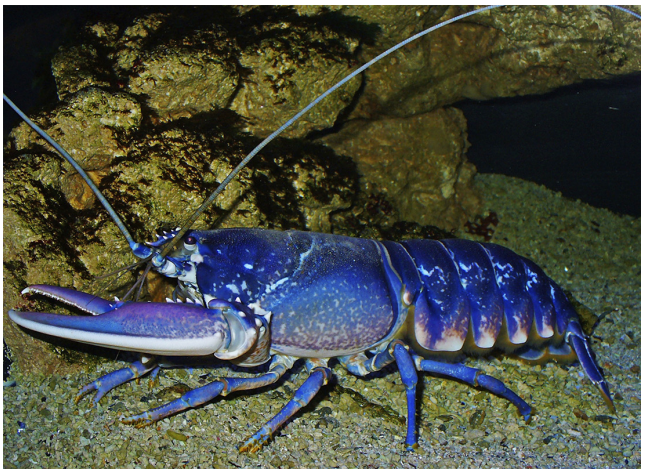
Changes in Benthic and Pelagic Habitats

RELEVANCE TO MARINE RENEWABLE ENERGY

Most marine renewable energy (MRE) devices must be attached to the seafloor in some way, either by gravity foundations, pilings, anchors, or mooring lines; many will also have transmission cables on the seabed, as well as the devices themselves in the water column. Physical changes in benthic and pelagic habitats have the potential to alter where species live and how common they are at a site, which may lead to habitat loss, alter ecological patterns, modify ecosystem functions and services, affect the behavior of many marine organisms, and provide opportunities for non-native species to become established.

STATUS OF KNOWLEDGE

The loss of benthic habitat caused by the footprint of anchors and foundations is limited and can be avoided or mitigated when fragile habitats have been identified during the siting process. Sediment scouring by local



turbulence in the immediate vicinity of an MRE device can create further loss of benthic habitat during operation. This concern has been assessed and measured around tidal turbines, with effects quickly dissipating with distance from the structure. This scouring effect on benthic communities is likely to be limited to the seafloor area directly adjacent to devices. MRE devices are linked to a substation or the shore-based grid by cables, and the cable-laying process may also lead to direct disturbance or alteration of large areas of benthic habitats. Studies of cables in different environments have shown that the benthic communities and habitats rapidly recover.

MRE devices may also provide new habitats for numerous organisms. Devices left in the water long enough will be colonized by biofouling communities (i.e., the accumulation of biological matter and organisms on the surfaces of submerged objects), which differ between deployment sites, specific MRE devices, and parts of the system because of natural ocean variability, the seasonal availability of planktonic larvae, and the survival rates of newly settled larvae. MRE devices may also act as artificial reefs or fish-aggregating devices by attracting mobile organisms like crabs and lobsters, demersal and pelagic fish, and top predators. Some of the biofouling and aggregating species may be non-native organisms. The accumulation of organic matter and decaying shells on/in the seafloor around MRE devices may lead to enriching the sediment around devices with organic material. Areas with MRE devices may act as marine reserves because their presence excludes fishing activities. The nature and importance of these effects will vary according to the size and location of the deployment, the existing ecosystem, and natural habitats.

The evidence base to date, along with discussions with subject matter experts, suggests that the changes in benthic and pelagic habitats caused by single devices or small numbers of MRE devices are well understood, supporting retiring the risks related to short-term changes in habitat for new projects with small numbers of devices (one to six devices).

REMAINING UNCERTAINTIES

Several knowledge gaps remain to advance our understanding of the risks associated with changes in benthic and pelagic habitats. There is still little understanding of the appropriate spatial and temporal scales over which MRE devices are likely to have effects, to guide monitoring programs. While studies around surrogate industries can help identify potential effects, no suitable surrogates exist from which to learn in tidal environments. In tropical regions, the composition of biofouling and aggregating species, their geographic distribution, and how widely planktonic larvae are spread remain poorly known. Filling these gaps would help assess risks and develop measures to identify impacts at an early stage. While surveys using underwater images are accepted as a powerful means of assessing habitat changes over time, they are challenging because very large areas must be covered, and extremely large datasets are needed to determine changes of ecological significance. It is unclear whether the effects of arrays on habitats will scale linearly with the number of devices or area occupied, and whether decommissioning (removing) of MRE devices will positively or negatively affect benthic communities.

RECOMMENDATIONS

MRE project proponents should identify existing datasets and historical knowledge before collecting new field data. Guidelines needed for data collection should include specific spatial and temporal scales to help reduce uncertainties about changes in benthic and pelagic habitats associated with MRE devices. More information is needed about species groups and their distributions to identify levels of change that are not deemed acceptable, using metrics such as biodiversity and habitat quality indices. Modeling can help define the best habitats and connections among MRE sites and natural habitats, and can identify the cumulative effects of MRE devices and other anthropogenic activities, as well as climate change.

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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