UNDERWATER OBSERVATIONS – MONITORING THE ENVIRONMENT AROUND MARINE ENERGY DEVICES

Presented by: Alicia Amerson and Joe Haxel

Pacific Northwest National Laboratory

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Triton Initiative is sponsored by the DOE Water Power Technologies Office

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U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

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A bi-monthly look into the ongoing work of WPTO sponsored projects and program areas

July R&D Deep Dive Webinars		
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- This webinar will be recorded and made available to registrants.
- Attendees' microphones are muted and attendees are not visible on video.
- Questions will be answered during the Q&A after the presentation has ended.
- To ask questions:
  - Submit question into Chat Box and select "Everyone"
- If you have technical issues, try calling into the webinar via phone.

Thank you for participating!

Hi, it's nice to meet you

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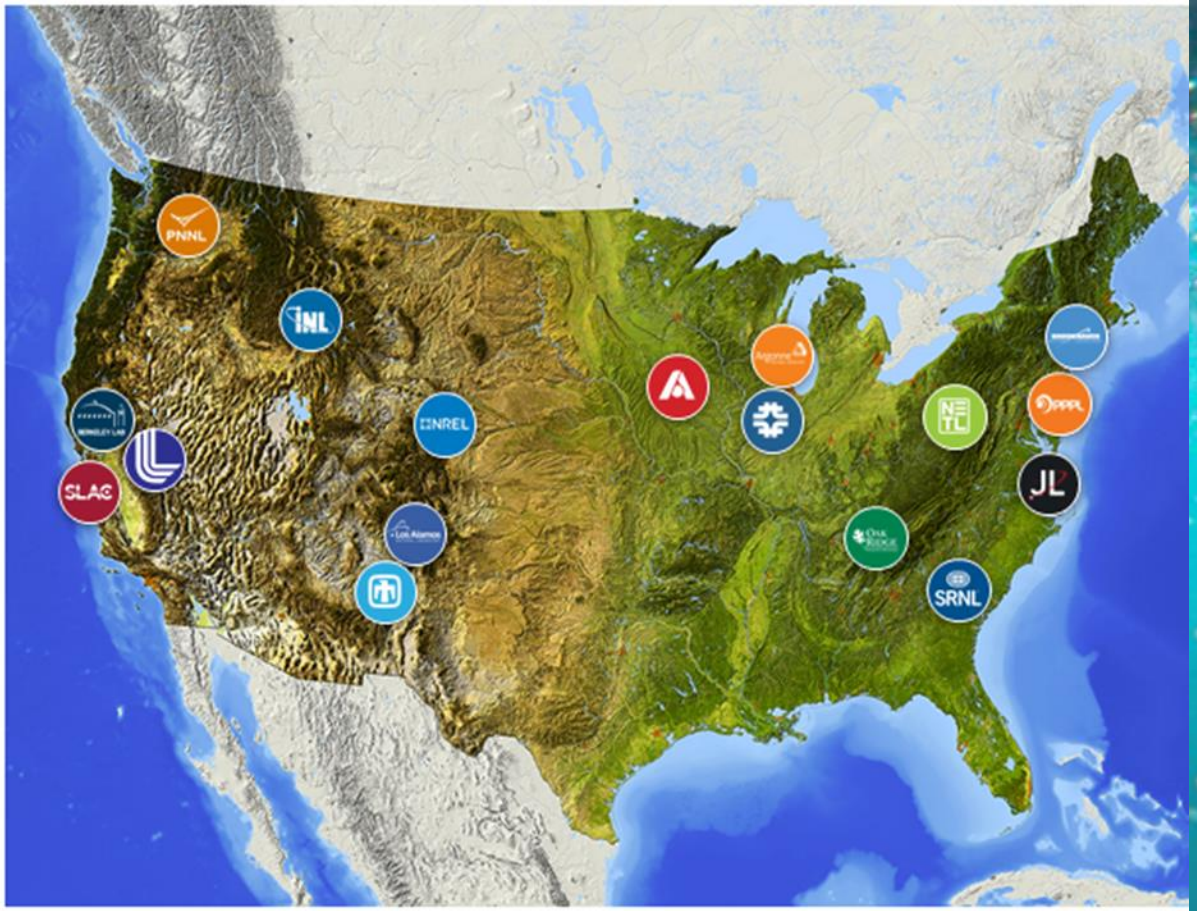
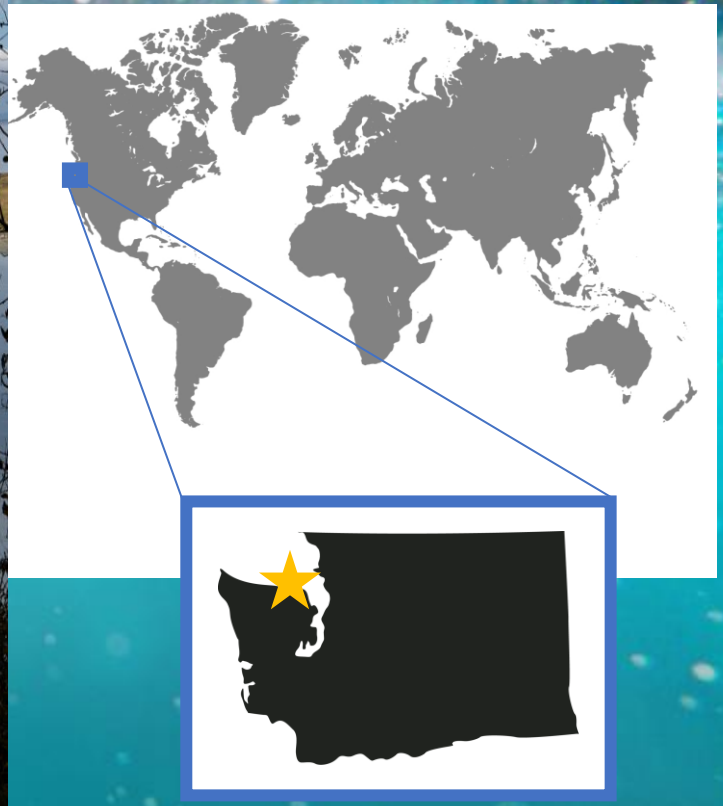


