Determining the contribution of fouling fauna to the marine organic matter pool of offshore wind farms

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The North Sea is becoming a worldwide leading area for renewable energies. This answers to the efforts of the European Union to become climate neutral, less dependent on fossil fuels, and at the same time, reduce the emission of Greenhouse Gasses. Offshore Wind Farms (OWFs) are key to meeting these goals. OWF presence in the marine environment changes the local ecosystem structure and functioning. They offer new artificial hard substrates that are rapidly colonized by epifaunal marine organisms. The new communities are mainly suspension-feeders, dominated by blue mussels (*Mytilus edulis*), tube-building amphipods (*Jassa herdmani*), and plumose anemones (*Metridium senile*). These organisms feed on suspended organic particles, including phytoplankton and zooplankton. They can filter ca. 7.5 Olympic swimming pools per day per turbine and excrete faecal pellets (FP), which are thought to play a crucial role in the local organic matter (OM) dynamics and possibly in the local carbon sequestration in the sediment.

The general objective of the project OUTFLOW (Quantifying the cOntribUTion of Fouling fauna to the Local carbon budget of an Offshore Windfarm) is to assess the role of FP from fouling fauna in terms of their contribution to the pelagic and benthic OM pools within OWFs. The first step is to develop isotopic tracers for the FP of the dominant species (*M. edulis, J. herdmani,* and *M. senile*) and the other components (phyto-, zooplankton, and bacteria-degraded OM).

To develop this tracer, we apply Compound-Specific Stable Isotope of amino acids (CSIA – AA) based on the analysis of amino acids (AA) in the FP and the other components. We measure the $\delta^{15}N$ signal of the AA, which varies depending on the diet of the organisms, the AA pathways from primary producers to consumers, and the possible alteration through the gut passage of the metazoans. Some AAs $\delta^{15}N$ signal will change little ("Source" amino acids) and others significantly ("trophic" and "metabolic" amino acids) from primary producer to consumers. Through multivariate techniques, specific AA ratios are selected to determine the AAs with the highest discriminating power. We will use these AAs in a Bayesian Mixing Model to estimate the contribution of FP to the OM pool of an OWF. This will be the first step to determine the fate of FP in the sediment, estimate the carbon sequestration potential of altered OWF sediments, and model the potential spatial dimensions of sediment enrichment induced by OWFs in the marine environment.

Keywords
Fouling Fauna; Faecal Pellets; Organic Matter Dynamics; Isotope Analysis; Stable Isotopes; Amino Acids; Mytilus Edulis; Jassa Herdmani; Metridium Senile; Offshore Wind Farm