02.08

The role of mussels (*Mytilus edulis*) for the functioning of the Baltic Sea and the generation of ecosystem goods and services

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Although dwarfed by salinity stress, the blue mussel *Mytilus edulis* totally dominates coastal areas of the Baltic proper down to 25m depth with about 90% of the shell-free dry weight benthic animal biomass. Due to its small size (max ca 3 cm) the mussels are not harvested, but they play a large role in the functioning of the Baltic ecosystem. Major environmental problems in the Baltic Sea today are eutrophication and critical oxygen conditions in deep water below the halocline. This paper analyses the role of the mussels for the eutrophication situation and attempts to value the ecosystem goods and services provided by the mussels along the Swedish coast. About 1/3 of the coastal pelagic primary production is channelled through the mussel population and sedimentation rates of CNP in the coastal zone are doubled by the mussels' activity. By actively removing pelagic plankton that would otherwise stay in suspension and depositing them as faeces and by regenerating nutrients directly to the trophogenic zone, or storing them in mussel biomass, nutrients are kept in the coastal zone for a longer time, instead of being deposited on deep bottoms or being flushed out of the area as dissolved nutrients or as plankton. Consequently, mussels increase the productivity and energy transfer in coastal areas. Furthermore, mussels increase the biodiversity of associated fauna and flora by structural and functional traits. Biodeposition provides associated benthic fauna with food, and leads to deposition of nutrients, toxicants and organic matter in the sediment. The mussels' filtration improves water transparency, allowing benthic vegetation to increase and grow deeper. It also promotes growth of perennial bladder wrack and red algae rather that filamentous nuisance species and thus also promotes aesthetic values and tourism. Scenarios involving changes in mussel abundance due to eutrophication, invading species, diseases and other natural and human threats will be discussed with regard to the net effects on goods and services and the functioning of the Baltic Sea.

02.09

Habitat preferences and distributions of macroinvertebrates in relation to plant habitat complexity on soft bottoms in the Baltic Sea

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Heterogenic habitats have been suggested to be more species rich and productive than homogenous habitats; e.g. diverse or structurally complex plant habitats should have high densities and diversity of associated fauna. We investigated macroinvertebrate distributions between plant habitats with different morphological complexity by means of habitat preferences in experimental containers and colonization experiments under field conditions. Both natural plants and artificial plastic replicas were used. Morphologically complex plant habitats were generally preferred and had higher densities of fauna than less complex habitats. The species diversity of fauna was also higher on complex artificial habitats, but not on complex natural plant habitats. The preferences for, and densities in the different habitats differed between faunal taxa. In the laboratory the crustacean genera *Idotea* and *Gammarus* preferred the complex plant *Myriophyllum* over plant habitats of *Chara* and *Potamogeton*. Contrary to the crustaceans the gastropod *Theodoxus* showed a tendency of preferring the *Potamogeton* habitat. The gastropods preference was probably related to a higher density and different composition of microepiphytic algae on the plant. In the field, faunal density was also strongly correlated with the amount of drifting filamentous macroalgae. This may in part explain the high faunal densities on plants with complex morphologies (*Myriophyllum* and *Chara*) since these taxa trapped more drifting algae. From the study we conclude that plant morphology is an important factor in structuring the aquatic macroinvertebrate community. Structurally complex plant habitats had higher densities of associated fauna, however there were differences in the response to habitat complexity between faunal taxa. The faunal species diversity showed an inconsistent response to habitat complexity. Also other factors such as food availability played a central role in the observed patterns.

02.10

The functioning of intertidal systems: The impact of cockle (*Cerastoderma edule* L.) harvesting on ecosystem function

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The common cockle, *Cerastoderma edule* L. occurs at commercially-exploitable densities in both species-poor and highly species-rich assemblages within sand/mud habitats on all British coasts. The functioning of these intertidal benthic systems is of particular interest, due to their role in the regeneration and re-supply of nutrients to coastal waters. Within these systems, cockles are likely to be a key contributor to a number of ecosystem functions. The question under consideration is: do species-rich and species-poor systems respond differently to the removal of cockles? In particular, are species rich systems able to more-readily retain ecosystem functions and therefore remain more resistant to impact? To explore this, adult cockles were removed from experimental plots at two contrasting shores in the north-west of England within the Dee and Morecambe Bay estuaries. Impacts on physical processes were measured over the summer and changes to ecosystem functioning within the infauna measured using a Biological Traits Analysis. Analyses show that the removal of cockles resulted in changes to the macrofaunal community structure of both systems. Implications to the functioning of the contrasting systems are discussed.

02.11

The zebra mussel (*Dreissena polymorpha*) and the benthic community in a coastal Baltic lagoon: another example of enhancement?

