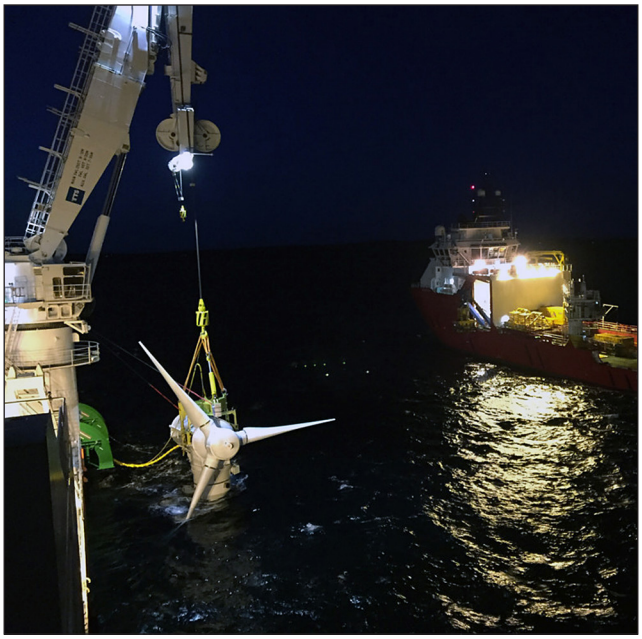
Collision Risk

RELEVANCE TO MARINE RENEWABLE ENERGY

The presence of marine renewable energy (MRE) devices—particularly the rotating blades of tidal and river turbines—is thought to pose a risk to marine animals. Animals might come into close contact with turbine blades in the course of their natural movements, because they are attracted to the device for purposes of feeding, shelter, or out of curiosity, or because they are not strong enough to avoid currents that might sweep them into the blades.



The concern is that a collision with moving device parts (e.g., turbine blades), a moving device (e.g., tidal kite), or perhaps the stationary part of a device (e.g., foundation) could cause irrevocable injury or death. For animal populations that are under stress for other reasons, such as climate change or other human activities, loss of even a few members due to collision might affect the survivability of the population. The greatest concerns are for marine mammals, especially those in protected or declining populations; commercially and recreationally important fish species; and endangered seabirds.

STATUS OF KNOWLEDGE

No instances of marine mammals, diving seabirds, or other marine animals colliding with an operational tidal or river turbine have been observed to date. Fish have been seen interacting with turbines but have not obviously been harmed by them. Environmental monitoring at existing MRE projects using integrated instrument packages is helping to better understand animal use of tidal and river environments, as well as their response to operational devices. Laboratory and field studies have shown that marine mammals may exhibit some mid-range avoidance, and fish may exhibit local avoidance and fine-scale evasion behaviors, likely reducing their overall collision risk. Modeling simulations, which have recently begun to incorporate behavioral data and information collected in the field, are being used to more accurately estimate the chance of animals encountering an underwater device, their behavioral responses, and the chance of collision. Most studies in Europe are focused on the interactions of seabirds and marine mammals, particularly seals, porpoises, and dolphins, around tidal turbines, while many North American studies are examining interactions and possible collisions of fish with tidal and river turbines. Research has also started to examine the consequences of collision for marine mammals and fish, some of which may be able to recover from many injuries, but this has yet to be explored for diving seabirds.

REMAINING UNCERTAINTIES

Remaining knowledge gaps and uncertainties about collision risk include the need for a better understanding of the likelihood of animals colliding with or avoiding turbines, the consequences to the animals of a collision with a turbine blade, and the overall risk to populations from potential losses. The lack of adequate observations of marine animals interacting with MRE devices is exacerbated by two factors: (1) making observations with underwater cameras (which can operate on light [optical cameras] or sound [acoustic cameras]) in very fast-moving currents is technically very difficult and results in very large sets of data that are costly to store and process; and (2) the chance of animals colliding with underwater structures is almost certain to be extremely rare, such that capturing these events is unlikely. Models can help fill information gaps when field studies are not possible, but these predictions are sensitive to assumptions made about marine animals' ability to detect, avoid, and evade underwater structures. Finally, as the MRE industry moves toward commercial arrays, there is a need to understand how collision risk to animals might change at the larger scale.

RECOMMENDATIONS

Additional research and monitoring around MRE projects, field studies, modeling, and flume studies are needed to advance our understanding of the risks of marine animal collision with MRE devices. Enhanced methods are necessary to improve our ability to observe the interactions of marine mammals, fish, and diving seabirds with tidal and river turbines. Information describing the occurrence and behavior of marine animals at close range to devices is indispensable. Improvements in the methodologies and instruments used to collect, store, share, and analyze data about collision risk are required, as are improved integration of algorithms and machine learning to recognize images of marine animals around turbines. As collision risk models are improved, field monitoring data will be needed to validate predictive models.

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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