Entanglement with Marine Renewable Energy Mooring Lines

POTENTIAL CONCERNS

Large marine animals, especially great whales such as grays or humpbacks, may potentially become entangled in mooring lines and power cables, resulting in drowning, or the lines may abrade the whale's skin, allowing debilitating infections to result in injury or death. Many wave devices and floating tidal turbines are attached to the seabed with mooring lines. In addition, marine renewable energy (MRE) devices must send energy to shore through large export cables, usually placed on the seabed; cables that collect power from individual devices may be strung in the water column before joining a single cable heading to the sea floor.

The greatest entanglement concerns are for large migratory whales that may encounter wave energy arrays or floating wind farms that have large numbers of mooring lines and draped cables, as they undertake their seasonal migrations. There are some concerns that diving seabirds and large fish such as sharks could also become entangled.

STATUS OF KNOWLEDGE

There is a large body of scientific literature on entanglement of marine mammals and other marine animals with fishing gear, including nets, cables, and traps. Typically these entanglements occur because there is a loose end to a line, allowing the whale or other marine animal to become wrapped in the gear. Alternately, lines may have sufficient slack to allow a loop of cable or line to encircle parts of the animal. Entangled loose fishing gear has been shown to affect the swimming and hunting ability of whales and other marine animals, potentially leading to death from starvation or drowning. There are some data on the force that will cause injury if a marine animal were to encounter a cable, but the force with which an adult whale or calf, or other marine animals, might collide with an MRE cable has not been calculated. Baleen whales have typically been the focus of papers on entanglement around offshore energy, but smaller

whales, such as orcas and other toothed whales have been reported caught or injured in fishing gear. Floating oil platforms could provide an important analogue to MRE devices as they use tensioned lines to secure the rig in deep water. No observations have been made of marine mammals or other animals becoming entangled in MRE mooring lines or devices.

HOW WE UNDERSTAND THE PROBLEM

Mooring lines from MRE devices are generally either tension-legged (under considerable tension) or catenary moorings which have some degree of slack. Entanglement of whales with these mooring lines is less likely to occur than entanglement with loose fishing gear. The tension in MRE mooring lines should allow large whales to swim past without becoming entangled. Taut cables could still pose an abrasion risk to whales, but little is known about this theoretical risk.

The chance of a whale swimming into a mooring line is small as mooring lines take up only a small amount of the ocean water column, even if the animals were preying upon fish attracted to devices. Mooring lines for floating wave and tidal devices are unlikely to cross one another as this would complicate maintenance. A large array of MRE devices with mooring lines could cause migratory marine animals to change their course of travel, but the probability of a high risk encounter with lines is low.

Power cables draped in the water column might pose risks to migratory species, although the cables are generally thought to be at greater risk from large whales, breaking before the whale becomes entangled. To further lower the risk of whale encounter, cables between MRE platforms could be placed at depths unlikely to be used by whales, and the cables run down the existing mooring lines to the seafloor for transit to shore.

FUTURE RECOMMENDATIONS

There is no indication in the existing literature to suggest that entanglement of whales in catenary or tensioned lines is likely to pose a significant risk; there are however some potential avenues of research that could resolve remaining uncertainty. Additional studies that focus on the sensory ability of large whales to detect mooring lines (including "acoustic" lines that are purposely wider than necessary) will help to determine the whales' ability to detect and avoid lines. Siting MRE devices outside of important breeding, feeding, or mating grounds will help avoid encounters. Better understanding of the risk posed by mooring lines will be aided by mapping seasonal densities of large whales including grays, humpbacks, North Atlantic Right Whales or blue whales. Encounter risk models can predict the number of whales likely to cross paths with MRE mooring lines, while field data will help to validate the models. Inherent to those models is the need to understand the action of the mooring lines in the water column due to waves, wind, and currents, as well as the forces on the mooring line during an encounter with a whale. Monitoring to determine whale behavior in the vicinity of early wave arrays will help to validate the assumptions and allow this potential risk from MRE devices to be retired.

FOR MORE INFORMATION

https://tethys.pnnl.gov/short-science-summary-entanglement-marine-renewable-energy-mooring-lines

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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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