

NEWSLETTER08

JUNE 2020





WELCOME

Danovaro R. – MERCES Coordinator

While the MERCES project is close to the end, interest in ecological restoration of marine ecosystems is exploding. The EU and international governments, following the declaration of the UN Decade for Ecosystem Restoration (2021-2030), are taking the restoration of degraded habitats and their biodiversity and ecosystem services very seriously.

The UN Decade on Ecosystem Restoration coupled with the UN Decade on Ocean Science and Sustainable Development (2021-2030) offer both a great opportunity and a challenge, because marine restoration, while it is at its infancy compared with terrestrial ecosystem restoration, is greatly needed by all governments involved with the exploitation and management of our oceans.

The United Nations Environment Programme last week stated that "the degradation of land and marine ecosystems undermines the well-being of 3.2 billion people and costs about 10% of the annual global gross domestic product in loss of species and ecosystems services". With the start of the UN Decade on Ecosystem Restoration, governments need to make significant progress on their commitments set out by the Convention on Biological Diversity (Aichi Biodiversity Targets 14 and 15), and the EU's 2011-2020 Biodiversity Strategy (EU 2011), to restore 15% of degraded ecosystems by 2020. The world can no longer afford to allow the loss of marine species and the destruction of the marine habitats and needs to invest in habitat restoration.

Several initiatives are being conducted, particularly in regionals seas. Restoration of our oceans is now possible, thanks to new technologies, and increasing experience and capacity to take action, not just for biodiversity conservation, but also to feed the growing human population and to maintain the ocean and planetary health. New approaches are being tested to find solutions to environmental problems and new technologies and protocols are being developed for marine ecological restoration. We can now start successful restoration not only of coastal habitats but also of the deep sea. These are the ambitious targets of the MERCES project; to make possible the restoration of all marine habitats.



Thanks to the MERCES project we have increased the awareness of the possibility to restore different types of marine ecosystems and to allow the rapid recovery of their ecosystem services. Moreover, it is becoming apparent that restoration of marine ecosystems can be a business opportunity, thereby favouring economic growth. Ecological restoration is a particular challenge in the deep sea, which can be limited by technological constraints and high costs.

Marine ecosystems contain an extraordinary array of biotic and abiotic components and thus require conservation and recovery when damaged. The UN Decade on Ecosystem Restoration aims to scale up massively the restoration of degraded and destroyed ecosystems as a proven measure to fight the climate crisis and enhance food security, water supply and biodiversity. We are proud that the MERCES project has acted as a catalyst for pilot actions in this perspective and has stimulated interest in marine ecosystem restoration in an audience beyond the scientific community, which is convinced already of the need to develop marine ecological restoration at a global scale.



Prof. Roberto Danovaro MERCES Coordinator Università Politecnica delle Marche, Italy

Cover. Before/after seagrass restoration on a *Zostera marina* bed in the Dutch North Sea. Photos by Laura Govers (top) and Max Gräfnings (bottom).



MERCES symposium at the 8th World Conference on Ecological Restoration, Cape Town, South Africa

Gambi C., Danovaro R.

The 8th World Conference on Ecological Restoration was held in Cape Town in September 2019. The SER conference was dedicated to "Restoring land, water & community resilience" and hosted almost a thousand scientists and more than 400 talks. The SER conference was attended by a large and heterogeneous audience, with multidisciplinary interests and backgrounds (practitioners, scientists, stakeholders and policy makers). All participants shared a common interest in practicing ecological restoration. Most of the topics were dedicated to discuss all problems related to the degradation of terrestrial ecosystems and the loss of their biodiversity and resources, but for the first time ever a symposium was dedicated — thanks to the MERCES initiative — to the restoration of marine habitats.

The conference offered a great opportunity to discuss and find restoration solutions in different terrestrial and marine ecosystems with special attention on the implications of the recovery of goods and services. The event was an excellent forum to present the results achieved during the MERCES project and to stress the importance of the ecological restoration of marine ecosystems. In particular, the conference offered the opportunity to show the innovative solutions and initiatives carried out in European seas for the recovery of different marine ecosystems from the coast to the deep sea. The following contributions were made by the MERCES consortium:

- Introduction to MERCES: Marine Ecosystem Restoration in Changing European Seas (Roberto Danovaro, UNIVPM and MERCES Project Coordinator).
- Marine restoration and MERCES Key Habitats/Species: Approaches, timescales, bottlenecks, and up-scaling (Chris Smith, Hellenic Centre for Marine Research, Greece).
- Success stories in restoration actions across coastal-marine ecosystems: the potential for synergies (Simonetta Fraschetti, Consorzio Nazionale Interuniversitario per le Scienze del Mare (CONISMA, Italy).
- Principles and key concepts for ecological restoration in the deep-sea (Telmo Morato, Instituto do Mar, University of the Azores, Portugal).





- Effects of marine restoration on ecosystem services (Hazel Thornton, World Conservation Monitoring Centre, Cambridge, UK).
- Stakeholder perceptions on marine restoration: beliefs, preferences and supporting actions (Nadia Papadopoulou, Hellenic Centre for Marine Research, Greece).

All abstracts of MERCES symposium are accessible in the Conference book available online at https://ser2019.org/.

Further information

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Restoration of fish nursery functions with artificial habitats

Lecaillon G. - Ecocean

The Biohut's latest advancements

Biohut is a small artificial habitat that reproduces fish nursery functions for port and coastal infrastructures (Figure 1). Since the confirmation of Biohut's ecological functions in Mediterranean waters with the <u>GIREL</u> and <u>NAPPEX</u> projects (MERCES Newsletter 04, May 2018), more than 3000 Biohuts have been installed, thus creating a network of 27 French marinas equipped with Biohut (between 20 to 90 units per marina), along with commercial ports such as Calais, Port-Vendres and Rotterdam.

