Lack of eelgrass recovery in a Danish estuary - evaluated by field evidence, modelling and GIS-analysis.

Abstract

Eutrophication has in the past reduced eelgrass coverage in most Danish estuaries. Despite a significant reduction in nutrient loading during the last 20 years and oligotrophication in progress, eelgrass (Zostera marina L.) has not managed to recover. This lack of recovery is evident even in very shallow locations with sufficient light. EU’s Water Frame Directive considers eelgrass is a key element for good ecological quality, but no Danish estuaries fulfill the EU criteria because of lacking eelgrass recovery. A national project was established to study processes and mechanisms that prevent the recovery of eelgrass. Field studies and laboratory experiments revealed that several mechanisms and processes explained the lack of eelgrass recovery despite sufficient water quality: 1) Eelgrass seedlings are easily uprooted in sediments with low anchoring capacity due organic enrichment; 2) space, which was eelgrass habitat in the past, is now occupied by macroalgae; 3) Ballistic effects of drifting macroalgae cause seedling; 4) Sediment resuspension maintains estuaries in a turbid state and prevents a sufficient benthic light climate for eelgrass in deeper basins; 5) Eelgrass expansion in sandy areas is prevented by efficient burial of eelgrass seeds and seedlings through lugworm (Arenicola marina) bioturbation activities. All the identified mechanisms and processes were quantified experimentally and introduced into a 3D ecological model and associated GIS-tool. The outcome is a precise analysis of how much each of the stressors contribute to the lacking eelgrass recovery in different habitats varying in nutrient loading, water depth and hydrodynamic conditions. Recently, the scientific effort has been acknowledged by the Ministry of Environment, that now are using the model system to quantify further reduction in external nutrient loadings for all larger Danish estuaries.

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