English summary

Eelgrass, a widely spread marine macrophyte, provides several ecosystem services (e.g. carbon sequestration, nutrient reduction, nursery for several fish species, increasing biodiversity, etc.). Declining of eelgrass coverage due to anthropogenic stressors (e.g. eutrophication, aquaculture) is a global problem, and many countries are developing eelgrass conservation and restoration strategies to fulfil international legislations (e.g. EU's Water Framework Directive). In Denmark, eelgrass currently covers only 10-20% of historical records. Even though Denmark has reduced nutrient runoff and improved water quality to mitigate eelgrass loss, no recovery of eelgrass has been observed.

Dynamical modelling allows analysis of how previously identified environmental pressures affects eelgrass recovery on a system level (e.g. estuary), and to test the efficiency of methods proposed for eelgrass restoration (e.g. sand capping). In this work, ecological models were used to evaluate eelgrass responses to stressors (i.e. sediment reworking by lugworms, ballistic stress from ephemeral macroalgae) and the efficiency sand capping as a restoration method. Furthermore, a newly developed Agent Based Model made it possible to estimate the recovery potential of eelgrass in a Danish fjord.

Manuscript I looked at stressors hindering eelgrass recovery despite the improved water quality. Analysis of pressures affecting eelgrass revealed that recovery is heavily affected by insufficient light and sediment reworking reducing eelgrass biomasses about 80 % compared to the reference condition (pre-anthropogenic influences, in the 1900s). The second biggest impact was found to be ballistic stress from perennial macroalgae and low benthic light, about 70 % reduction compared to the reference condition. **Manuscript II** was focused on development and testing of the new marine tool, sand capping, to improve benthic light and anchoring capacity for eelgrass. Sand capping of muddy sediments greatly decreased resuspension thresholds, where the erosion threshold of muddy sediments (LOI = 16%) increased from a free stream velocity of 12 cm s^{-1} to 40-50 cm s^{-1} after sand capping, thus, improving benthic light. In **manuscript III**, sand capping was tested in a dynamical 3D model, to analyse the potential effect sand capping has on light climate, anchoring and eelgrass biomasses in Odense Fjord. Sand capping the muddy areas will increase eelgrass maximal depth to 4.5 m and lowers uprooting of eelgrass shoots by currents and waves about 63 % in muddy areas (LOI 7-10 %). Natural recovery potential through seeds was estimated with a newly developed ABM seed dispersal model in **manuscript IV**. Currently the majority of produced seeds are lost to areas prohibiting seedling establishment (e.g. insufficient light, low anchoring capacity, high lugworm densities), and only 5 % of seeds are predicted to form seedbanks in areas suitable for recovery by seeds.

This thesis provides valuable tools for researches and environmental managers to aid in selection for suitable restoration method and site. Furthermore, the provided tools can be used to find critical conservation sites for eelgrass to insure natural recovery potential and test newly developed methods.