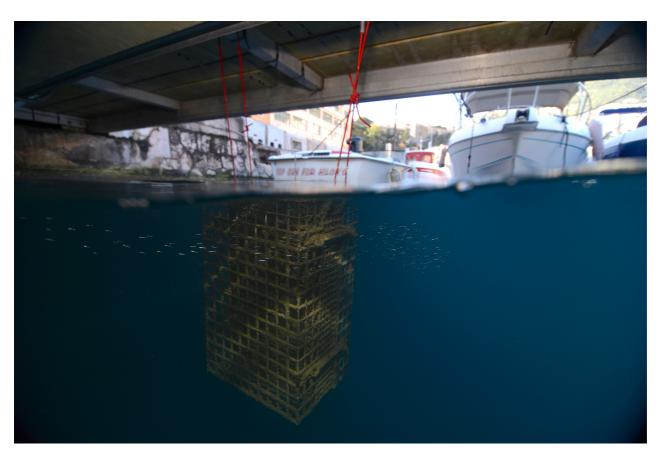


Figure 1. Pontoon Biohut immersed in a marina. Port Hercule, Monaco, ©Rémy Dubas/Ecocean.





Figure 2. Juvenile dusky grouper (*Epinephelus marginatus*) hiding among the shell substrate of a Biohut. 50mm, La Ciotat, France, ©Rémy Dubas/Ecocean.

The Biohut habitats are monitored 2 or 3 times per year to analyse their colonisation by fish and mobile invertebrates. Analysis of the Biohut monitoring data has improved our understanding of several aspects of the Biohut's functions. We recorded the presence of juveniles of several patrimonial species in the Biohut nurseries, such as dusky grouper (Figure 2), royal grouper, cod, European eel and seahorses. In total, 105 different fish species have been observed in the Biohut, most of which present in their juvenile stage. The Biohut is colonised mainly by juvenile fish by which to enhance their survival, although this efficacy can vary among species (Figure 3).

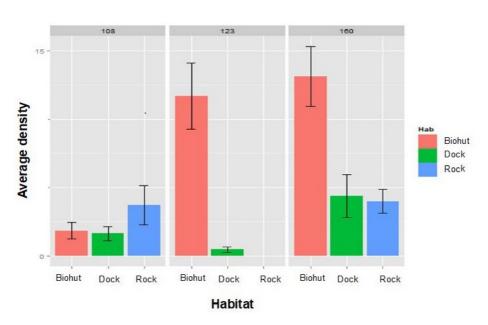


Figure 3. Average and standard deviation of individuals abundance, all species combined, per habitat and monitoring action, in 3 different areas of Marseille Commercial Port.

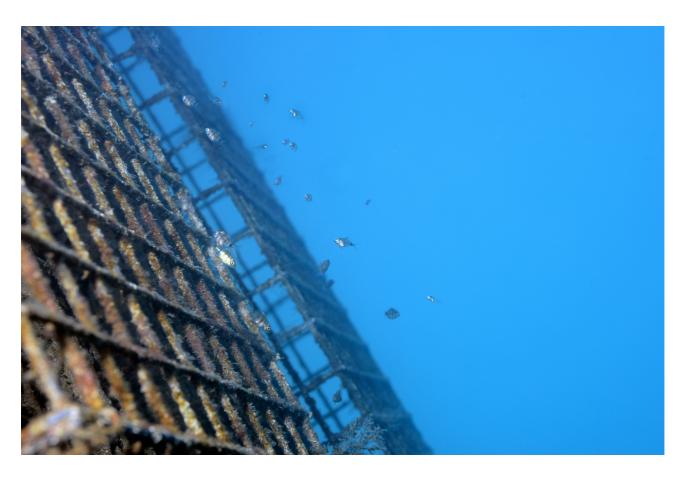
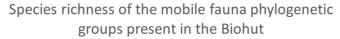


Figure 4. Juvenile seabream (*Diplodus* spp.) feeding and sheltering on a Biohut mesh. 20mm, ©Rémy Dubas/Ecocean.

Some species can benefit greatly from such artificial habitats. Juveniles of species such as Annular seabream, which normally rely exclusively on seagrass meadows as nurseries, were observed in large numbers in the Biohut (Figure 4). Studies have also shown that there are no significant differences in the physical condition and growth of demersal juvenile fish growing in ports and those growing in natural environments.

Ecocean and its partners have started to study the different assemblages of invertebrate species found in the Biohut. New monitoring protocols have since been developed. A scientific publication from the University of Exeter characterises the assemblages of invertebrate mobile fauna in the Biohut and the dependence of their evolution on immersion time. More than 170 species of invertebrate organisms have been observed in Mediterranean Biohut systems (Figure 5).



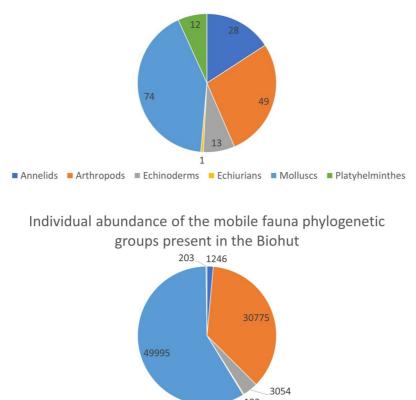


Figure 5. Summary of repartition of species richness and abundance of the different invertebrate taxonomic groups in the Biohut installed in the Mediterranean.

■ Annelids ■ Arthropods ■ Echinoderms ■ Echiurians ■ Molluscs ■ Platyhelminthes

To broaden the spatial application of the Biohut, Ecocean had the opportunity to install Biohut in the port of Helsingør in Denmark. This allowed us to analyse the behaviour of different local fish communities. The density and species richness of fish in Helsingør exceeded that in the Mediterranean, with up to 90 juvenile fish representing 11 species occurring simultaneously in a single Biohut. Many North Sea fish species, such as cod, saithe and pollack, were observed feeding and sheltering in the Biohut.

As an exciting development with huge commercial potential, Ecocean will be the first to install artificial habitats on floating offshore wind turbines. Ecocean is involved in the on-going EFGL (Floating wind turbines of the Gulf of the Lion) consortium that will deploy three 10-MW floating turbines in the Gulf of the Lion (Leucate) in 2021. To better determine habitat shapes, materials and optimum fixation, Ecocean has developed a 15m buoy equipped with different types of Biohut (Figure 6) in order to adapt to the biodiversity that will settle on a floating structure. Installed in mid-2019, 16 km offshore at 70 m depth, the buoy is being monitored by the University of Perpignan using visual census and acoustic monitoring.