Where we are located



Research at Marine and Coastal Research Lab (MCRL)

Algal Biofuels

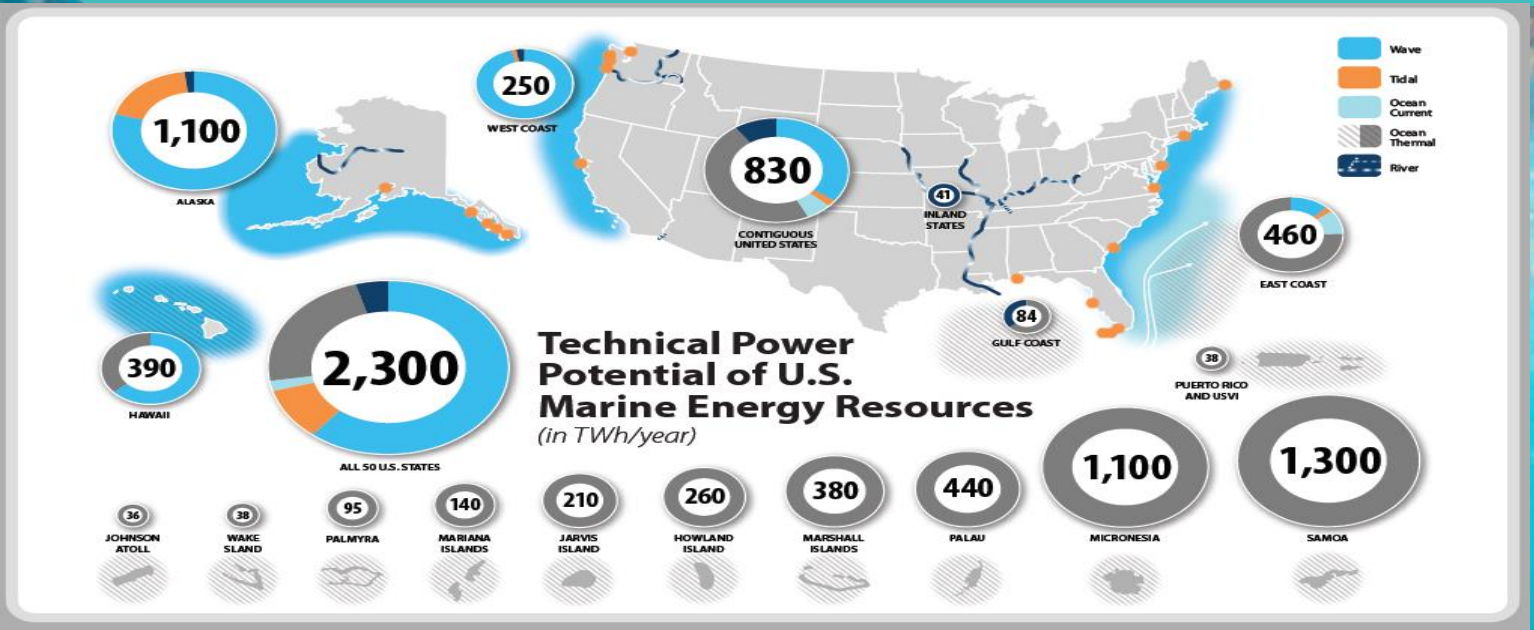
Wetlands Ecology

Ecological Modeling

Analytical Chemistry

Monitoring Impacts of Marine Energy

Utility Scale Marine Energy



Kilcher et al., 2021

U.S. States[a]	Technical Resource (TWh/yr)[b]	Potential Number of Homes Powered[c]	Resource as a Percent of U.S. Electricity Generation (%)[d]
Wave (to EEZ)	1,400	130,000,000	34
Tidal	220	21,000,000	5.4
Ocean Current	49	4,600,000	1.2
Ocean Thermal	540	51,000,000	13
River	99	9,300,000	2.4
Total	**2,300**	**220,000,000**	**57**

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The Triton Initiative supports industry partners, innovates technology, and performs tests to explore the best methods and technology for environmental monitoring around marine energy (ME) devices

