Food web structure of fouling communities along the ecological zonation of artificial hard substrates in a North Sea offshore wind farm

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Man-made structures provide habitat for sessile organisms altering the natural biodiversity. This alteration impacts both ecosystem structure and ecological functioning, e.g. food web interactions. An understanding of trophic linkages among organisms is a fundamental requirement to explain energy flow from primary carbon fixation to higher trophic levels and provide a mean to investigate how man-made structures impact ecosystem functioning. The aim of this study is to describe the structural and functional food web characteristics at different ecological depth zones along a wind turbine. Fouling organisms were collected at the intertidal, *Mytilus edulis*, *Jassa herdmani* and *Metridium dianthus* zones, and on the erosion protection layer (EPL) and the nearby soft substrate. Food sources (water particulate organic matter, plankton) and mobile predators were sampled from the surrounding water column. All organisms were identified at the lowest possible taxonomic level and were processed for stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$). The results indicated that the food web structure is changing along different ecological zones; the largest standard ellipse area (SEA) was formed by the EPL community (16.81 ‰^{2}) and the smallest one by the intertidal community (5.06 ‰^{2}). Overlaps between the ellipses were estimated and it was found that the intertidal zone had the lowest overlap with all other communities. In contrast, the soft sediment community had the highest overlap SEA with all the other groups but no clear depth-related pattern was revealed. Based on SEA_B, the probability that the SEA of *Mytilus edulis* zone is smaller than the SEA of EPL was found 100%. Variation in the highest trophic position in the different zones was large and ranged between 6.59 (*Trisopterus luscus* in the EPL) and 4.37 (*Homarus gammarus* in the soft substrate). The range in trophic positions within each zone was again highest in the EPL community (2.36 - 6.59), the narrowest range was observed for the intertidal community (1.89 - 3.33). The species-specific study revealed the trophic plasticity of some species, such as *Metridium dianthus* and *Ophiothrix fragilis*, which shift food sources and trophic positions depending on the zone they inhabit. This study provides fundamental knowledge on the food web structure along a wind turbine and gives innovative information about the homogeneity of the trophic structure of fouling communities along the ecological zones formed at a 25 m depth.

Keywords: stable isotope analysis; marine food chain; artificial hard substrates