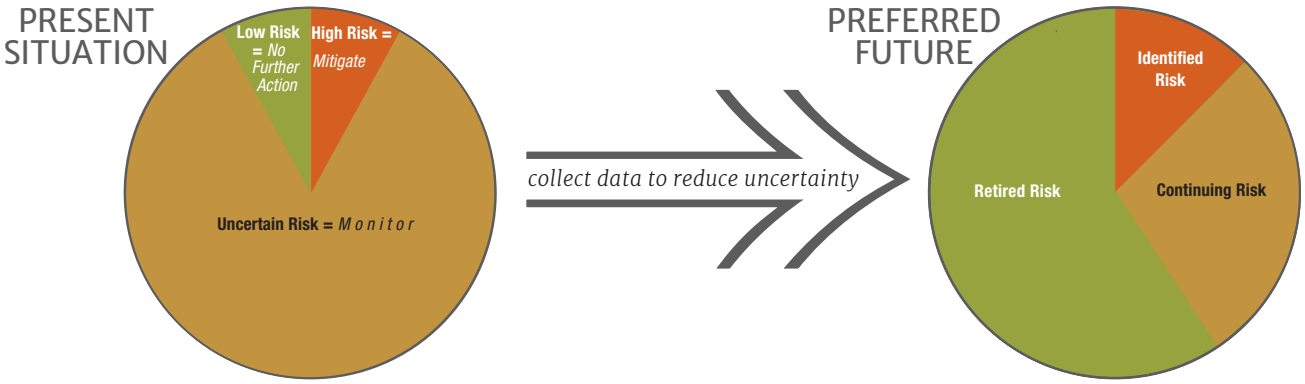
Next Steps in Resolving Risk from MRE Devices

As single marine renewable energy (MRE) devices and commercial arrays are deployed, several interactions between devices and marine animals continue to concern regulators and stakeholders:

- Collisions of marine animals or seabirds with tidal turbine blades;
- Effects of underwater sound from MRE devices on marine animals; and
- Potential effects of electromagnetic fields on marine animal health and behavior.

Each of these concerns is driven largely by the high degree of scientific uncertainty surrounding the probability (likelihood) that events will occur, and the severity of consequences (outcomes), if they occur. The intersection of probability and consequences is broadly defined as the potential risk of the interaction.

As more information and data become available, the industry and regulators need to begin to retire risk for interactions that are not harming the marine environment; this will allow the MRE community to focus efforts on mitigating the real risks in an effective manner. The collection of additional data may help to lower uncertainty about interactions, and thereby lower risk. Risks could be retired for certain interactions at the single device scale while investigations continue to determine whether there is increased risk for that same interaction as deployments move towards commercial scale. The perception of risk for many interactions is currently driving regulators to request large amounts of data collection pre- and post-installation, saddling MRE developers with burdensome and costly monitoring programs. The path forward for the industry involves retiring risks by decreasing scientific uncertainty; identifying risks that require mitigation; and optimizing data collection efforts by monitoring interactions where more certainty is still needed, as illustrated in the figure.



Categories of risk and uncertainty reduction pathways. The risk categories can be considered as low or discountable risk (green); medium risk (yellow); and identified risks (orange) for which mitigation strategies are needed. Moving from the present situation (left) to the preferred future condition (right), through increased data collection, will help accelerate the MRE industry. (Figure courtesy of Brian Polagye and Andrea Copping)

A CONSTRUCT FOR MOVING FORWARD IN THE FACE OF UNCERTAINTY

Reducing uncertainty about animal/device interactions is a critical step to ensuring that the MRE industry continues to grow. The path forward must continue to decrease uncertainty for priority interactions, while maintaining momentum with early deployments, pilot projects, and commercial arrays. Parsing the priority interactions for data collection to decrease uncertainty can be approached using three strategies:

- Certain interactions can be effectively observed now with existing instruments, platforms, and technologies; these observations should continue, taking advantage of improvements in measurement and data acquisition capabilities.
  - *Example:* Seals changing their swimming patterns around tidal arrays can be monitored using boat-based and aerial observations, and tags on seals, although there is a need for better tags and more automated observations.
- Other interactions would benefit from targeted strategic research efforts in the near term, to help reduce the cost and duration of mandated monitoring programs.
  - *Example:* Interactions of marine animals with tidal turbine blades; key research and development efforts are needed to improve instruments for observation and the ability to observe rare events in high flow environments.
- Certain interactions can only be advanced with key upfront strategic research investments, because there is no viable path forward for monitoring at this time.
  - *Example:* Individual marine mammals, seabirds, sea turtles, and large fish may avoid significant areas around tidal or wave arrays, which may harm their population success. Targeted studies are needed to improve baseline assessment of populations including distributions, population structure, feeding and migrating behavior.

STRATEGIC RESEARCH STUDIES

A coordinated approach for developing robust appropriate monitoring practices and determining gaps in instrumentation and techniques necessary for data collection and analysis will lead to better understanding of interactions between marine animals and MRE devices. Filling these gaps by conducting strategic research studies is a necessary step for determining whether risks from MRE devices require ongoing monitoring and perhaps mitigation, as well as determining the most effective way to create ongoing data collection programs. Designing strategic research studies requires collaborative experimental designs, scoping of costs, identifying key players in research and government, and ensuring that the information is broadly shared internationally.

DEVELOPING GOOD PRACTICES

The MRE community must seek to better understand the potential outcomes of animal encounters with turbines, animal reactions to noise, potential barrier effects due to EMF from power cables, and other possible deleterious consequences. The best way to advance this understanding is by collecting data around single MRE devices and commercial arrays. Drawing from these data collection and research efforts, the development of a set of good practices will optimize the quantity of data to be collected around devices, provide insights into potential risks, and inform future mitigation strategies. The research community must continue to come together, along with regulators and developers, to share information, collaborate on strategic research projects, and define good practices in order to accelerate the siting and permitting of MRE devices and arrays.

FOR MORE INFORMATION

Annex IV State of the Science full report and executive summary available at: *http://tethys.pnnl.gov/publications/state-of-the-science-2016*

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

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