Displacement

RELEVANCE TO MARINE RENEWABLE ENERGY

As the marine renewable energy (MRE) industry expands and more devices are deployed in the water, animals may be displaced from their preferred or critical habitats due to the physical presence of the devices or other aspects of the projects. Displacement is triggered by an animal's response to one or more stressors acting as a disturbance, with various consequences ranging from individual- to population-level effects. Migratory animals might be moved off their normal pathways while benthic organisms may be kept from their preferred habitats.

Animals could respond to stressors from MRE arrays in a variety of ways: attraction (going toward), avoidance (going around), and exclusion (going away from). Marine animals may be vulnerable to displacement from MRE arrays at different life stages and during different project phases (i.e., construction, operation, or decommissioning). Displacement responses may be very species-specific and depend on maneuverability and migration patterns of each species. These effects could be severe enough to result in impacts on populations.

STATUS OF KNOWLEDGE

A variety of animals could be affected by displacement from MRE arrays; they can best be considered in functional groups that demonstrate similar behavioral activities:

- Large whales and large, slow-moving sharks
- Small cetaceans
- Pinnipeds
- Sirenians
- Sea turtles
- Diving seabirds
- Pelagic sharks, large pelagic fish, and pelagic invertebrates
- Forage fish
- Benthic sharks, skates, and rays
- Demersal fish
- Mobile benthic invertebrates
- Sessile benthic invertebrates

Large migratory marine animals like whales may need to spend more energy, resulting in exhaustion or lower reproductive rates to go around arrays. Smaller marine mammals like porpoises and seals may exhibit temporary displacement during construction activities because of increased vessel traffic, but are likely to become habituated and return to their preferred habitats. Temporary displacement effects may also occur for sea turtles, pelagic sharks, large pelagic fish, and pelagic invertebrates, but there is little information upon which to estimate what the long-term consequences of these displacements might be. Diving seabirds might be displaced from foraging habitats, depending on their species and their use of a project site. Forage fish, like herring, and bottom-living fish, like flatfish, might avoid MRE devices or they may be attracted to the new habitat created by the foundations or anchors of devices; these effects are likely to be dependent on individual species and life stages. Both mobile and sedentary invertebrates might become attracted to MRE devices, especially at the larval stage, increasing their susceptibility to other stressors, such as electromagnetic fields.

With few MRE arrays in the water, it is not yet possible to determine the effects of displacement on functional groups or individual species, although numerical models can provide some insight.

REMAINING UNCERTAINTIES

The lack of direct information about displacement from monitoring surveys around MRE arrays leaves many uncertainties, including estimates of the level of risk from animal displacement—both the likelihood of displacement occurring, and the consequences should it happen. There are no standardized methods for displacement monitoring and mitigation, and presently no regulatory processes expressly take displacement around MRE devices into consideration.

RECOMMENDATIONS

While the risk of displacement is low with single devices, it is time to start the discussion and investigation about this stressor-receptor interaction around large MRE arrays to better prepare for their deployment. Important considerations include determining mechanisms of displacement and the consequences that might affect the marine animals, as well as generating realistic models of displacement consequences, identifying monitoring and mitigation measures, and collecting relevant field data to validate displacement models.

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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