ABSTRACT: Benthic animals have profound impact on biogeochemical processes in the sediment through their mobility and feeding activities altering sediment structures. Their overall activities regulate inputs of organic material to marine sediments and the vertical distribution of solids and solutes within the sediment. The results of this influence the organic matter mineralization in the sediment and sediment-water exchange of oxygen and dissolved nutrients.

This thesis focuses on the importance of macrofaunal bioturbation and biodiversity for organic matter mineralization and nutrient fluxes in sediment habitats. Interactions between fauna, micro-organisms, sediment and the overlying water were examined in detail for several macrofaunal species in the Baltic Sea and the Skagerrak.

Sediment reworking was described for seven benthic species of macrofauna representing different functional groups from the Skagerrak. Image analysis of luminophore tracers was a powerful method for quantifying sediment reworking of different functional groups on both temporal and spatial scales. Different specific traits and activities of benthic fauna influenced rates and pathways of organic matter mineralization in highly reducing sediment from beneath a mussel farm. The addition of *Amphiura filiformis* and *Nephtys incisa* to the sediment resulted in significantly different benthic nutrient fluxes and solute pore water distributions. Addition of Skagerrak and Baltic Sea macrofauna increased organic matter mineralization in Baltic Sea sediment. A higher functional biodiversity did not enhance oxygen consumption and nutrient fluxes within the two experimental systems. However, the deep burrowing crustacean *Calocaris macandreae*, which is present in the Skagerrak but not present in the Baltic, had species-specific traits that were more important for ecosystem functions compared to all other species combinations. The low functional biodiversity in the Baltic Sea makes every benthic species relatively more ecologically important compared to a system with high diversity. The Baltic Sea isopod *Saduria entomon* had significantly higher oxygen consumption and excretion of nutrients compared to all other Baltic Sea species during animal-water incubations, whereas, the polychaete *Hediste diversicolor* had significantly higher phosphate fluxes compared to *Saduria entomon* during the sediment-water incubations. This highlight that rates may be due to interactions between species traits and experiment conditions. In the same study the multi-species treatment increased benthic amminium fluxes compared to the single-species treatments. In the Baltic Sea field study, ecosystem functions were products of macrofaunal activities due to high biomass of *Macoma balthica* and specific macrofaunal functional traits (e.g. *Marenzelleria arctia*) rather than physical and chemical sediment properties.

In conclusion, macrofaunal bioturbation and biodiversity are important for reaction and transport of organic material and nutrients in Skagerrak and Baltic Sea sediments.

KEYWORDS: benthic fluxes • biodiversity • bioirrigation • bioturbation • closed sediment incubations • ecosystem function • functional groups • mineralization • nutrient • organic material • pore water • sediment reworking