Evaluating the Potential for Marine and Hydrokinetic Devices to Act as Artificial Reefs or Fish Aggregating Devices

Based on Analysis of Surrogates in Tropical, Subtropical, and Temperate U.S. West Coast and Hawaiian Coastal Waters

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Project Overview

"Evaluating the Potential for Marine and Hydrokinetic Devices to Act as Artificial Reefs or Fish Aggregating Devices"

Questions and Challenges

- Could threatened and endangered wildlife be harmed by marine and hydrokinetic (MHK) energy devices off the West Coast and Hawai'i?
- What factors influence whether devices will have negative effects?
- Agencies are reluctant to permit devices without knowing more or imposing stringent, costly requirements
- Most studied installations are in the Atlantic, providing few direct answers

Needs

- Identify whether and how devices could affect wildlife
- Inform and facilitate the environmentally responsible siting, design, permitting, and monitoring of new MHK devices

For Partners and Collaborators, see Slide 12.

Program Strategic Priorities

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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 mitig… risks
- Build… tech…
- Ens… are … and … proces…
- 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 … 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

“Support research focused on retiring or mitigating environmental risks and reducing costs”

Program Strategic Priorities

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

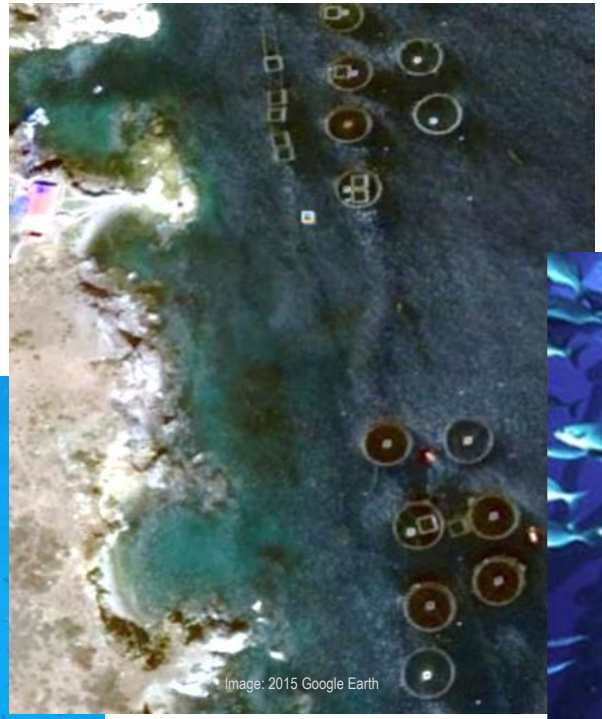
- Decrease environmental uncertainty
- Inform siting and design
- Facilitate permitting
- Support environmental analyses (e.g., for National Environmental Policy Act, Endangered Species Act, Essential Fish Habitat)
- Potentially reduce the need for costly studies of individual projects
- Focus monitoring efforts
- **Assist successful and responsible deployment of marine and hydrokinetic (MHK) energy devices**

Technical Approach

1. Analyze the literature on surrogate structures in four regions: three off the West Coast and one in Hawai‘i.
2. Hold guided discussions with subject-matter experts.
3. Account for numerous physical, biological, and structural variables.
4. Ask:
   - Do surrogate structures attract fish? Which species?
   - What about special-status species?
   - If attraction occurs, are there negative effects?
   - What physical, biological, or structural variables are important in predicting effects?

Technical Approach

5. Predict effects on biotic communities off the West Coast and Hawai‘i based on the effects observed at surrogate structures:
   - Fish aggregating devices (FADs)
   - Artificial reefs
   - Rocky reefs and kelp beds
   - Oil platforms
   - Mariculture net pens
   - Piers and docks
   - Marine debris



6. Pinpoint additional data gaps to guide further research.

Findings

1. Fish are likely to associate with MHK structures, depending on location and type of structure.
2. Location, water depth, and temperature influence which species are present, and their behavior and life history needs determine likely interactions.
3. In tropical and subtropical waters (warm, clear), fish are likely attracted to surface and midwater structures (FAD effect).

Findings

4. In all waters, reef-oriented fish will use bottom anchors as artificial reefs.
5. Special-status species that may interact with ocean-bottom MHK components are: adult rockfishes off the U.S. West Coast and snappers in Hawaiian waters.
6. Special-status species that may interact with surface and midwater components are: juvenile rockfish such as bocaccio and canary rockfishes in temperate waters.
7. **No negative effects on special-status fish were indicated;** adverse interactions were determined to be unlikely.

Accomplishments and Progress

Outcomes

- Predicted likely responses of fish communities to MHK device structures in four Pacific regions
- Distilled data that will inform and facilitate MHK project design and licensing, especially for wave energy converters; also applicable to offshore wind projects
- Pinpointed topics where uncertainty persists
- Established framework to which further monitoring data can be added

Project Plan and Schedule

Initiation Date: April 2014

Completion Date: June 2015

All milestones completed on time or ahead of schedule, final milestone completed one month ahead of schedule

Project Budget

Budget History			
FY2014		FY2015	
DOE	**Cost Share**	**DOE**	**Cost Share**
$52.906k	$19.907k	$21.591k	$7.644k

- No variances in the planned budget occurred; however, staff time was provided in kind to supplement DOE budget
- Budget is 100% spent, no other funding sources were required

Research Integration & Collaboration

Report available at: https://tethys.pnnl.gov/sites/default/files/publications/Kramer-et-al-2015.pdf

Partners, Subcontractors, and Collaborators

- Science advisors: Dr. Pete Nelson from Collaborative Fisheries Research West (now at H. T. Harvey & Associates), and Mr. David Itano in Hawai‘i, providing limited high-level support.
- 14 subject-matter experts, including consultants, professors, federal and state resource agency staff, commercial fishermen and aquaculturists, providing insights during guided discussions.

Communications and Technology

Presented at **Annual American Fisheries Society** Meeting, Portland Oregon September 2015 and **Federal Renewable Ocean Energy Working Group,** December 2015 (webinar).

Future Research

There is uncertainty about potential FAD effects in temperate waters. Few studies are available to **elucidate fish associations with midwater and surface structures in temperate West Coast waters.**

Topic can be studied using existing structures in temperate waters, such as navigational buoys or weather buoys already deployed along the West Coast.