Marine Energy Devices

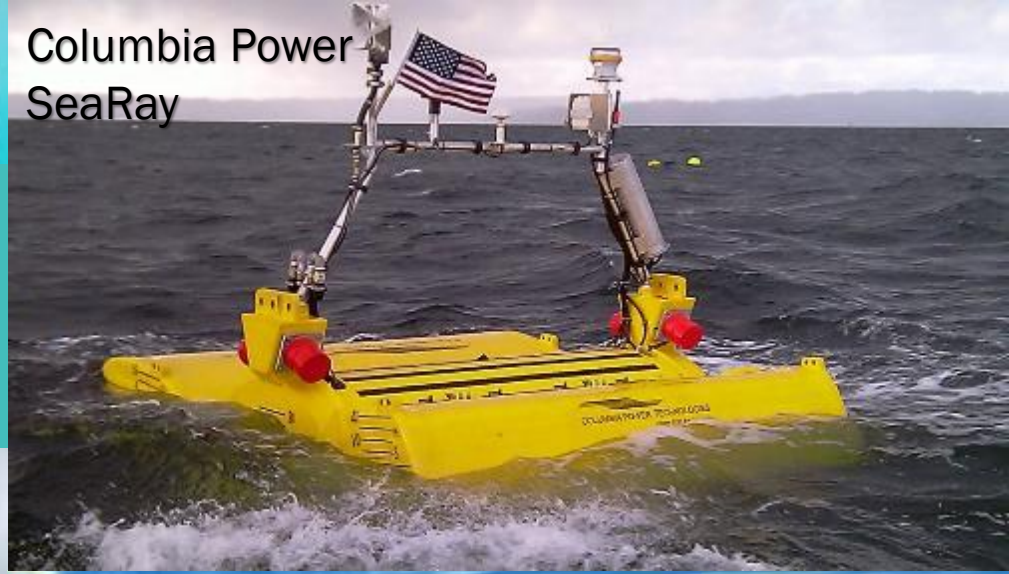
Tidal and Current Energy Production

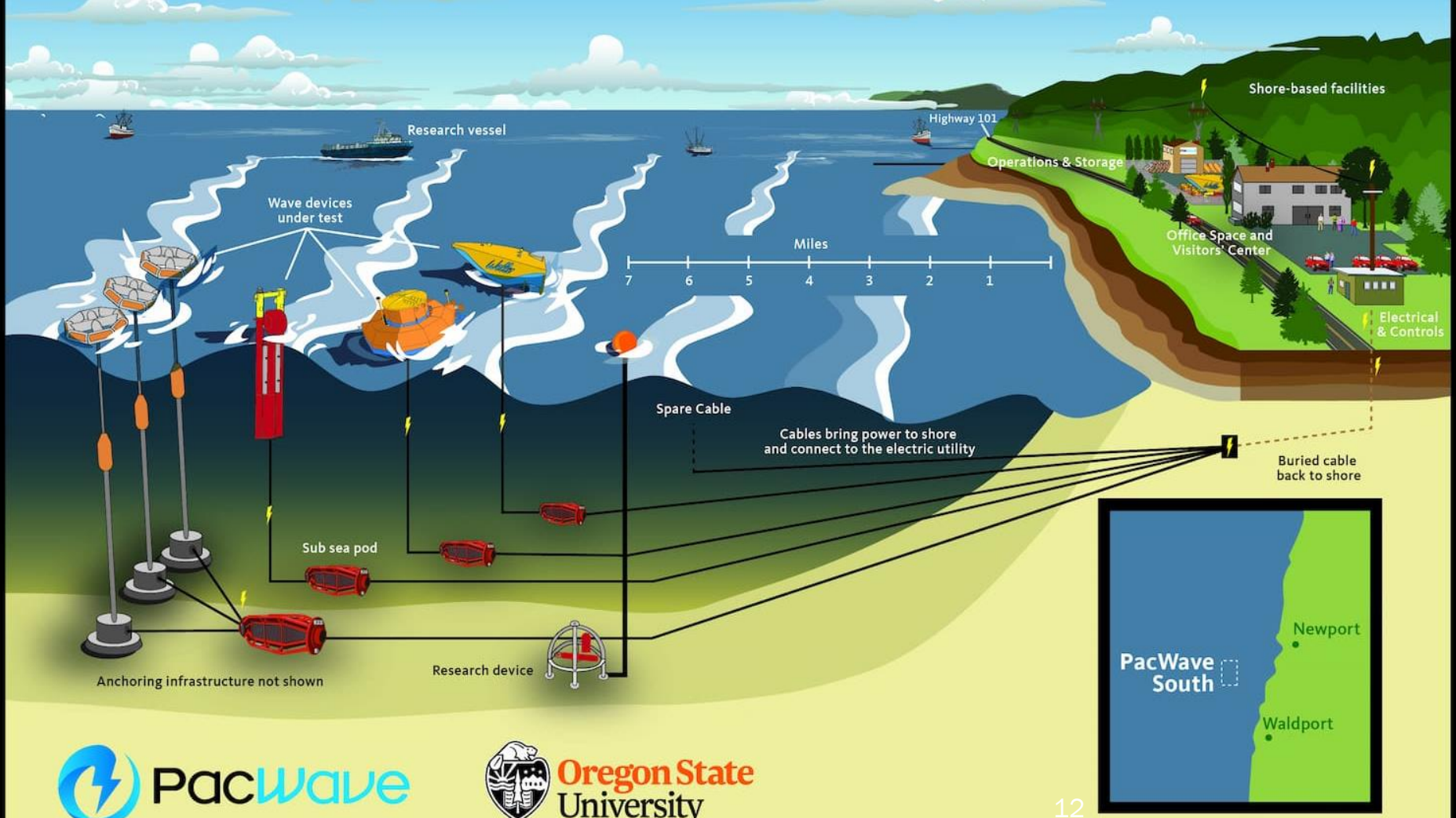
Current Energy Converter (CEC)

- Turbine

Wave Energy Converter (WEC)

