SeaStore - Diversity Enhancement Through Seagrass Restoration

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SeaStore aims to build robust and scientifically sound restoration techniques for *Zostera marina* #seagrass, quantify return of #ecosystem services, and guide future restoration activities across the #German #BalticSea coast and potentially beyond.

Using the single shoot method (Moksnes et al. 2016), a total of 12,288 individual seagrass shoots were transplanted to 2,048m^2, spanning two sites in the German state of Schleswig Holstein. To monitor and optimize restoration success, SeaStore uses an integrative portfolio of tools and approaches: Site conditions are monitored via sediment properties, site exposure, light penetration, while a number of different treatments combinations are established, including variable densities (16 plants per m^2 and 8 plants per m^2), with and without mussel facilitators. Mussels have previously been shown to have a positive correlation with shoot growth (Reusch et al. 1998). Soil and seagrass microbiomes are being examined to assess the effect of transplantation on these communities and the role of these microbiomes in restoration success.

Simultaneously, hydraulic model tests will be conducted in a wave flume and 3D wave basin to identify links and dependencies between physical, biogeochemical and biological processes, to offer insights into parameters that support successful seagrass recovery and reintroduction.
Here, we also trial the use of supporting structures (a so-called restoration facilitator) to increase shoot survival for successful reintroduction and to address them in the decision support tool.

In parallel with these scientific activities, we aim to raise awareness of the ecosystem services seagrass provides to society via collaborations with representatives from communities, government authorities, and the tourism industry.

An assessment of the socio-economic aspects of seagrass resettlement will also be carried out. For example, a cost-benefit analysis will provide the basis for deciding in which cases to use a restoration facilitator and a monetary evaluation of the ecosystem services will compare costs of habitat loss versus restoration. Finally, we will analyse the social acceptance and public perception of seagrass restoration projects along the German Baltic Sea coast and develop an information campaign and analyze determinants of public acceptance of seagrass restoration - a crucial aspect for upscaling and implementing such projects nation-wide.

Acknowledgements

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Eelgrass restoration in NW Sweden: Lessons learned

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Along the Swedish northwest coast, more than 60% (approximately 12 500 ha) of the eelgrass has vanished since the 1980s as a result of nutrient pollution and overfishing. Although measures have improved the water quality in recent years, no natural recovery of eelgrass has occurred. Instead the losses of eelgrass continue as a result of coastal exploitation and local regime shifts[1]. Restoration of eelgrass constitutes a potential tool to recreate historic habitats and to mitigate eelgrass meadows that are destroyed during exploitation.

Since 2010, extensive studies have been carried out to develop and assess methods for large-scale restoration of eelgrass in Swedish waters. This effort has resulted in a detailed technical handbook[2] and video guidelines[3] that includes all important steps in the restoration process, from site selection and permit processes to harvest and planting of eelgrass, and monitoring and evaluation of results.

For eelgrass restoration in Sweden, the *single-shoot method* is recommended where single, adult shoots are harvested and planted by hand, without sediment or anchoring, using diving. The harvest method does not result in any measurable impact on the donor meadows, and the planting methods are relatively fast. Studies suggest that 4 divers could harvest and plant 40 000 shoot in 10 working days, and that the shoot density can increase 10 times before the winter during optimal conditions. Seed-methods for eelgrass restoration have also been developed for Swedish conditions, but cannot presently be recommended due to very high and variable losses of seeds, mainly due to seed predation[4,5].

Monitoring and evaluating of the environmental conditions at a potential site constitute a critical first step in the restoration process. When an eelgrass meadow is lost, the environment may change so much that it no longer allows eelgrass growth. In NW Sweden, test planting failed in over 90% of evaluated sites, mainly due to poor water quality resulting from local sediment resuspension, but also because of shading from algal mats and disturbance from shore crabs and geese[1]. In Sweden it is recommended that eelgrass restoration should only be attempted at sites where test-planted shoots show positive growth after one year.

At present the recommended restoration methods are being applied in several medium to large scale projects (0.1-1.0 ha) along the Swedish west coast and in the Baltic Sea. Diving consultants have harvested and planted up to 80 000 eelgrass shoots in two months to a cost of approximately €130,000 per hectare. Preliminary results show variable success. Presently, news methods using sand capping to improve environmental conditions for eelgrass are being developed and evaluated.

