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Title:

A unique approach to assessing the impact of low-frequency noise and magnetic fields generated by offshore wind farms on behavior and dispersal of fish larvae

Abstract:

The number and size of offshore wind facilities (OWFs) is increasing rapidly to meet the demand for renewable energy. When OWFs operate, they produce low-frequency noise at a higher intensity than that naturally present in the sea soundscape. This noise can travel far from the source location, and potentially impact marine organisms. The energy produced by OWFs is transported through high voltage Direct Current (DC) subsea cables. These produce magnetic fields (MFs) that could impact marine organisms transiting through the network of DC cables. There is very little knowledge of the impact of operational noise and MFs on the early life history stages of marine fish. We present a novel approach to investigating these questions that couples *in situ* and laboratory-based experiments to assess the impacts of OWFs' low-frequency noise and MFs on the swimming, orientation and dispersal of the larvae of commercially important species that could be impacted by large-scale wind farms. Using cutting-edge technology, we observed the behavior of larval cod (*Gadus morhua*) swimming in drifting chambers at sea. Using a low-frequency sound projector, larvae were exposed to 100 Hz signal in the intensity range of that produced by OWFs. Using hydrophones and a 3D-particle velocimeter, we assessed the behavioral response of cod larvae *in situ* to the sound pressure and particle motion generated by the signal. We also conducted lab-based experiments using electric coils to simulate the scenario of larvae swimming by a MF gradient generated by DC cables. We tested potential attraction/avoidance to MF and its impacts on swimming of both Atlantic haddock (*M. aeglefinus*) and lesser sandeel (*A. marinus*). Both low-frequency noise and MF significantly impacted the behavior of these larvae. We show the impacts of each stressor and how, on a large scale, they could significantly modify the larval dispersal of these species.

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Keywords

Offshore wind farms, fish larvae, low-frequency noise, magnetic field, subsea cables, behavior, orientation, swimming

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