- Floating
- Buoy





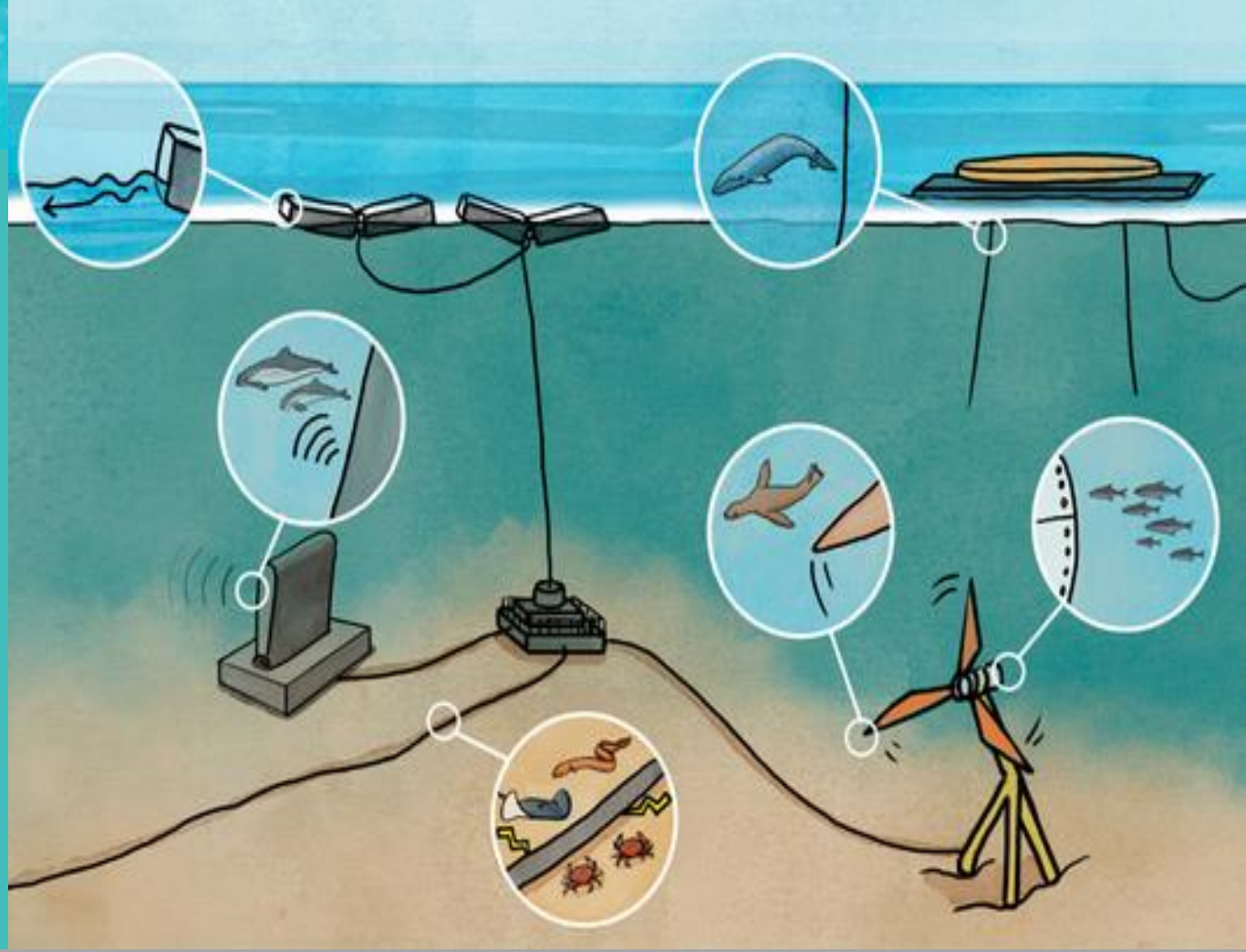
PacWave

Oregon State University

Triton Field Trials (TFiT)

Four environmental stressors the Triton team research in the field to create recommendations about different types of technology and scientific methods to help further the deployment of marine energy devices.

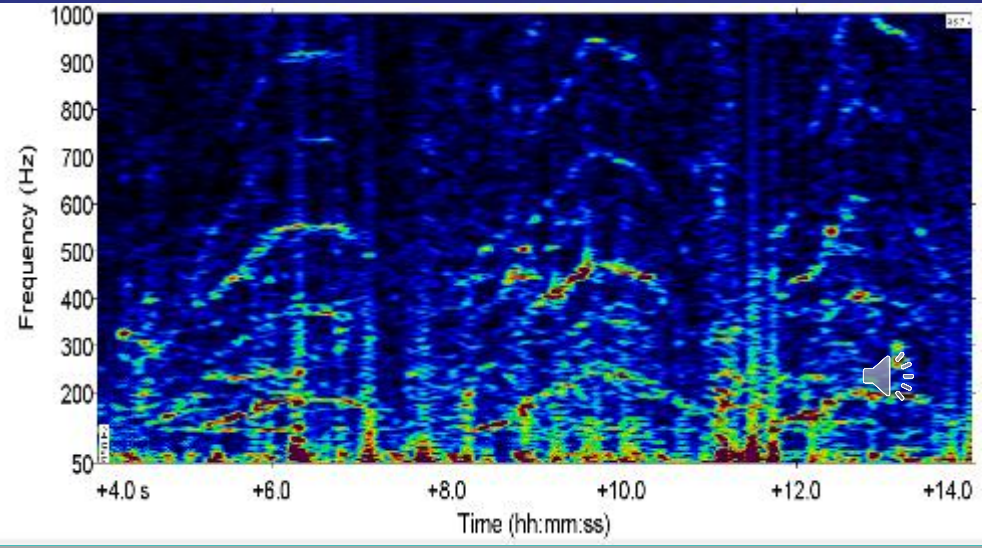
Illustration by Rose Perry, OES-Environmental



Monitoring underwater noise

- Marine mammals, fish, turtles and invertebrates use or are sensitive to sound for critical life functions – foraging, communication, navigation
- Uncertainty -> concern for disturbance from ME projects
- How do we best measure and evaluate changes in acoustic conditions from ME?
  - Cost effective
  - Regulatory compliance

Hawaiian Island Humpback Whale NMS/ Jason Moore



Field trials for monitoring underwater noise

- Acoustic characterization of marine energy converters **IEC TS 62600-40 (2019)**

Tidal/Riverine

- University of New Hampshire – Living Bridge (UNH-LB)

