Offshore wind farms as stepping stones for Non-indigenous species

THE PROBLEM

One of the most important effects of offshore wind farms is the unintentional provision of a new habitat which invariably is rapidly colonized by hard substrate species. Turbine foundations provide hard vertical substrates and, depending on the structure and scour protection used, varying degrees of habitat complexity. These novel surfaces span the full water column from the splash zone to the seafloor, often in areas where comparable natural hard surfaces are absent.

Photo by, Bob Rumes, Royal Belgian Institute of Natural Sciences

Non-indigenous species (NIS) are species that did not occur in a particular geographic region, such as the North Sea, prior to a certain date (e.g., the beginning of the 17th century). They consist of species introduced by human activities outside their natural past or present range (introduced species), and species that spread by their own means (range expanding species) due to rising temperatures or other factors. As ocean sprawl in shallow and coastal waters has favored NIS, there is concern that increasing development of offshore wind farms will accelerate this phenomenon. In the shallow southern North Sea, where offshore wind farms were first installed, NIS were found among the colonizing species and included both introduced and range expanding species, such as the Pacific oyster *(Crassostrea gigas)*, the midge *(Telmatogeton japonicus)* and the southern barnacle *(Balanus perforatus)*. The highest number of NIS was found in the intertidal and splash zone. These habitats are relatively rare in the open sea and offered a new substrate to occupy. NIS made use of this available habitat to both extend their distribution and/or strengthen their population. Subtidally, records of NIS are scarcer.
At Block Island Wind Farm in the United States, the regionally widespread invasive

Photo by, Bob Rumes, Royal Belgian Institute of Natural Sciences

ascidian *(Didemnum vexillum)* was observed on both the foundation structure and as an epibiont, or an organism that harmlessly lives on another organism. At wind farms in the North Sea, only a few subtidal NIS were recorded, including the very successful and omnipresent introduced slipper limpet *(Crepidula fornicata)*. Research in the Southern North Sea points to those wind farms that are closer to shore as being important for colonization by NIS.

Photo by, Bob Rumes, Royal Belgian Institute of Natural Sciences

The substantial increase of hard substrata in the North Sea, an environment consisting largely of soft mobile substrata, has facilitated the spread of hard substrata species by creating new dispersal pathways and facilitating species migrations - the so called 'stepping-stone effect'. The settlement of previously known introduced species, actively translocated by human action prior to offshore wind development, is favored. In Europe, southern hard substrata species are extending their range further to the north into the North Sea, where some did not previously occur. Thus far, no records exist of species causing significant ecological, environmental, and/or economic damage using this pathway to expand their range as was the case in other industries such as aquaculture and shipping.

MONITORING IMPACTS AND MITIGATION MEASURES

To prioritize management effectively, the risks posed by NIS, specifically introduced species, need to be assessed, but so too does the feasibility of their management. Prior to construction, project developers should conduct a site-specific assessment for potential NIS that could take advantage of the new habitat and use the results thereof to develop a monitoring strategy. Periodic visual monitoring of the fouling community on a representative selection of turbine foundations per study area, starting on an annual basis and adjusted to multiannual after an initial period, is recommended to document the arrival and subsequent proliferation of NIS. If it is deemed necessary, fouling assemblages in the intertidal zone can be removed mechanically at a reasonable cost, but efforts to remove the fouling in the subtidal zone are likely to be challenging. Another way to limit the influx of NIS is by ensuring that they are not transported by vessels operating in the wind farm or, on a broader scale, by any vessel operating in the region.

RESEARCH PRIORITIES

- Develop technical and cost-effective solutions for the detection and/or removal of subtidal invasive species.
- Standardize monitoring protocols and coordinate reporting with other relevant marine stakeholders.
- Quantify how the expected large-scale roll-out of offshore wind is likely to affect invasive patterns and processes across broad geographical gradients under different scenarios of climatic change.

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