MANAGING ENVIRONMENTAL EFFECTS OF MARINE RENEWABLE ENERGY DEVELOPMENT THROUGH REGULATOR ENGAGEMENT, DATA TRANSFERABILITY

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BACKGROUND

With only a few wave and tidal devices in the water and no long-term post-installation datasets available, there continue to be uncertainties around risks to marine animals and habitats from the deployment and operation of marine renewable energy (MRE) systems [1] [2]. Based on these uncertainties and lack of familiarity with MRE devices, regulators and stakeholders continue to perceive a wide array of potential environmental interactions as risky and require considerable monitoring in order to permit or license a project. The MRE industry is struggling with the high cost of baseline assessments and post-installation monitoring, as well as long timelines for obtaining permits, leading to uncertainty and risk for financing projects.

In order to move towards commercial development of MRE projects, there is a need to distinguish among environmental risks and to manage them. Risks due to uncertainty can likely be reduced and perhaps retired with the collection of additional data, while actual risks to animals and habitats can be avoided or mitigated. Interactions that continue to be uncertain, yet are perceived to be potentially risky, can become the focus of proportional monitoring programs, with the goal of better understanding and minimizing those risks.

CURRENT STATE OF KNOWELDGE

The most recent comprehensive review of existing information, the Annex IV 2016 State of the Science report [1], summarized the key risk areas that continue to slow siting and permitting of MRE devices and arrays. The greatest concerns expressed by regulators and stakeholders are associated with:

- Potential collision of marine animals with tidal turbine blades;
- Effects of underwater noise from tidal turbines and wave energy converters (WECs) on marine animal behavior and health; and
- Potential effects of electromagnetic fields (EMF) from cables and energized devices on sensitive marine species.

To date there have been no observations of marine mammals or seabirds colliding with tidal turbines, while fish interactions have not been shown to be harmful. The amplitude and frequency of sound from WECs and tidal turbines does not appear to be sufficient to significantly disturb marine mammals or fish, although animal behavior studies in response to these sounds are virtually non-existent. Effects of EMF on sensitive species do not appear to prevent crab and other invertebrates from reaching their preferred habitats or affect their distribution patterns based on observational studies. However, specific data gaps remain for these and other interactions.

REGULATOR ENGAGEMENT

Regulators at the federal and state level in the US, and analogously in other nations, must satisfy legal and regulatory mandates in order to grant permission to deploy and operate MRE devices. Inherent in these laws and regulations is a concept of balancing risk to the environment, human uses of public resources, economic development, and human well-being. Research efforts related to the potential effects of MRE development are focused

on this concept of risk, and the interactions between devices and the environment most likely to cause harm, or those for which the greatest uncertainty exists [1].

Regulator Survey Results

In 2017, US regulators were engaged through webinars and an online survey to better understand their views on risks, conflicts, and challenges associated with permitting environmental effects of MRE devices. US federal and coastal states regulators were invited to participate in an online survey to understand their familiarity with MRE technologies, their perceptions of the most important environmental challenges, and their thoughts on the best approach to MRE development and data transferability between projects.

Of the 35 responses, 15 participants worked in federal agencies and 20 worked for state agencies; not all respondents logged information for every question. The majority of participants (60% federal and 65% state) had directly participated in permitting an MRE device.

Familiarity with MRE technologies

The regulators' familiarity with wave and tidal technologies was low. Overall, federal participants were more familiar with wave and tidal technologies than state participants (Figure 1).

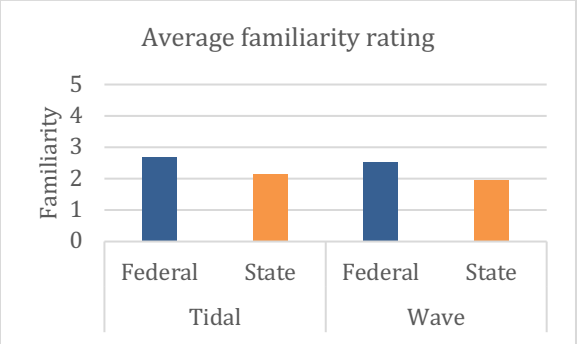

FIGURE 1. REGUALTORS' RESPONSE FOR FAMILIARITY WITH WAVE ENERGY CONVERTERS AND TIDAL TURBINES, RANGING FROM 1 (NOT FAMILIAR) TO 5 (VERY FAMILIAR).