Wave/Oceanic

- Scripps Institution of Oceanography, CalWave WEC

Technology

Commercial off the shelf technology: Ocean Sonics drifting buoy and hydrophone

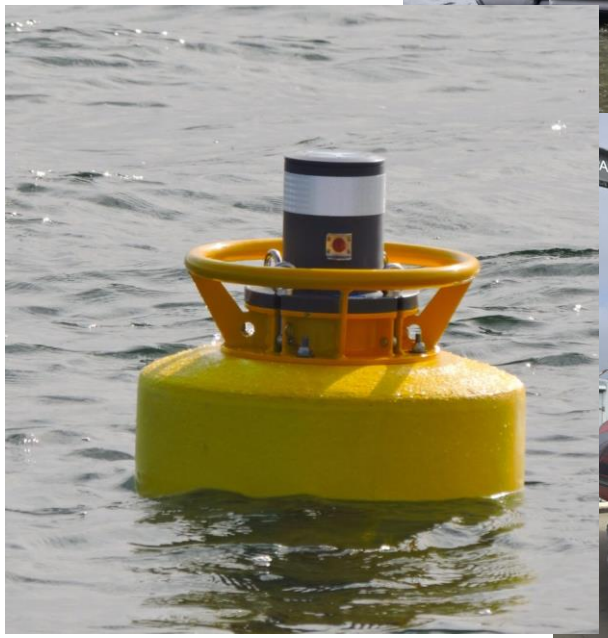


Photo courtesy of Ocean Sonics

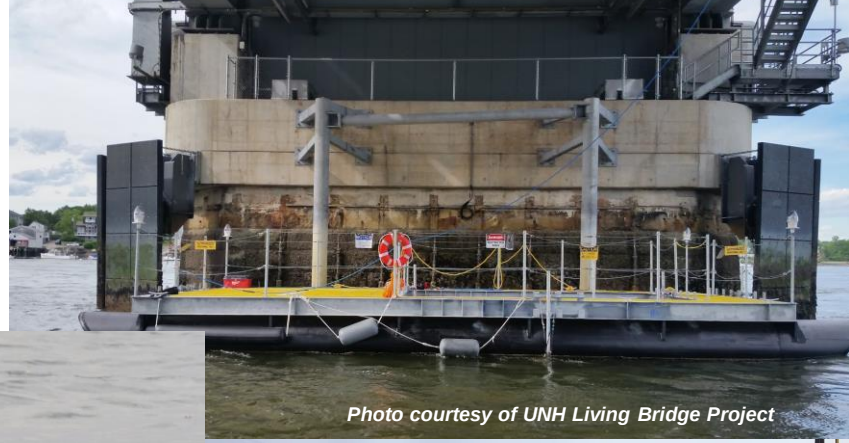


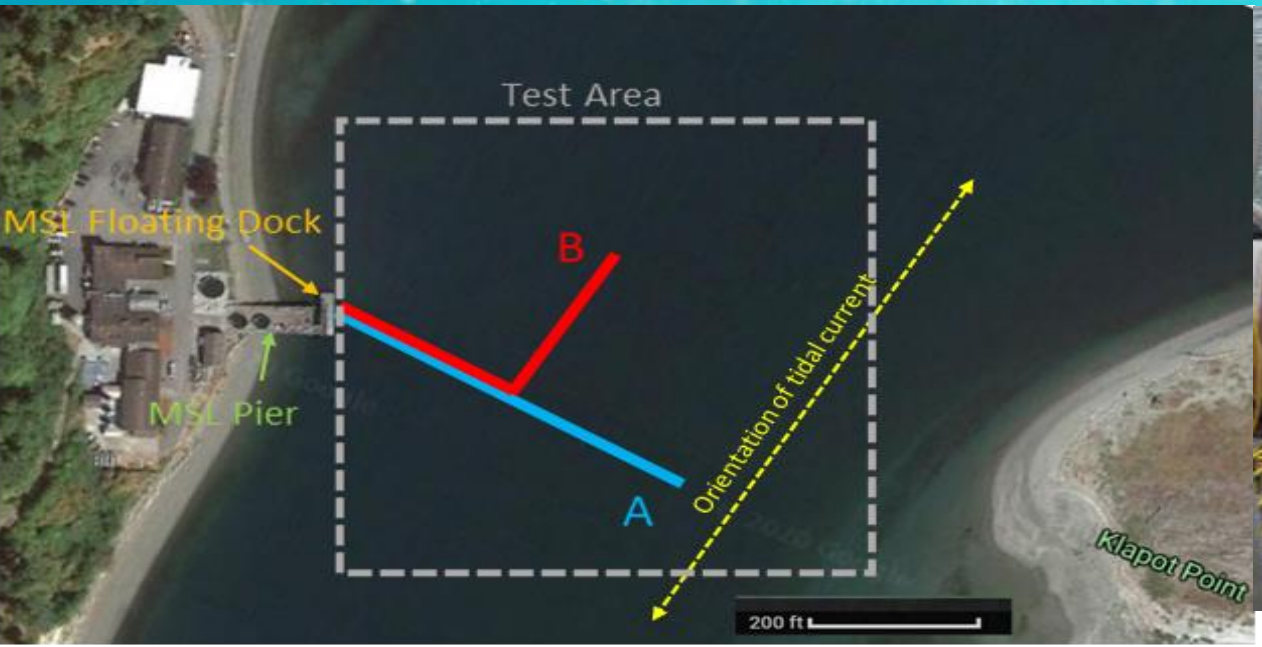
Photo courtesy of UNH Living Bridge Project

