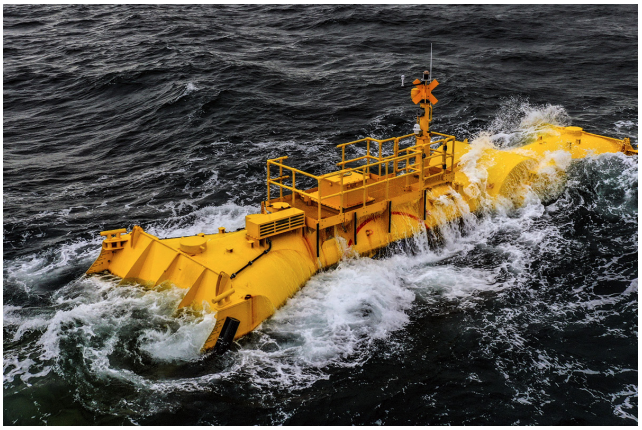
Entanglement

RELEVANCE TO MARINE RENEWABLE ENERGY

Many marine renewable energy (MRE) devices are attached to the seabed with mooring lines, which allow them to maintain their position within the water column or on the sea surface. In an array, underwater cables are also used to carry power from multiple devices to a single power export cable installed on the seabed. The potential for these lines and cables to become a hazard for marine animals that may become entangled in them is uncertain but has been raised by stakeholders.

STATUS OF KNOWLEDGE

No entanglement of marine animals with MRE systems has been observed and little is known about this risk. Most knowledge regarding the likelihood of entanglement is from adjacent industries (i.e., offshore wind, marine aquaculture, and fishing). Observations of entanglement with fishing or marine aquaculture gear mostly involved large marine animals being entangled in the loose end of a line, a net, or a slack line that can loop around the animal. For small marine animals, higher risks of entanglement have been linked to



abandoned fishing gear and marine debris. Compared to gear used in other offshore industries, the mooring lines or cables associated with MRE devices are never sufficiently slack to create a loop, nor are there any loose ends. Additionally, it is unlikely that multiple mooring lines and cables will be close together enough for an animal to be caught between them.

When assessing the risk of entanglement with mooring lines and underwater cables associated with MRE devices, it is important to consider the characteristics of marine animals. The greatest entanglement concerns are for large marine animals such as migratory whales that may encounter MRE device mooring lines and draped cables. There are some concerns that smaller marine mammals, diving seabirds, sea turtles, or large pelagic sharks could also become entangled. The conservation status of marine animals can increase the level of concern regarding potential entanglement. Secondary entanglement (marine debris or derelict fishing gear getting caught in MRE systems and potentially impacting marine animals) has also been raised as a concern. There have been no reports of secondary entanglement of marine animals with debris getting caught in MRE systems. For a small number of devices (one to six devices), the risk of entanglement is considered low.

REMAINING UNCERTAINTIES

Although the concerns about entanglement of marine animals with mooring lines and underwater cables around single MRE devices are minimal, the risk of entanglement with cables and mooring lines in an array of MRE devices may need to be investigated as arrays are deployed in the future. It is also possible that as MRE devices are deployed, marine animal behavior may change, and aggregation could increase the probability of entanglement. Collecting information about critical habitats (e.g., breeding, feeding, migration) for large whales as well as for other small marine animals such as sea turtles or sharks could help with the siting MRE farms to minimize the risk to these animals.

RECOMMENDATIONS

The remaining uncertainties related to entanglement may be mitigated by applying various strategies. Assessing migration pathways, habitats, behavior, and distribution of species of concern at the siting stage is critical. Models can be used to predict entanglement rates of species of concern. Developing monitoring technologies for tracking the tension of cables and lines for different MRE systems should be considered. As projects are deployed, it will be crucial to routinely monitor mooring systems to detect their malfunction or the accumulation of derelict fishing gear. Future studies might also be focused on the risk of entanglement from MRE systems and nearby offshore activities as the MRE industry advances and large arrays are deployed.

OES-Environmental 2024 State of the Science report and executive summary available at:
https://tethys.pnnl.gov/publications/state-of-the-science-2024

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

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