

MODELLING BIOTA-MUD INTERACTIONS IN ESTUARIES

Cozzoli Francesco, Tom Ysebaert, Tjeerd J. Bouma and Peter M.J. Herman

Netherlands Institute of Ecology (NIOO-KNAW), Centre for Estuarine and Marine Ecology (CEME),
Department of Spatial Ecology, Korrिंगaweg 7, 4401 NT Yerseke, the Netherlands
E-mail: f.cozzoli@nioo.knaw.nl

The ecological literature describes many examples of the influence of benthic biota (microphytobenthos, benthic animals) on sedimentation/erosion properties of intertidal sediments. On a larger scale these biota-mud interactions can affect transport dynamics and estuarine morphology. Modelling of these relations is often based on empirical, statistical approaches. The reverse process, namely how mud content of sediments influences the composition of the biological community, is well known from a descriptive point of view. Numerous field studies have linked the composition of the benthic community to sediment characteristics. However, these relations are usually described from an ad-hoc, location-specific point of view and generalisations are rare or absent.

Within the present project, generalisations of these descriptions will be sought. The aim of the project is to develop and test model formulations for the mutual influence of mud on benthic (and pelagic) communities and, vice versa, for the influence of biological communities on mud content. The influence of mud on benthic communities is investigated through the (statistical) analysis of a large macrobenthic dataset that is available for the Westerschelde and Oosterschelde. These two estuaries nowadays differ substantially from each other due to human interferences over recent centuries. After the Delta Works only the Westerschelde remained a true estuary with an open connection to the sea, while the Oosterschelde got partly closed off by a storm surge barrier. This has abruptly reduced the in and outgoing tidal volume of this basin by approximately 30%. Furthermore, the Oosterschelde has changed into a sedimentation basin (i.e. channels are filling up) with a pronounced trend towards the erosion of the intertidal areas. On average, mud content in the sediment is nowadays much lower in the Oosterschelde compared to the Westerschelde. The different (morphological) evolution these two systems undergo make them interesting study areas to compare. The benthic communities present in both systems still show similarities and have many species in common, but abundance and dominance often differ.

The data set was analyzed through B-spline quantile regression to account for heteroskedasticity and realized species abundances distributions typically showed non-linearity along single environmental gradient (sediment texture in present case). The analysis shows a well-defined turnover of species predominance between Westerschelde and Oosterschelde (from mud-fitted to sand-fitted), related to a trend towards coarser sediment in the intertidal areas of the Oosterschelde. Moreover the rate of change increases progressively during time (analysis span: 2000-2008), suggesting still a transitional situation. In Oosterschelde, sand-fitted ones gradually replace mud-fitted assemblages of species, following the general erosive trend generated by the Delta Works.

This framework will be further extended converting the observed patterns in specific abundances in modeled effects on sediment dynamics (i.e. if the changes in Oosterschelde's species compositions have the effect to 'buffer' or further 'emphasize' the existing erosive trend). A more general quantification of biotic responses along the sediment texture gradient will result in a better understanding of the morphological evolution of estuarine ecosystems. The final aim is to include the biotic influences into existing morphodynamic models, increasing accuracy in 'biologic' and 'fluvial engineering' future scenarios predictions. This project is part of the innovative program Building with Nature (www.ecoshape.nl).