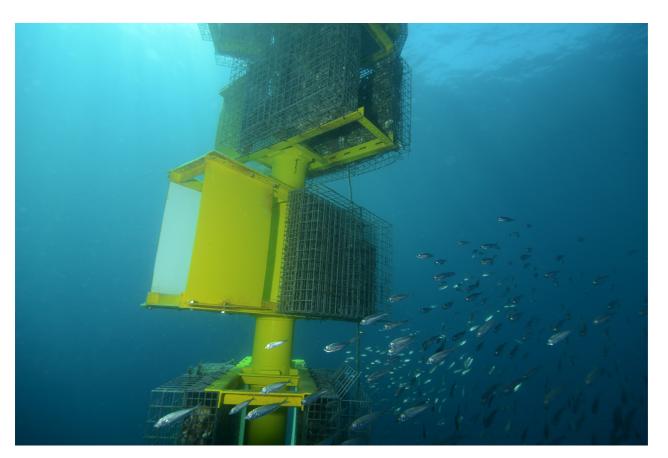


Figure 6. Biodiversity observation Buoy (BoB) aims to study fish and invertebrate colonisation in offshore conditions, ©Rémy Dubas/Ecocean.

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Further information

Further information about Biohut® projects around the world (including pictures and videos): www.nappex.fr.

General information about Ecocean: <u>www.ecocean.fr</u>. Gilles Lecaillon (<u>gilles.lecaillon@ecocean.fr</u>).



The search for effective nature-based restoration solutions that work

Didderen K. - Bureau Waardenburg, BESE; van der Heide T. - Royal Netherlands Institute for Sea Research

To test the applicability of biodegradable matrix structures for ecosystem restoration, an international consortium consisting of developers, scientists, manufacturers and end users investigated the efficiency of the BESE elements to restore e.g. peat, saltmarsh, seagrass and shellfish reef habitat across Europe over the past 4 years. The results show that nature-based restoration solutions that mimic properties of existing ecosystems can work effectively if applied at appropriate locations, proper spatial scales and a suitable manner of construction.

Salt marsh and seagrasses - top or bottom

For multiple ecosystems and restoration-needs the matrix structures work well on a small scale. Since we have already conducted pilot experiments for several years, we were able to scale-up, and to study mechanisms behind the success and the limiting factors. For example, in salt marsh restoration we use a 3-layer structure on top of the intertidal mudflat in salt marsh restoration. Experiments demonstrate that salt marsh transplant survival and growth are strongly facilitated in areas with strong waves and mobile sediments by below-ground 3-sheet high BESE units, which simulate sediment stabilising root mats of established vegetation. Moreover, we found that the transplants profit even more from above-ground BESE units that i) simulate wave dampening as is normally provided by larger well-established dense patches of plant stems, and that ii) trap both sediment and plant seeds, which further facilitate salt marsh development. This tremendously increased the survival of out-planted tussocks of Spartina anglica and S. alterniflora and at the same time enhanced natural recruitment of pioneer plant species like Salicornia. We also learned that the outgrowth of S. anglica continues over time and results are often comparable across sites.

The global seagrass experiment, with MERCES partners, included similar experiments on seagrasses across different climate zones (tropical and temperate seagrass). Results are showing that for this habitat below-ground structures, that mimic root mats, facilitated seagrass transplant survival the most, by stabilising the sediment.

From science to practice

We are currently transferring the BESE restoration technique into field applications, for example in re-establishing *Spartina* patches in an estuary with a lack of natural accretion (Figure 7). Furthermore, the structures were applied in a Coastal Defence Scheme in the UK where salt marshes were transplanted (Figure 8). In 2020, we will release an implementation guide for restoration practitioners that will show the best practises for individual ecosystems. At the same time, we have new pilot studies across the world testing applicability in restoration of e.g. shellfish reefs (Figure 9) mangroves (Figure 10), riverbanks, and dune vegetation.



Figure 7. Spartina anglica surviving and producing seeds in structures, but not in controls (Texel and Zeeland, Netherlands).



Figure 8. Coastal Defence Scheme in Portsmouth, UK (ESCP) where structures are used to aid salt marsh transplants.



Figure 9. Shellfish reef habitat trial in Pumicestone Passage, Australia (link to https://www.youtube.com/watch?v=N1ZKITKE7SA&t=720s).





Figure 10. Mangrove pilot. Members of Bunya Bunya Country Aboriginal Corporation, Australia, planting mangrove seedlings inside the BESE structures (https://takeactionpumicestonepassage.com.au/project/project-one/).

Learning from failures

As with all innovations, learning from failures is accelerating the learning-curve. We found that at exposed intertidal locations with very harsh conditions due to strong waves and mobile sediments, it is difficult to really kick-start restoration, even with BESE-elements. Although the structure is quite strong and was able to withstand several hurricanes in the USA, it failed to work for restoration in those locations. At the same time, when conditions are benign, a technical solution to stimulate plant or reef growth may be unnecessary. We now conclude that it is in intermediate exposure situations where BESE proves most valuable to increase restoration success.

From science to business

Apart from the scientific results, we celebrated some business successes. In 2019 we were able to commence a start-up company BESE Ecosystem Restoration Products (https://www.bese-products.com/). The goal is to aid restoration of ecosystems worldwide through knowledge transfer and the application of new innovative technical solutions and to achieve successful restoration without the use of permanent artificial materials such as plastic. We now have 50 projects on 4 continents in 11 ecosystems, some through the MERCES network. We learned that the challenge to help nature restoration with the help of nature itself is a way forward that will pay off. BESE director Wouter Lengkeek "Our inspiration when working with our "restoration-building-blocks"? Engaging people. A great way of reaching the restoration goal, generating new ideas and transfer knowledge all at the same time."

Initiative

The BESE-elements have been developed by Bureau Waardenburg, NIOZ, Radboud University of Nijmegen, Enexio and Rodenburg Biopolymers.

Further information

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Photo credits: NIOZ, Bureau Waardenburg, Healthy Land and Water, Ocean Rovers, Havant Borough Council.



The Solent Oyster Restoration Project

Kean-Hammerson J. - Blue Marine Foundation (BLUE)

The Solent Oyster Restoration Project is a collaborative project, led by the Blue Marine Foundation (BLUE), that is working to restore oyster populations to England's south coast through a combination of innovative restoration techniques (https://www.bluemarinefoundation.com/projects/solent/). The long-term vision is to see a healthy, self-sustaining oyster population contributing to improved biodiversity and water quality and benefitting the local community.

