Testing macrobenthos adaptation with a trait based model (TBM) in the Belgian Coastal Zone

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Trait-based models (TBM) simulate the growth of many species simultaneously by hypothesizing that one biological trait is responsible for structuring a defined community in a defined environment (Litchman & Klausmeier, 2008). The value of the trait varies among the species and determines the performance of each species under the environmental conditions. Besides, the performance of individual species is hampered by the existence of trade-offs, which ensure that a biological function is only improved at the expense of another. The fittest species under given environmental conditions is the one able to benefit from its trait without suffering from the associate trade-off.

In this study a TBM of bivalves is developed to test some hypothesis about the bivalve's distribution in the Belgian Coastal Zone (BCZ). Data analysis and literature research allowed formulating some hypothesis on the significant bivalve traits and environmental factors structuring the communities in the BCZ. Suspended particulate matter (SPM) through its organic content is the main source of food for bivalves, and it features a concentration gradient from East to West along the BCZ (Fettweis et al., 2006). To capture enough food, the bivalves must filter high amounts of organic matter without clogging. Gills and palps are the organs responsible for two different food harvesting functions: particles filtration and particles selection respectively. Several studies have demonstrated that these two functions are related to the size of the organs (e.g. Milke and Ward, 2003; Riisgard et al., 2011). A trade-off between the two is introduced, assuming that a fixed fraction of energy is invested in the food harvesting apparatus (gills plus palps) but that each species allocates it differently between the organs. Therefore the two biological functions for food harvesting can be reduced to one trait, the gills-to-palps mass ratio.

The following hypothesis is formulated: bivalve communities in the BCZ are firstly structured by food availability and quality, i.e. SPM, and the trait determining the fittest species is the gills-to-palps mass ratio.

This concept was designed into equations describing bivalve's growth, and then translated into a simple box model simulating the BCZ biogeochemical conditions. The gills-to-palps ratio allowing the fittest species to grow under varying conditions are compared with in situ measurements of gills-to-palps ratios in the BCZ.

To our knowledge this is a first TBM for organisms other than primary producers.

References

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