Habitat suitability mapping of epibenthos and demersal fish communities in the Belgian part of the North Sea

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To protect and restore the health of our oceans, as outlined in the European Union mission 'Restore our ocean and waters', it is key to gain comprehensive knowledge on the distribution of seabed communities, as these are important bio-indicators of marine ecosystem health.

Elucidating the original distribution of communities, facilitates investigating the impact of human activities, such as for example the approaching construction of the Princess Elizabeth energy island. Typically, baseline conditions are determined based on point observations and are thus spatially-explicit. Habitat suitability maps offer an area-wide coverage by extrapolating biological point data information based on modelled inferences with environmental variables. This is essential for future ecosystem health assessments and marine spatial planning to conserve biodiversity.

The goal of our study was to develop a habitat suitability map for epibenthos and fish for the Belgian part of the North Sea (BPNS). This entailed a three–step process: first, clustering of density data was performed to define distinct epibenthos and fish communities; second, a predictive model was created linking the presence of these communities to a combination of environmental variables; and lastly, the predictive models were used to develop habitat suitability maps visualising the community distribution.

Based on epibenthos and fish density data of 449 beam trawl events in the BPNS from 2008 until 2020, four distinct communities could be delineated: two nearshore and two offshore communities. The nearshore communities are characterised by high densities of brown shrimp (*Crangon crangon*) and common sole (*Solea solea*), while the offshore communities typically have higher densities of lesser weever (*Echiichthys vipera*) and striped red mullet *(Mullus surmuletus*). Some species such as plaice (*Pleuronectes platessa)* and the common starfish (*Asterias rubens)* occurred in all communities. Distinction between both nearshore communities (i.e. mud and fine sand) is mainly based on differences in density for certain species with higher density of e.g. common dragonet (*Callionymus lyra*) and *Ophiura albida* in the fine sand community. Both offshore communities are distinguished because samples occurring on top of the sandbanks are entirely dominated by lesser weever. Overall, nearshore communities have a lower number of species (avg. 24.47 ± SD 4.14) and Shannon-diversity (avg. 1.123 ± SD 0.37) compared to the wide spread coarse sand offshore community (resp. avg. 28.10 ± 5.30 & 2.10 ±0.58).

Next, we modelled which environmental variables best predicted the presence of these four communities. Predictor variables included in the models were sediment, hydrodynamic (e.g. mean bottom stress), and water-related variables (e.g. salinity, chlorophyll, ...). Best predictor combinations varied depending on the community. Best models for the offshore coarse sand community always contained maximum bottom stress and the bathymetric position index (BPI) for explaining a significant part of the variation. For the fine sand community, variables mean bottom stress and mud fraction of the sediment were significant predictors. For the mud community, mud fraction, BPI, and maximum bottom stress showed significant p-values.

In a final step, we will calculate the probability of the presence of each of the four communities for each grid cell (200x200m) in the BPNS based on the developed predictive models in combination with BPNS-wide coverage maps of the environmental predictors. In this way, a habitat suitability map for each distinct community will be developed representing the distribution of the different communities in the BPNS. This type of information supports the sustainable management of our seas and oceans.

Keywords
Epibenthos; Demersal Fish; Belgian Part Of The North Sea; Habitat Suitability; Community Distribution Modelling