The study site

The Solent, a 20-mile strait that separates mainland England from the Isle of Wight, once had the largest native oyster - European flat oyster (Ostrea edulis) fishery in Europe. In 1978, 450 vessels were involved in oyster fishing and 15 million oysters were harvested in that year alone. However, since this peak, the oyster population has declined significantly and in 2013 the fishery collapsed. Today, the entire native oyster fishery remains closed with oyster numbers alarmingly low. The area also faces several other challenges such as pollution and introduction of invasive species that are threatening local biodiversity.

Why is oyster restoration important?

Oyster restoration provides a great opportunity to address a number of the issues facing the Solent. Oysters feed by filtering the water and a single adult can process up to 200-liters of water every day. Large populations of oyster can contribute to improved water quality and clarity by removing suspended sediments and pollutants preventing toxic algal blooms and reducing the impacts of nitrates. Increasing the denitrifying potential of the Solent's habitats could be a remedy to the severely eutrophic waters off the Hampshire coast. Oyster reef habitats across the world are known to be highly productive ecosystems. When left undisturbed they create three-dimensional ecosystems that act as nursery grounds and a refuge for many species, boosting both finfish and shellfish stocks.









Figure 12. Broodstock cages ready to be deployed beneath

marina pontoons.

Figure 11. A fully

grown native oyster.





What has been done?

The Solent Oyster Restoration Project has been operating since 2015 and has employed a number of restoration techniques to bolster local populations. Working with the University of Portsmouth, the project has developed novel restoration aquaculture cages. These cages are designed to keep oysters at high density, so they breed and pump out larvae into the Solent. MDL Marina group have partnered with BLUE on this initiative and have suspended cages from pontoons at eight of their marinas. Since the project started, 23,000 oysters have been restored in these cages. These have been a success, with over one billion larvae being released in a single year. The oyster cages have also attracted a wealth of biodiversity, with over 100 species inhabiting the cages or on the oysters themselves.

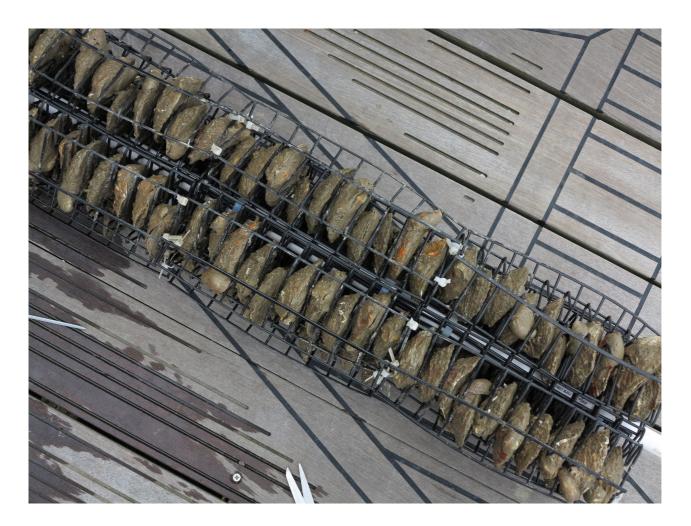


Figure 13. Oysters housed in innovative microreefs.

The larvae from these cages settle on the seabed, where BLUE has been running small scale restoration trials. A total of 45,000 oysters reared on oyster farms have been re-seeded over 2 acres of protected seabed. Pilot studies have been testing the ideal density and location of restoration and results have been encouraging, with oyster survival higher than expected. Plans to scale up restoration in 2020 are underway. In order to facilitate large-scale restoration, BLUE and the University of Portsmouth are working together to set up the UK's first restoration native oyster hatchery. If successful, the hatchery will produce millions of 'spat-on-shell' native oysters, which will be reseeded directly from the hatchery to restoration sites.



Figure 14. School students learn about the benefits of oysters.

The partnership

Our partners include the University of Portsmouth, University of Southampton, MDL Marinas, Southern Inshore Fisheries and Conservation Authority, 1851 Trust, and the Hampshire and Isle of Wight Wildlife Trust.

Other projects supported by the Blue Marine Foundation (BLUE)

Outside of the Solent, BLUE work with the Essex Native Oyster Restoration Initiative (ENORI), where significant strides have been taken in the restoration of these historic oyster beds (see MERCES Newsletter No 2). Over 300 cubic meters of shell and aggregates, also known as 'cultch', has been laid to promote oyster settlement, covering of 1200m² of seabed. This is now being monitored for oyster recruitment, growth and survival.

BLUE is also working to restore other important marine habitats. In Sussex, BLUE is working with partners including the local Wildlife Trust to pioneer the UK's first Kelp restoration project. This project has been encouraged by the recent vote by the Sussex IFCA to remove trawling from 302 km² of their district. The bylaw will now go to the Environment Secretary for approval.

Further information

Solent Oyster Restoration Project visit https://www.bluemarinefoundation.com/ projects/solent/, Twitter: @SolentNative, Instagram: @SolentOyster.

Jacob Kean-Hammerson (jacob@bluemarinefoundation.com).

Creating wetland habitat to deal with impacts of climate change – 5 years on

Laver A. - Steart Marshes Reserve Office, Wildfowl and Wetlands Trust (WWT)

The Wildfowl and Wetlands Trust (WWT) Steart Marshes is one of the largest managed coastal realignments in the UK. It is recognised as one of the best examples of design and engineering for wetland habitat creation with multiple benefits including flood defence. Research since the Steart Marshes Reserve was created in 2014 is providing not only invaluable data to inform the future design and management of newly created wetlands but also evidence of the multiple benefits to be realised from wetland restoration.



Figure 15. The Steart Marshes Reserve in September 2018 (WWT Sam Stafford). Below Pennyroyal and Sea Aster in freshwater marsh (WWT Ronan Conn).

Restoring biodiversity

In the winter of 2018-19, 53 species of waterfowl were surveyed totalling 29,309 individuals, including nationally important numbers of avocet, dunlin, golden plover, lapwing and shelduck. This is considerably more than the 49 species and 18,900 individuals recorded in 2015-16, indicating a growth in numbers of wildfowl using the maturing habitat. The extensively grazed saltmarsh is important for breeding skylark and within an area of saline lagoons a population of 31 breeding pairs of avocet now occur.

Vegetation surveys across the developing saltmarsh site show a shift from species-poor grassland towards saltmarsh and swamp communities reflecting changes in hydrology and salinity and the application of management measures. Rapid colonisation of saltmarsh plants has taken place with 17 species recorded, including sea lavender, a species rare in coastal realignment sites, and the nationally scarce sea barley. These species, closely associated with Atlantic Saltmarsh habitat-type, reflects the success of the project in the passive restoration of saltmarsh species.