Challenges for Permitting MRE Devices

Participants were asked to rank the top challenges for permitting a single MRE device and permitting an array. Responses varied by federal or state regulators and by the number of devices. For single devices, the top challenge for federal regulators was "effects of underwater sound emissions from devices on animals" whereas for state regulators the top challenge was "benthic/habitat destruction." For arrays, the top challenge for both federal and state regulators was "avoidance, attraction, and/or displacement of animals."

Data Transferability

Participants were asked if data collected from projects in other locations could be applied towards environmental permitting within their jurisdictions. The results showed that data transferability should be further explored, especially as 25% of state regulators and 36% of federal regulators answered "absolutely" and no regulators thought data could "never be transferred" (Figure 2).

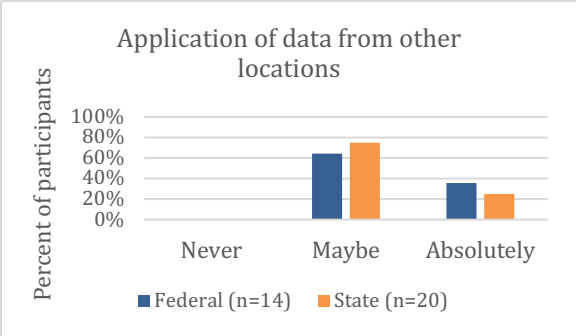

FIGURE 2. REGUALTORS' RESPONSE FOR USE OF DATA COLLECTED FROM ONE LOCATION FOR ENVIRONMENTAL PERMITTING IN THEIR JURISDICTION.

Survey Conclusions

Overall, regulator survey results showed that specific concerns about risks to marine animals and habitats from MRE development are driven by the jurisdiction of individual regulators (for the US, federal versus state), and by their level of knowledge about specific types of wave or tidal energy converters. Based on these survey results, progress can be made by: 1) active and ongoing disseminating of information on MRE devices and their interactions with the marine environment; 2) conducting new research to answer outstanding effects questions; and 3) applying data collected from one project or locale to planning and permitting another project, in another location.

DATA TRANSFERABILITY AND COLLECTION CONSISTENCY

Regulators require assessment and monitoring information to support their analyses to describe, permit, and manage the environmental risks associated with new MRE technologies and new uses of ocean space. However, regulators and stakeholders currently lack access to synthesized and contextualized data emerging from early-stage MRE projects and there are no mechanisms by which to apply data and information across geographically distinct projects. This leads to each

individual project bearing the full burden of information requirements on a site-by-site basis.

In addition, data are collected around early-stage MRE devices using many different methods, instruments, and measurement scales. Different data collection procedures that produce a variety of data can greatly affect the transferability of data [3], as can the spatial scale, temporal scale, definition, and context of the data collected [3] [4]. Inherent in the ability to transfer monitoring data about MRE devices and their applications from one jurisdiction to another is ensuring that data used from one (origin) location are compatible with the needs of another (target) location. Developing common standards for data collection can aid in the comparability of findings and data transferability [4]. As monitoring data around the first commercial arrays become available, it is essential that those data be captured in organized databases for comparison and to understand transferability of learning from one project/location to another.

As the MRE industry matures, the ability to readily transfer research and monitoring results, data, study designs, data collection methods, and best practices from project to project and across jurisdictional boundaries can help reduce risks to the industry and the environment. Enabling data transferability and collection consistency for MRE development can also lead to cost reductions for baseline environmental studies and post-installation monitoring and also facilitate more efficient and shorter permitting processes, that would decrease financial risk for MRE project development.

FRAMEWORK AND NEXT STEPS

Elements of data transferability and collection consistency were examined and lessons learned have been applied to a plan for furthering the ability to use MRE environmental data collected from one project to another, and among locations. Based on a literature review that investigated potential data transferability frameworks, models, and approaches, a framework is proposed to assist in managing environmental risks of MRE development. This framework can help overcome perceptions of high risk, the need for collection of large datasets, and facilitate permitting based on the ability to transfer learning, analyses, and datasets among countries and projects and across jurisdictional boundaries.

Marine Renewable Energy Project Archetype

Based on studies of data transferability from other industries including economics, transportation, ecology, and land system science, it is clear that certain similarities and criteria must be met to use data collected from MRE projects in one location to assist in permitting processes in another. Similarly, a level of data collection consistency is needed to consider comparing data among projects and jurisdictions.