Launching boat from Scripps Institution of Oceanography pier in La Jolla, CA Photo courtesy of Alicia Amerson

Monitoring electromagnetic fields (EMFs)

- Transmission lines are necessary to bring electricity from marine energy devices back to shore
- As electricity is transmitted along the cable, it generates an electromagnetic field
- Many animals are known to be sensitive to marine life, perhaps using electromagnetic fields to sense prey or migrate
- There are still many unknowns around electromagnetic fields, including understanding the intensity and variability in a marine energy site

Field trials for measuring electromagnetic fields



SeaSpy2, calibrated by Erin Walters, measures the generated magnetic fields

- 2020 Field trials in Sequim Bay tested EMFs from cables and a point source generator calibrated to be comparable to a marine energy device
- 2021 Field trials in Sequim Bay test background EMF, initial data analysis highlights the importance of collecting background characterization to detect cable's magnetic field

Collision Risk

- Typical turbine applications are in fast tidal and river currents
- Risk concerns are with marine animals
- No observed blade strikes
- Difficulty of observations in such energetic environments
- Additional uncertainty about consequences of blade strike

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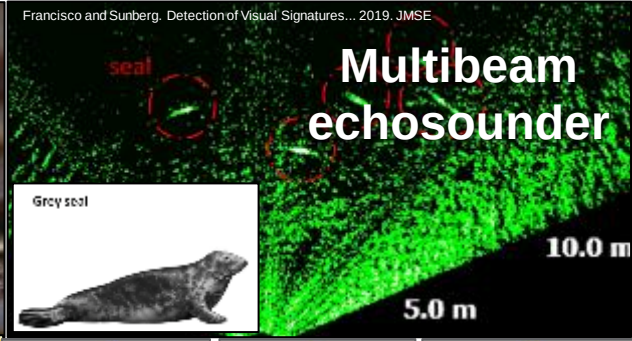
Field trials for collision risk

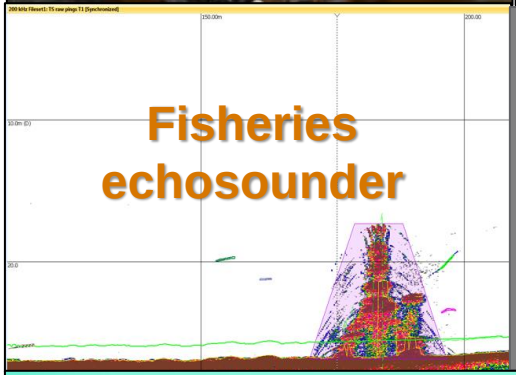
Field trials conducted at:

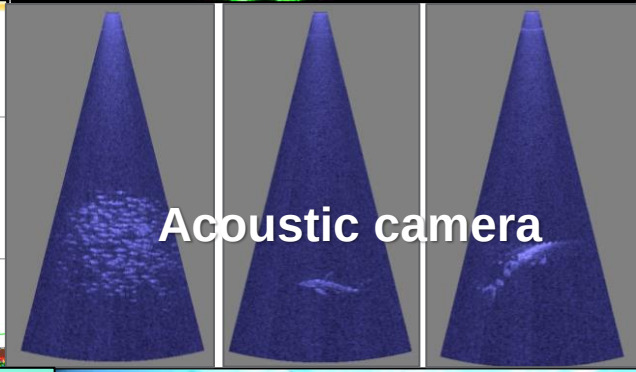
- University of New Hampshire
  Living Bridge
- University of Alaska, Fairbanks
  Tanana River Test Site

Technology tested:

- Acoustic camera
- Multibeam echosounder
- GoPro







Monitoring changes in habitat

What is Changes in Habitat?

- Modification of species communities
- Alteration of habitat of these species
- Benthic and pelagic habitats
- Small and large spatiotemporal scales

How does is translate?