Figure 16. Dunlin at high tide (WWT Joe Cockram).



The freshwater area also merits recognition as a Priority Site of National Importance for its dragonfly assemblage. A minimum of 9 bat species have been recorded regularly in the reserve, and moth surveys discovered the nationally-scarce Crescent Striped Moth. Twenty-four species of butterfly have been recorded and ditch surveys have found 33 beetle species including the near-threatened great silver water beetle.

Natural wealth of wetlands

Saltmarshes provide ideal feeding and breeding grounds for commercially important species of fish. Surveys at the Steart Marshes have recorded common eel, flounder and sea bass in the Reserve. Comparative topographical surveys have enabled cumulative sedimentation to be measured and converted into carbon accumulation rates. Preliminary findings have found that the amount of sediment deposited and the amount of carbon buried are substantial (publications in preparation).

The Reserve's agricultural management plan as part of a viable farm business is providing opportunities for the production of high-end food products such as saltmarsh beef and lamb. The experience of managing both farm business and biodiversity conservation are being used to model longer-term sustainable adaptation to climate change.

Numerous health and well-being benefits are being realised. A network of disability accessible paths is being used by a wide range of visitors. In addition, the WWT is encouraging volunteers with physical and mental health conditions to work and benefit from the wetland environment.

The WWT strives to inspire people to value healthy wetlands through The WWT's work in conserving, restoring and creating wetlands around the world. WWT Steart Marshes offers opportunities to reach new audiences and demonstrate the services that wetlands can deliver.

The Natural Capital for the Reserve has been valued as around £43.8M/yr and with additional data collection a more accurate valuation is expected over time giving a glimpse of the potential value of investing in wetlands.

The WWT seeks to demonstrate practical and achievable solutions, engage people directly with wetland nature, encourage wider action for wetlands and use knowledge to influence national and international wetland policies. WWT Steart Marshes is a perfect example of what can be achieved through concerted action between different arms of Government to bring about real change.





Figure 17. Traditional Longhorn cattle used for grazing marsh and a volunteer undertaking practical work (WWT Sam Stafford).

Further information

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https://www.wwt.org.uk/wetland-centres/steart-marshes ttps://www.wwt.org.uk/our-work/projects/steart-marshes/ https://en-gb.facebook.com/wwtsteartmarshes/

Why is there so little policy support for reusing oil and gas installations as reefs in the North Sea?

Ounanian K., van Tatenhove J., Ramírez-Monsalve P. – Centre for Blue Governance, University of Aarlborg

Why is there so little policy support for reusing oil and gas installations as reefs in the North Sea? MERCES researchers, Kristen Ounanian, Jan van Tatenhove and Paulina Ramírez-Monsalve answer this intriguing question in their open access paper, "Midnight in the oasis: does restoration change the rigs-to-reefs debate in the North Sea?", published in the Journal of Environmental Policy & Planning. This article is one of the outputs of the governance and legal work package in the MERCES project.

Many oil and gas fields in the North Sea will soon reach the end of their productivity; their associated structures will be decommissioned. Decommissioning is the abandonment, disposal and removal of equipment and installations used in offshore industries, such as oil and gas. Decommissioning will remain an important issue in the near and far future in the North Sea, because not only will offshore oil and gas installations reach the end of their productivity, in fifty years structures related to wind farms will also face decommissioning. A decision (98/3) of the Regional Sea Convention for the North-East Atlantic (OSPAR) prescribes removal of all disused offshore structures as the only acceptable decommissioning option. This policy is the legacy of the 1995 Brent Spar incident. Shell wanted to dispose of the offshore oil storage buoy (Brent Spar) in the North Sea, which was fiercely opposed by Greenpeace, fuelling the dominant discourse of "Hands off the Oceans". The main storyline of this discourse is that there should be nothing dumped into the oceans and that abandoned or disused installations and platforms should be dismantled onshore. This discourse - or mental frame - was institutionalised in the OSPAR's decommissioning decision.

Nonetheless, in the past years, environmental management at sea has evolved from a conservation and protection paradiam to one advocating restoration. This paradigm shift could favour the "Rigs as Restoration" discourse, in which the conversion of rigs and platforms into artificial reefs, the Rigs-to-Reefs (RtR), becomes a new decommissioning option. The article poses the question whether the emerging restoration discourse related to decommissioning in the form of RtR is capable of changing the dominant 'Hands off the oceans' discourse? The analysis described the emerging 'RtR as Restoration' discourse, as four different storylines; cost-savings; the rigs as habitats for (threatened) species; oases in the desert, and RtR as de facto Marine Protected Areas. However, given the present, fragmented nature of this discourse, and the counter-arguments voiced, it is not expected that the 'RtR as Restoration' discourse will challenge the dominant 'Hands off the Oceans' discourse, nor will it open a debate on OSPAR's decommissioning decision in the near future. However, the development of wind farms and the EU Biodiversity Strategy could result in a reframing of the restoration discourse and in the end put decommissioning as RtR conversion on OSPAR's agenda again.

Further information

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What is causing restoration of habitats in Europe to fail or succeed?

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The aim of this work has been to analyse the recovery efficiency and potential of different habitats across Europe. Altogether 128 sites distributed across 12 European countries were studied, including seagrass meadows, macroalgae beds, seamounts (with different coral species), coralligenous assemblages and kelp forests (Laminaria hyperborea and Saccharina latissima). For each site, the habitat size and degree of patchiness were recorded and integrated in GIS together with the modelled environmental conditions, disturbances and overlap of areas of management interest.

As of September 2019, 44% of the selected case study sites were restored successfully. Overall results showed that seamounts had the highest success rate (75%), followed by coralligenous assemblages (58%), macroalgae beds (45%), seagrass meadows (34%) and kelp forests (25%).

The greatest variation among sites was highly related to habitat type and region, which means that habitat- and region-specific restoration protocols are needed if we are to succeed. The duration of the restoration work has a positive impact on the restoration success, which highlights the need for long-term projects to support the restoration process. The time needed for restoration projects is a challenge and it might take from several years to decades before the success of the restoration methods can be evaluated. This requires substantial funding and, particularly in deep-sea habitats, high-technology (and expensive) equipment.