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The zebra mussel (*Dreissena polymorpha*), a sessile suspension feeder, is thought to be an agent in pelagic-benthic coupling. Biodeposition by the bivalve has been reported to enhance benthic communities inhabiting sediment surrounding zebra mussel beds and druses on the bottom. In summer 2007, we studied distribution of *D.polymorpha* beds and their effects on the benthos in Kleines Haff, the German part of the Szczecin Lagoon, a southern Baltic coastal water body. Meiobenthos was sampled by SCUBA divers at two sites in the southern part of the area, one site (MB4) featuring *D.polymorpha* druses and the other (MB5) supporting a distinct zebra mussel bed. At MB4, samples were

collected as close to a druse as possible and away from it, while the sampling at MB5 was performed adjacent to and about 10 m away from the bed. The two sites differed distinctly in their sediment characteristics: while the sediment at MB4 consisted of permeable sand mixed with detritus and shell debris, MB5 showed a layer of sand (mixed with detritus and shell fragments) overlaying a peat deposit near the *Dreissena* bed and permeable sand away from it. The two sites differed in their meiobenthic communities: while no difference in abundance and composition was observed between the sets of samples collected at MB4, MB5 showed a distinctly more abundant meiobenthos in the uppermost sediment layer near the zebra mussel bed, but the overall abundance was lower than that away from the bed. We conclude that the meiobenthic response to the presence of *D.polymorpha* was, at least in part, mediated by sediment characteristics. Macrozoobenthos was sampled mostly in the western part of Kleines Haff, but was also identified in the sediment samples collected for the meiobenthos. The macrobenthic abundance varied greatly over the area sampled, but higher abundances were found at stations with live *Dreissena* and empty shells. Data from the two meiobenthic sites showed the maximum macrozoobenthic abundance and the highest diversity near the dense zebra mussel bed. The study was supported by the German Ministry for Education and Research (BMBF) Project MOE 07/R58 “Biological Restoration Methods for the Szczecin Lagoon”

02.12

In situ observations of macrofaunal and meiofaunal bioturbation patterns in an enclosed sea loch

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Bioturbation by infaunal organisms is an important process in influencing sediment oxygenation and the recycling of nutrients. Most studies of bioturbation use a rapid assessment approach that averages activity over a short incubation time. However, these assume that bioturbation activity remains constant over time, although photoperiod and temperature are known to influence net activity. Here, we used in situ time-lapse sediment profile imaging (t-SPI), to examine temporal changes in bioturbation by meio- and macrofauna across an organic gradient. We quantified bioturbation activity by measuring burrow area against the camera faceplate, i.e. analysis of voids, and identified how a change in void area is influenced by the tidal cycle, photoperiod and current direction. We were also able to identify the minimum time period in which bioturbation activity remained at the same magnitude, thus identifying the minimum sampling frequency to detect apparent patterns in bioturbation behaviour. Our findings indicate that infaunal behaviour changes in relation to environmental variables on scales of tens of minutes, and suggests that short-term bioturbation events are more important in determining ecosystem processes than previously envisaged.

02.13

Spatial distribution of the subtidal meiofauna communities

Alves AS, Adão H, Marques JC

Meiobenthos is an important benthic component of marine and estuarine sediments. In estuarine sediments meiofauna facilitates biomineralization of organic matter, enhancing nutrient regeneration, serves as food for a variety of higher trophic levels and exhibits high sensitivity to environmental modification. Spatial (horizontal and vertical) variations, temporal changes, abundance, species composition and fluctuations of estuarine meiofauna communities are influenced by several biotic and abiotic factors such as trophic relationships, bioturbation, oxygen, salinity, temperature and sediment grain size characteristics. The objective of this study was to analyse and compare the spatial distribution of the density and composition of subtidal Meiofauna and Nematoda communities in two southern European estuaries, exposed to different degrees of anthropogenic stress, in Portugal: Mira, a relatively undisturbed estuary, and Mondego, a system under sever anthropogenic impacts. Samples were collected along the salinity gradient of the two estuaries, from freshwater (<0.5psu) to euhaline areas (>30psu). Data were analysed in a way to describe and compare the distribution patterns of composition and density of meiofauna taxa and Nematoda communities along the salinity gradients of both estuaries and to identify the specific environmental factors structuring that distribution. In what refers to the environmental parameters, the two estuaries were different, with the Mira estuary presenting higher proportions of silt + clay and organic matter content and the Mondego estuary presenting higher percentage of dissolved oxygen and phosphate concentration. In both estuaries, meiofauna communities were characterised by the dominance of the taxa Nematoda, Copepoda and Polychaeta. The spatial patterns of density and composition of both meiofauna and Nematoda communities reflected the salinity gradient, being these assemblages structured and influenced by this natural stressor. Besides salinity, sediment properties also influenced the communities and the responses of the communities to both anthropogenic and natural stress could not be easily differentiated. Nevertheless, different patterns of the trophic nematode structure assemblages between Mira and Mondego overlapped the salinity effects and the feeding guilds and their response could detect the anthropogenical-induced stress in these estuaries.

02.14

Density dependent effects of an infaunal suspension feeding bivalve (*Austrovenus stutchburyi*) on intertidal nutrient fluxes and microphytobenthic productivity

Sandwell DR, Pilditch CA, Lohrer AM

Dense aggregations of suspension-feeding bivalves can enhance benthic-pelagic coupling in coastal ecosystems. For example, grazing can regulate phytoplankton biomass and the resulting biodeposits increase the flux of organic matter to the benthos accelerating rates of remineralisation and the supply of potentially limiting nutrients to primary producers. *Austrovenus stuchburyi* is a venernid clam that exists in large beds at high densities (up to 2000 ind. m^{-2}) on sheltered, intertidal sandflats in many New Zealand estuaries. Due to habitat loss and over-harvesting some populations are in decline. The aim of this study was to determine if reduced densities of *Austrovenus* impact on nutrient fluxes and microphytobenthic (MPB) production. We established nine experimental plots