polagye (PI)
  - Dr. James Joslin, Applied Physics Laboratory
- SMRU Consulting
  - Dr. Jason Wood
  - Dr. Frances Robertson

## Communications and Technology Transfer:

- None to date

## FY17/Current research:

- Budget Period 1
  - Complete benchtop integration of playback system
  - Conduct preliminary surveys to finalize methodology
- Budget Period 2
  - Conduct playback studies and interpret results

## Proposed future research:

- *If successful*, similar observational methods could be applied to operational projects in areas with significant numbers of marine mammals.
- *If successful*, playback methodology could be repeated with other intensities/types of marine energy converter sound to evaluate their potential effects.