Distance to main ports had a notable impact on restoration success. This result indicate that anthropogenic disturbance and pressure decrease the potential for restoration success and suggest that baseline human disturbances around restoration sites should be considered when planning restoration activities.

Although the restoration of degraded ecosystems may be expensive and a lengthy process, "working with nature" and using ecological engineering approaches may provide cost-effective solutions. The restoration sector is accumulating expertise gradually, but knowledge, technologies and capacity need to grow rapidly (and to be shared) if restoration actions are to achieve their potential.





Figure 18. Pictures of the focal habitats in this study. A: seagrass meadow (Zostera marina), B: kelp forest (Laminaria hyperborea), C: macroalgae bed (Treptacantha elegans), D: coralligenous assemblage, and E: seamount with octocorals (Callogorgia verticillata, Acanthogorgia sp. and Dentomuricea). Photos by Christoffer Boström (A), Janne K. Gitmark (B), Alba Medrano (C), Cristina Linares (D), and EMEPC, ROV Luso (EMEPC/Luso/Açores/2009) (E).

Further information

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An expert judgement on habitat features and their effect on the restoration potential of marine habitats in Europe

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One of the aims of MERCES WP1 has been to collect the existing knowledge on the key processes and habitat features that allow for recovery after disturbance. A total of 25 experts representing 11 European countries (Figure 19, group photo), from Norway and Finland in the north to Greece and Turkey in the south, were part of a workshop to discuss this topic, covering key habitats found within the Mediterranean Sea, the Baltic Sea, and the NE Atlantic Ocean.

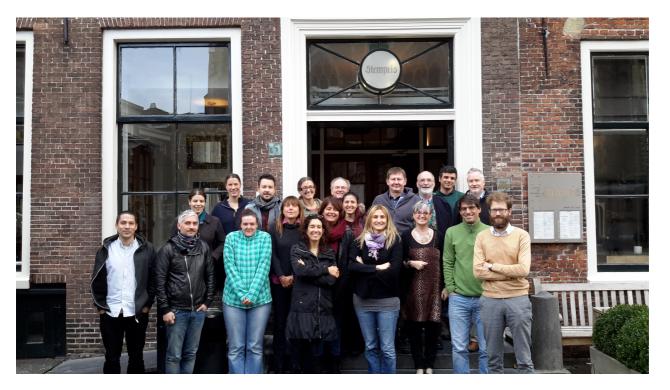


Figure 19. Group photo of the experts from the different European countries at the workshop in Haarlem, Netherlands, 16-17. November 2016.





Figure 20.

Laminaria

hyperborea kelp
forest at the west
coast of Norway
seen from above
the water surface.
Photo: Trine

Bekkby, NIVA

A set of biological and ecological features (i.e. life-history traits, population connectivity, spatial distribution, structural complexity and the potential for regime shifts) was identified for five key marine habitats in Europe known to be important ecosystem engineers and ecosystem service providers: seagrass meadows, kelp forests (Figure 20), Cystoseira macroalgal beds, coralligenous assemblages and cold-water coral habitats. The agreed on features and characteristics were based on knowledge from both past and ongoing restoration efforts within the European seas.

Following the discussions, each feature was assessed further in terms of its relevance to recovery potential, in general and for each habitat individually. The result was a consensual judgement (a "scoring", see Table 1) of the different biological and ecological features according to their contribution to the successful accomplishment of habitat restoration. Results are published in Frontiers in Marine Science.

	Habitat features					s
Habitat		Life history	Population connectivity	Spatial distribution	Structural complexity	Regime shifts
Seagrass m	Seagrass meadows		5(1)	2	5	Prone to regime shifts
Kelp forests		5	5	5	5	Prone to regime shifts
Cystoseira macroalgal	(shallow, i.e. 0-10 m)	4	3	4	5	Prone to regime shifts
beds	(deeper, i.e. 10-50 m)	3	2	2	5	Prone to regime shifts
Coralligenous assemblages		2	1	1	5	Likely but unclear
Cold-water coral habitats		1	1	1	5	Unclear

Table 1. The agreed-on expert "scoring" of the habitat features according to their contribution to the successful accomplishment of habitat restoration; 1 – low contribution, 5 – high contribution.

The expert group concluded that most of the kelp forests features facilitate successful restoration, whereas the features for the coralligenous assemblages and the cold-water coral habitat did not promote successful restoration. For the other habitats the conclusions were much more variable. Seagrass meadows are difficult to score when it comes to life history, as the life history of the different seagrass species may lead to both restoration failure and success. Also, some seagrass populations have extremely low connectivity (leading to the score 1 in brackets). Shallow *Cystoseira* macroalgal beds have a different community and different life history traits than deeper beds, and scores are therefore given separately.

The lack of knowledge and uncertainties of the relationship between acting pressures and resulting changes in the ecological state of habitats and the habitats' features is a major challenge for implementing restoration actions. However, this work provides some best practice guidelines to overcome potential constraints and improve restoration success. Even though habitat restoration is much more complicated than that which has been discussed in this work (for example with species and area specificities), it is hoped that our discussions and recommendations will be useful when designing and executing future marine restoration.

Further information

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Habitat restoration and ecosystem services

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Marine ecosystems are an invaluable resource for society. They provide homes for nature, regulate our climate, and attract tourists from around the world. No less than 206 million people live along the European coastline, 7 million people have jobs connected to the sea and 485 billion Euro is generated from maritime activities.

Unfortunately, European marine and coastal ecosystems are being lost and degraded at an alarming rate through human activities. These include over-exploitation, pollution, the introduction of invasive species and loss of habitat. Marine habitats also face a range of other threats: the sea level is rising, the ocean is becoming more acidic and the sea surface temperature in Europe is increasing even faster than the global average.



Figure 21. Soft bottom habitat and rocky macroalgae seabed in Nordland, northern Norway. Photo: Trine Bekkby, NIVA.

People all over the world are recognising the urgent need to conserve and protect these valuable habitats. Agreements at the national, regional and global level have set goals and targets to restore degraded ecosystems.

In the MERCES project we looked into the drivers of restoration success and failures, linked this to effects further up the food web and assessed how all this impacts ecosystem services. A total of 128 case studies from 12 European countries were included, covering both soft and rocky seabed and shallow and deep areas.

