Benthic production and energy export from man-made structures to softbottoms: Does it matter?

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Over the last decade, the installation and operation of extensive offshore wind farms led to a substantial increase in artificial substrates in the North Sea. Man-made structures (MMS) such as wind turbines, oil and gas rigs represent additional hard-substrate habitats in the areas of the North Sea that are predominantly characterized by soft sediments.

Research on large offshore structures has identified a suite of unique effects ranging from biodiversity changes with repercussions on local ecosystem functioning to the provision of habitat for fouling communities, acting as stepping stones also for non-native species. Consequently, MMS might induce structural, functional and process-driven changes over various spatial and temporal scales, that are different from those expected for natural soft-bottom benthic systems. However, our current understanding of how ecological functioning might be modified by the addition of these MMSs is still scarce.
Many ecosystem goods and services of the North Sea such as long-term carbon storage and natural resources (e.g. for fish, birds, mammals and finally humans) are intimately linked to the benthic system. Benthic invertebrates form the major food source for many commercially exploited fish species and thus the production (i.e. species energy that is turned into biomass) of benthic communities is of direct relevance for the food provisioning ecosystem service.

In this study, production was calculated based on species populations as a quantification of energy flow and trophic interactions. The obtained results may thus provide clear signals for status and possible responses of populations and entire ecosystems to the introduction of MMS. The analysis included different datasets from various monitoring programmes of offshore wind farms and oil and gas rigs (i.e. the production and biomass of fouling communities and of natural soft-bottom community) from the Southern North Sea over several years. We analysed production changes due to environmental parameters and the presence of the structures in a meta-analysis. The analysis revealed clear modifications in the upper parts of MMSs, where the highest production values and potential biomass export to soft bottoms were detected. The outcome may thus represent a first step to disentangle the potential effects of additional biomass discharge from MMS on the ecological functioning of benthic systems.

Keywords: macrobenthos; man-made structures-MMS; offshore wind farms; ecological functioning; secondary production; energy flow changes