Abstract

Seagrass meadows are being lost at alarming rates due to anthropogenic pressures which calls for conservation and restoration of these ecologically important habitats. Seagrass restoration programs have therefore been initiated worldwide but the overall success rate is generally low. Further developments in approaches and guidelines for seagrass restoration are needed to increase the success rate. Seagrass recolonization is often lacking, even after nutrient reduction, and was investigated for in Odense Fjord through ecological modelling (manuscript 1). The model demonstrated that natural recolonization was severely hampered in Odense Fjord by a 95 % loss of seeds to unsuited habitats. Related field studies in eelgrass meadows in Dalby Bay showed a low seed production, a high loss of seeds and consequential absence of a seedbank. These findings highlight the need for eelgrass restoration and identification of where restoration is possible. Transplantation trials from multiple estuaries were compiled to identify nitrogen related thresholds for positive transplant performance (manuscript 2). Positive eelgrass transplant performance can first be expected at growth season averages of DIN <2.5 µM and at estuarine nutrient loadings <7.9 g N m^{-2} y^{-1}. A distance-based estuarine gradient analysis revealed that only the outer 70 % of the estuarine gradient can support positive transplant performance. Transplantation success is dependent on site-suitability and optimal transplantation methods. Site-selection combined with test of multiple seagrass transplantation including protective measures was assessed in relation to stressor variability. Both successful transplantation sites and methods were identified in a Danish and in an Australian estuary (manuscript 3 and 4). Large-scale transplantation was further tested in Horsens Fjord to test if transplantation can regain ecosystem services on scale comparable to natural meadows (manuscript 5). The transplanted eelgrass developed 70-fold in shoot numbers and provided sediment stabilization, together with assimilation and burial of both C and N in the transplanted eelgrass at rates comparable to natural eelgrass meadows. These findings highlight that seagrass restoration is possible in estuaries, although strongly controlled by nitrogen loadings, and may require intricate site-selection together with method developments targeted at reducing negative impact from specific stressors. Furthermore, large-scale eelgrass transplantation initiated almost immediate return of important ecosystem services that can be applied nationally as a tool to mitigate eutrophication and climate change by retention and burial of C, N and P.