Results from these studies indicate that the habitats are under a lot of pressure and that the level of anthropogenic disturbances needs to be considered when planning restoration activities. It is also important that plans for restoration are specific for each habitat and region, due to differential responses of different habitat-forming species, and that enough time is set aside for restoration in order to succeed (see "What is causing restoration of habitats in Europe to fail or succeed?" in this newsletter). Human pressures on marine ecosystems are expected to increase considerably in the next few decades, leading to a loss of marine biodiversity and degradation of ecosystem functioning.

All habitats selected for restoration in MERCES are important engineers, creating three-dimensional structures that provide important ecosystem services. Ecosystem service restoration needs to be assessed to identify policy recommendations, including identification of ecological bottlenecks, thresholds for effective ecosystem service restoration and upscaling to the correct management level. Currently, ecosystem service restoration is often not routinely studied or included as a criterion of success when planning or executing restoration projects. This offers an area for further discussions within MERCES and the restoration sector in general. Our study assessed this issue by various modelling tools capable of reproducing links between habitat structure, functioning and ecosystem services (see "From restoration of habitat-forming species to recovery of marine ecosystem services: progress and challenges" in this newsletter).

Further information

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Assessing the effectiveness of restoration actions for Bryozoans: the case of the Mediterranean *Pentapora fascialis*

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Ecological restoration in overlooked benthic species

Ecological restoration is increasingly implemented worldwide to protect and recover ecosystems that have been degraded, damaged or destroyed. Traditionally, most conservation efforts in marine systems have focused on the creation of marine protected areas. However, rapid rates of ecosystem degradation highlight the need to apply and develop active management actions together with the establishment of protected areas to conserve and manage biodiversity. Restoration efforts in marine ecosystems have focused on charismatic taxa, such as corals and seagrasses, overlooking other groups, such as bryozoans. Bryozoans are one of the most abundant and common structural groups in marine benthic ecosystems distributed worldwide. Due to their rigid skeleton, they are considered habitat-forming species, which increases ecosystem complexity and provide shelter for other species. Moreover, due to their fragility, some species have been used as ecological indicators for anthropogenic threats, such as recreational diving. However, there is a lack of knowledge of many ecological aspects of bryozoans, and the effects of restoration action on these aspects have not been explored previously. Within MERCES project, we have developed for first time effective protocols to restore these abundant organisms

Restoration techniques tested

Our study was carried out within the Marine Protected Area of the Montgrí, Medes Islands and Baix Ter Natural Park in the north-western Mediterranean Sea. Restoration actions were focused on *Pentapora fascialis* (Pallas, 1766) (Figure 22A), a common and dominant Mediterranean bryozoan in rocky benthic communities. We tested two types of previously restoration methodologies applied effectively to restore other benthic species: the installation of different types of surfaces to enhance the recruitment of the target species (Figure 22) and the transplantation of adult colonies through a study of the best methodology for adult transplantation.

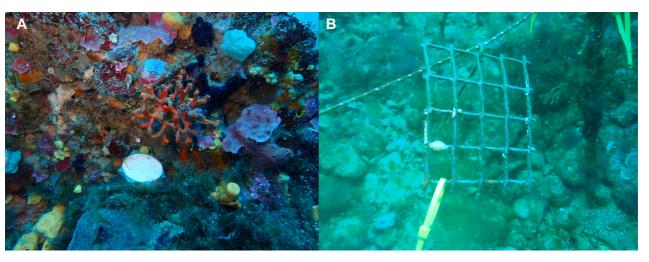


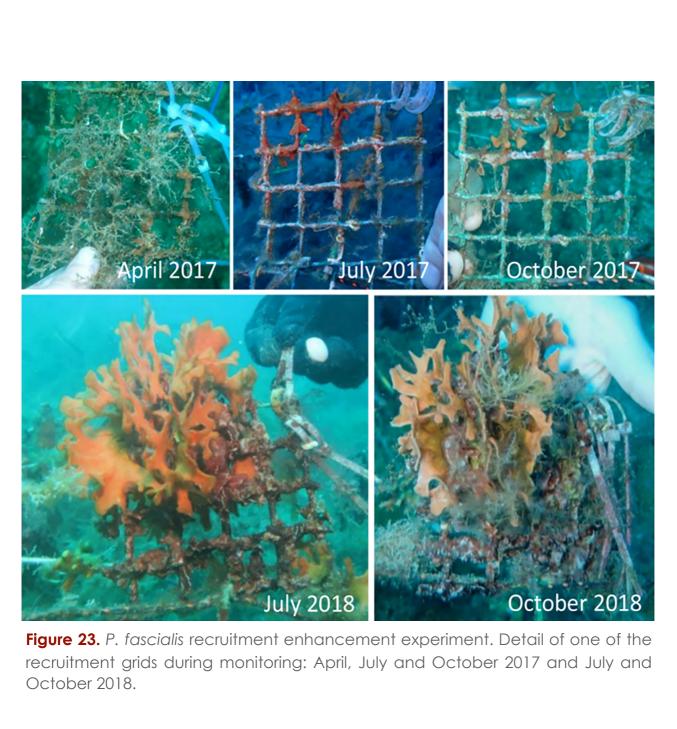
Figure 22. Types of recruitment surfaces for the enhancement of the recruitment of *P. fascialis*: A) 5x5 cm plain-surface natural rock/stone plates B) Structural 10x10 cm plastic grids.

Plastic grids offer the best recruitment surfaces to enhance the recruitment of *P. fascialis*

The recruitment and growth of *P. fascialis* was high in the experimental conditions highlighting the capacity of bryozoans to recover after perturbations. Structural plastic grids were the best recruitment surfaces to enhance the recruitment of *P. fascialis* (Figure 23). By contrast, we did not observe any recruitment on plain-surface settlement plates. This is in agreement with the globular shape and vertical growth of *P. fascialis*, which prefers to settle in complex interstices of substrates, rather than on flat surfaces.

The best technique for adult transplantation

The best technique to transplant adult colonies was to attach the colony to a plastic screw on the boat (ex situ) using a nylon thread and then attach the screw to the substrate with epoxy (Figure 24E). Due to the fragility of the calcified *P. fascialis* skeleton, higher survival rates were reached when the colonies were manipulated on the boat where the manipulation could be done more carefully and precisely. By contrast, underwater manipulation resulted much lower survival rates of the colonies. Moreover, we transplanted adult colonies collected from a ghost fishing net trapped on the bottom and six months later their survival rate was at 50%, which is similar to successful transplantation actions of other benthic groups.