Although functional methods for eelgrass restoration are available for Swedish waters it is important to note the eelgrass restoration is very labor intensive, expensive and the results are many times uncertain. Also in areas with apparent good environmental conditions, a storm or a heat wave can result in unsuccessful restoration. In addition, hand planting using diving limits the scale of projects to a few hectares per year, which is a very small amount in comparison with the 1000s of hectares that has been lost in Sweden. Thus, the available restoration methods can likely not alone recreate the historic distribution of eelgrass. Hence, it is imperative that environmental managers prioritize the protection and conservation of remaining eelgrass habitats. Still, in combination with large-scale measures that improves the conditions for eelgrass growth, restoration at strategically chosen locations may constitute an important complement that could enable and accelerate natural recovery of Swedish eelgrass habitats.

References

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Tweetable abstract

At #MASTSasm2021 the @zorrogroup presents 10 years of experience developing large-scale eelgrass restoration methods for Swedish conditions that have resulted in a detailed technical handbook and video guidelines presently used in several large-scale projects.

Twitter-handle: @zorrogroup

Community-led Seagrass and Native Oyster Restoration, Loch Craignish, Scotland (*Seawilding*)

Danny Renton

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[3] *www.seawilding.org.*

I would prefer to deliver a talk.

The talk is about community-led seagrass and native oyster restoration; how we do it and the lessons we're learning. *Seawilding* is a Scottish Charity helping Scottish communities take practical action to restore the Priority Marine Features, Ostrea Edulis and Zostera Marina to enhance biodiversity and sequester carbon.

Twitter: *Seawilding* works with Scottish communities to create pioneering projects to restore seagrass and native oysters which enhance inshore bio-diversity and sequester carbon

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Restoring the Humber - approaches to *Zostera noltii* protection and broadscale restoration

Dr James Wood

[1] *Yorkshire Wildlife Trust*

I would prefer to deliver a talk – (can also provide as a documentary video short or blend)**.**

An introduction to seagrass restoration in the Humber Estuary and the associated challenges of regulation, recovery and restoration of *Zostera noltii* in a multi-designate protected area. A reflection on progressive protection and novel approaches to improve the efficiencies of intertidal restoration.

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Twitter: @YorksWildlife leading protection and restoration of the seagrass meadows in the #Humber.

Developing intertidal seagrass restoration in the Dutch Wadden Sea

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Short abstract (picture attached to email):
Intertidal seagrass restoration can be successful and efficient! An adaptive & experimental restoration approach has resulted in high restored seagrass densities (57 plants m²) and substantial seed loss-reductions in the Dutch Wadden Sea. #MASTSasm2021

Twitter handle: @MGrafnings

Abstract
Seagrasses form the foundation of many coastal ecosystems, but are rapidly declining on a global scale. The Dutch Wadden Sea once supported extensive seagrass meadows that almost completely vanished during the 20th century. Seagrass restoration trials have been conducted on and off in the Netherlands since the early 1990s, with most restoration projects drawing the same conclusion: Intertidal seagrass restoration is very challenging. Here, we report on the setbacks and successes of the latest round of intertidal seed-based restoration experiments in the Dutch Wadden Sea (2014-2020). We have conducted research-based, adaptive eelgrass (*Zostera marina*) restoration, yearly adjusting methods based on previous results. We have applied various seeding methods trying to find the most suitable method for our restoration sites and needs– from Buoy Deployed Seeding (BuDS) (Pickerell et al. 2005), to a newly developed 'Dispenser Injection Seeding' (DIS)-based technique. Our adaptive experimental approach revealed a high seed loss in winter (>99.9%), which was mitigated by controlled harvest and storage of seeds throughout fall and winter, followed by Dispenser Injection Seeding in spring. These innovations and the optimization of the DIS-method, have resulted in 4750 times higher plant densities in the field (0.012 to 57 plants/m²) and a substantial reduction in seed loss (99.93 to 88.6%). Our outcomes suggest that an iterative, research-based restoration approach may result in advancing knowledge and the development of novel methods that may greatly improve seed-based seagrass restoration.

References

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