- Footprint / Scour
- Community composition
- Colonization / biofouling
- Artificial reef / FAD
- Marine reserve
- Food web

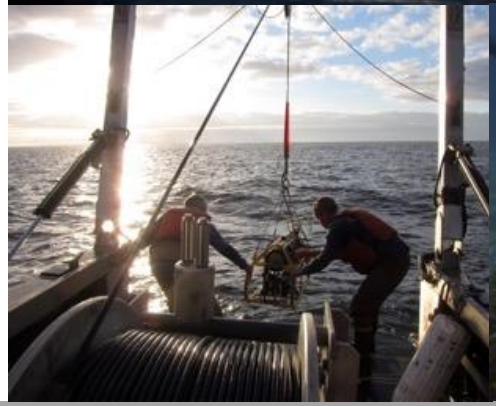
Field trials for changes in habitat

How do we measure?

- Seabed characterization: sonars, cores, imagery
- Benthos (infauna & epifauna): cores, imagery, trawls
- Pelagos: sonars, trawls, imagery
- Biofouling: scrape samples, imagery

What is Triton's role?

- Discuss with subject matter experts
- In-depth literature review of methods
- Identify methods best suited for ME context
- Test (new) methods at ME sites
- Propose guidelines and best practices

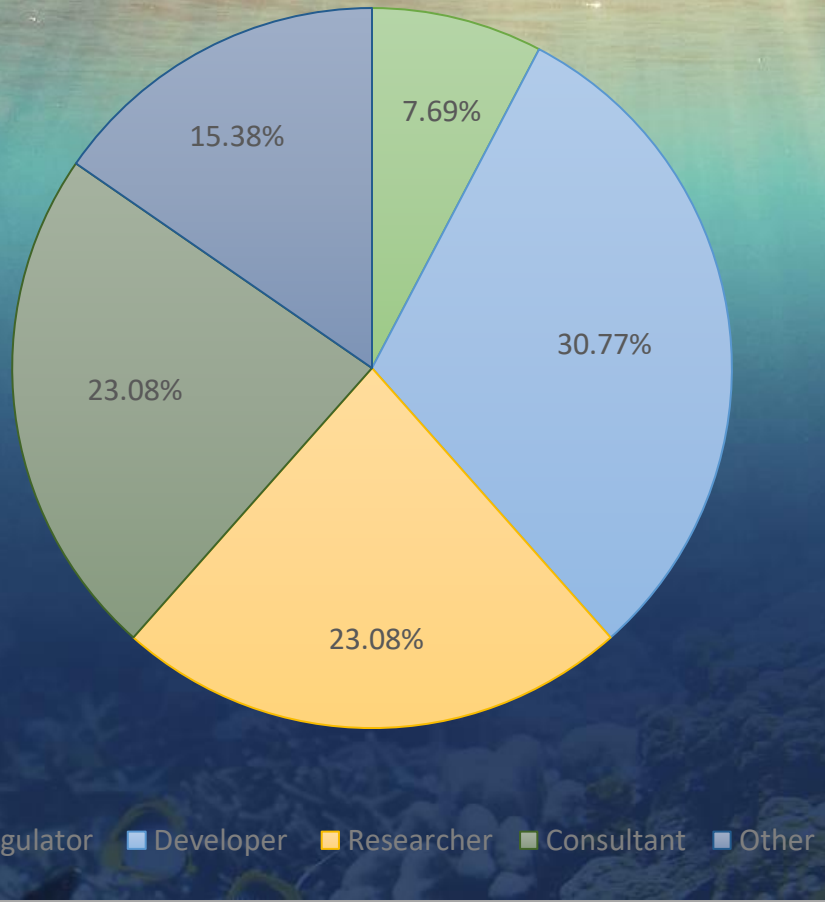


Survey Results

Survey Results

Who took the survey:

- **100%** of respondents were familiar with ME
- **87%** said their primary role was in ME
- **69%** are familiar with, but do not work in ME environmental monitoring
- Only **8%** work in ME permitting



Survey Results: Key Questions

What type of environmental data are needed to fulfill permit requirements?

"Longer term deployments of environment device interactions, such as noise, material ablation, mooring and anchor scouring, etc."	"Site characterization data, often with surveys for seabirds, marine mammals, fisheries, benthos"	"Data that informs compliance with NEPA, ESA and MMPA"	"Baseline data, which will need to be collected if it does not exist already. Then monitoring data after device installation."

Survey Results:
Key Questions

What instrumentation or technology is needed to collect the environmental data to fulfill requirements?

“seafloor samples via dive surveys, seafloor visual inspection via dive surveys”	“So far, we haven't lacked needed instrumentation or technology. It's the cost of such instrumentation and technology that needs to come down significantly.”	“Passive acoustic and audiovisual equipment to detect species/devices interaction”	“fish tagging, pinniped and cetacean telemetry tags to collect behavioral data”

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Q&A

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Underwater noise monitoring technology at PacWave

J. Haxel, H. Matsumoto, S. Stalin, and C. Meinig