The most promising transferability methodology and framework that might be applied to MRE permitting is gleaned from the literature presented by Václavík et al. [5] for sustainable land management purposes. The authors' concept of defining a project "archetype" based on a variety of indicators can be applied to other place-based studies, including MRE studies. By adopting the concept of an "MRE project archetype" (MREPA), a combination of stressors, site conditions, MRE technologies, and receptors can be applied to help meet MRE regulatory needs (Figure 3). The comparability between archetypes at the location of origin of the data set and the target location where data will be transferred must be evaluated.

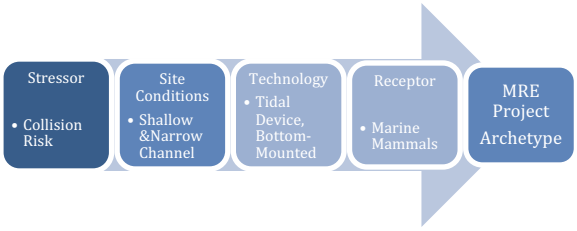

FIGURE 3. PATH TO IDENTIFYING MARINE RENEWABLE ENERGY PROJECT ARCHETYPES.

A series of matrices have been developed for each stressor to evaluate comparability and identify MREPAs for each project or set of data that might be useful for transfer. Table 1 is an example of such a matrix, using "collision risk for tidal devices" to demonstrate MREPAs for this stressor. Defining the project MREPA is the first step to determining the transferability potential of data from a project.

Outcomes

The preferred outcome of applying the data transferability framework is characterization of the level of risk associated with each key MRE technology interaction with the marine environment, simplification of the questions associated with these key interactions, and decreased need for extensive onsite data collection or ancillary research studies to elucidate the level of risk. The key to enabling transfer of data is ensuring regulators and advisors are engaged and willing to implement the framework for sharing data.

Outreach and Engagement

This framework can be used to provide a background against which discussions with regulators can proceed to understand the limits of transferability, based on the confidence individual

regulators have to accept data and information collected in one location for information analyses of applications for MREs in her/his jurisdiction. The framework can also help pinpoint where additional data collection, analysis, and interpretation can help increase the degree of data transferability.

TABLE 1. EXAMPLE OF A MARINE RENEWABLE ENERGY PROJECT ARCHETYPE MATRIX – COLLISION RISK.

Site Conditions *	Technology	Receptors
Shallow and Narrow Channels	Tidal Device, Bottom-Mounted	Marine Mammals
		Fish
		Diving Birds
	Tidal Device in the Water Colum	Marine Mammals
		Fish
		Diving Birds
Deep and Wide Channels	Tidal Device, Bottom-Mounted	Marine Mammals
		Fish
	Tidal Device in the Water Colum	Marine Mammals
		Fish
		Diving Birds
Shallow and Wide Channels	Tidal Device, Bottom-Mounted	Marine Mammals
		Fish
		Diving Birds
	Tidal Device in the Water Colum	Marine Mammals
		Fish
		Diving Birds
Deep and Narrow Channels	Tidal Device, Bottom-Mounted	Marine Mammals
		Fish
	Tidal Device in the Water Colum	Marine Mammals
		Fish
		Diving Birds

***Shallow channels are defined as having a depth less than 40 m. Deep channels are defined as having a depth greater than 40 m. Narrow channels are defined as having a width of less than 2 km. Wide channels are defined as having a width greater than 2 km.**

REGULATOR FOCUS GROUPS

US regulators were brought together in a series of focus groups to understand the challenges of interpreting data and analyses from existing MRE projects, and the limitations for transferring data to projects in their jurisdictions. The regulators were also used as sounding-boards for the data transferability framework/MREPAs, and asked to help promote data collection consistency and data transferability. More details will be included in the paper as they become available.

Next Steps

Following the regulator focus groups, progress on the MREPA framework will be shared with the MRE community at an international workshop. This workshop is planned to provide additional feedback for the MREPA framework, to eventually develop a set of best practices for data transferability and collection consistency.

CONCLUSION

This paper will present findings of the regulator survey and other engagements with regulators, provide insight into the process of data transferability, present the data transferability framework/MREPA, and detail efforts to engage the research community in furthering this process.

Progressing towards the ability to transfer data between MRE projects can aid the industry by satisfying regulatory requirements and shortening siting and permitting processes for MRE development, amplifying understanding of environmental effects, allowing funding resources to be re-directed to help solve uncertainty and risk, and standardizing processes for data collection and analysis. The proposed framework coupled with iterations of feedback between the regulatory community and the MRE community can contribute to this progress.

ACKNOWLEDGEMENTS

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