Adaptive Management

RELEVANCE TO MARINE RENEWABLE ENERGY

Uncertainty surrounding the potential impacts of marine renewable energy (MRE) technologies on sensitive marine animals, habitats, and ecosystem processes means that even robust baseline environmental information cannot comprehensively address all pre-deployment knowledge gaps. Tools and practical approaches are needed to help with the sustainable development of the industry. Adaptive management (AM) enables MRE projects to be deployed gradually, despite uncertainty, in a way that prevents unacceptable harm to the marine environment.

STATUS OF KNOWLEDGE

AM is best defined as an iterative management process that seeks to reduce scientific uncertainty and improve management through rigorous monitoring and periodic review of management decisions in response to growing knowledge gained from monitoring data. Monitoring is designed to address specific scientific questions and contribute to the wider scientific knowledge base, which can be used to amend decisions, change monitoring focus, refine policy and improve consenting processes in light of new information.

From a procedural perspective, AM is a six-step cycle:

- Conduct baseline monitoring, environmental assessment, and problem identification.
- Define measurable management objectives.
- Design management actions: project proposals and mitigation plans, compensation, habitat enhancement measures, and monitoring.
- Implement the project and conduct follow-up monitoring to collect data after the project has been deployed.
- Evaluate the monitoring results.
- Adjust/adapt the management and monitoring methods in light of what has been learned from empirical observation.

AM implementation has enabled the deployment of several wave and tidal projects, contributed to the testing of monitoring technologies, and has helped answer some fundamental questions about the environmental interactions of single devices and small arrays. Several case studies of successful AM are described in detail in the 2020 State of the Science report, including the MeyGen tidal project (Scotland), the SeaGen tidal turbine (Northern Ireland), the DeltaStream tidal turbine (Wales), the Roosevelt Island Tidal Energy project (U.S.), Ocean Power Technology's Reedsport Wave Park (U.S.), the Ocean Renewable Power Company's TidGen and RivGen turbine power systems (U.S.), and the PacWave South test center (U.S.).

REMAINING UNCERTAINTIES

AM has contributed to lowering the risk associated with several projects by allowing single devices or small arrays to be deployed under a structured incremental approach with embedded mitigation and monitoring. However, while AM offers some flexibility to consent and deploy MRE projects despite uncertainty, AM at larger deployment scales has the potential to become an onerous process that creates significant financial uncertainty for project developers. Advancing the use of AM for MRE will require the development of mechanisms that minimize undue financial risks for developers, while assuring adequate protection of the marine environment, which may require investments by governments to gather data that will assist with large-scale planning and management of marine resources.

RECOMMENDATIONS

As the industry moves toward commercial deployment, implementation guidance should be issued by responsible governmental bodies to support a common understanding of AM and to guide the design of AM plans at the scale of MRE arrays. The industry will particularly benefit from guidance documents that specify the circumstances under which AM is acceptable and establish clear and mandatory elements of AM plans, including the design and conditions for post-installation monitoring, stakeholder engagement, information sharing, and thresholds for AM intervention.

MRE developers that use AM can learn from their fisheries counterparts by using clearly controlled rules for monitoring and evaluating project effects relative to pre-defined thresholds, including the ability to adjust mitigation and monitoring as part of a formal structured AM process. Monitoring approaches must be question-driven, and the questions must be directly connected to thresholds/triggers to avoid unacceptable impacts. In practice, designing monitoring that informs and works with thresholds may be extremely challenging; it requires the ability to confidently measure and monitor the appropriate metrics of concern with the required levels of accuracy and precision to inform management decisions.

REPORT AND MORE INFORMATION

OES-Environmental 2020 State of the Science full report and executive summary available at:
https://tethys.pnnl.gov/publications/state-of-the-science-2020

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Go to *https://tethys.pnnl.gov* for a robust collection of papers, reports, archived presentations, and other media about environmental effects of MRE development.

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