Conclusions

Recruitment enhancement is the most effective restoration technique for the studied bryozoan species as it offers a non-invasive methodology and yields high recruitment and growth rates. By contrast, adult transplantation should be considered only in cases such as the detection of lost fishing nets detached at the bottom with epibiotic bryozoans. Despite the high economic costs of restoring marine habitats, our study represents a low-cost and low-tech approximation, encouraging non-scientists and managers of marine protected areas to implement these techniques at larger scales.



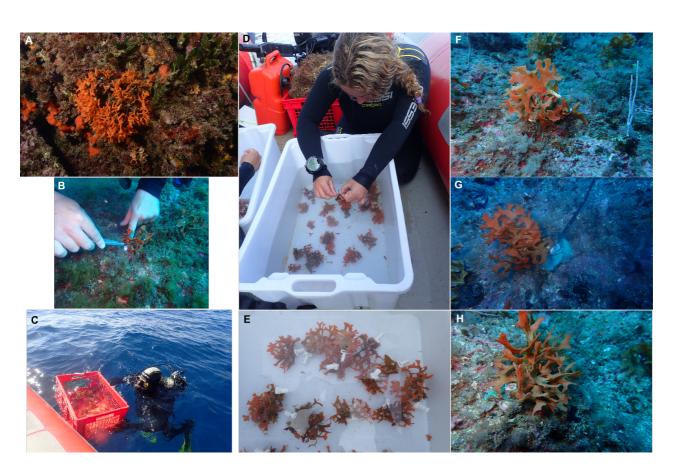


Figure 24. Pilot action to find the best methodology for adult transplantation *P. fascialis* colonies. A) Restoration area; B) Manipulation of the colonies *in situ*; C) Transport of adult colonies from the sea bottom to the boat to tying ex *situ* the colonies to the plastic screws; D) Methodology of manually tying the colonies to the plastic screws on the boat; E) Colonies attached do the plastic screws on the boat; F) Colony attached directly to the bottom using two-component epoxy putty; G) Colony attached to the bottom using a flange and plastic screw; and H) Colony attached to the bottom using a nylon thread and plastic screw.

Further information

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From restoration of habitat-forming species to recovery of marine ecosystem services: progress and challenges

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Coastal areas host habitat-forming species (such as corals, seagrasses, kelp and algae beds) that can play essential ecological roles as primary producers, nursery areas, refuge habitats and foraging grounds. When these habitat-forming species degrade, these roles diminish or can even disappear. To date the influence of restoration of habitat-forming species on the whole marine ecosystem is only poorly known.

We applied state-of-the-art (Ecopath with Ecosim and Ecospace) food web modelling tools in data-rich case studies to assess the impact that restoration of habitat-forming species may have on ecosystem functioning and structure, and ultimately, on ecosystems services. Food web models allow considering species abundance and biomass, production and consumption, density-dependencies and species interactions, and are useful to study complex ecological interactions within an ecosystem context and its reactions to changes in external stressors.

Here, we focussed on three case studies following a latitudinal gradient and targeting different habitat-forming species: (i) Coastal areas of the NW Mediterranean Sea, which included seagrass meadows and coralligenous habitats inside marine protected areas; (ii) Seagrass meadows in the Wadden Sea, which focussed on the effect of a large-scale seagrass recovery event, and (iii) the deep-sea Arctic in Norway, focussing on a deep-sea ecosystem with dependencies from coastal adjacent ecosystems due to important kelp detritus imports.

Our results show that habitat-forming species in these case studies play important ecological roles. These roles are not only related to their importance as primary producers and direct involvement in prey-predation interactions, but also to the positive indirect ecological relationships (e.g. mediation) that they establish with other species. The loss of these ecological roles can have large effects on biodiversity and productivity of marine ecosystems, which are translated into losses of key services to humans such as food provision, carbon sequestration and touristic attractiveness. Consequently, the conservation and recovery of these species is essential to maintain and bring back key processes that are involved in the functioning of marine ecosystems, and in key ecosystem services provided to humans.

We identified that there is a general lack of knowledge about the shape and strength of the ecological relationships between distribution, abundance and complexity of main habitat-forming species and of related species using the habitat directly or indirectly. This main challenge is the "Achilles heel" of such an analysis. Thus, improving our knowledge on the relationship between habitat-forming species and associated fauna is crucial to move forward our knowledge about the potential contribution of marine ecosystems recovery to key ecosystem services.

Seagrass as key habitat-forming species

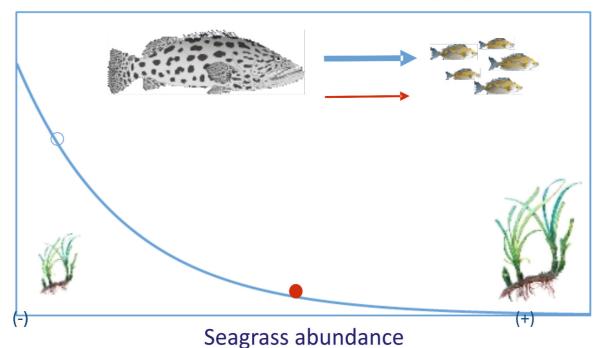


Figure 25. An example of a positive ecological relationship (e.g. mediation) between seagrass and the vulnerability of a prey to its predator. The blue dot represents a situation where seagrass abundance is low, and thus the vulnerability of a prey to a predator is high (the prey does not find places to hide). The red dot represents a situation where seagrass abundance is high, and the vulnerability of the prey to the predator is low (the prey is able to hide between the seagrass).

Further information

Prey vulnerability

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Recovery of mangrove ecosystem carbon stocks in abandoned shrimp ponds

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Mangrove forests are highly effective carbon sinks that contribute disproportionately to the global carbon budget. Also known as 'blue carbon' ecosystems, these habitats contain particularly large amounts of organic carbon in their sediments, accumulated over very long timescales (centuries to millennia). They also provide numerous social and environmental benefits to coastal communities. Many of these benefits are crucial for climate adaptation and resilience, such as erosion control, stabilising sediments, and coastal protection against storms, ocean waves and sea level rise. Yet mangrove forests are also among the world's most threatened ecosystems due to anthropogenic stressors. Since around the 1940s, it is estimated that up to 50% of mangroves have been destroyed globally, representing a major loss of natural CO₂ sink capacity.

Shrimp aquaculture is one such land-use change substantially driving global mangrove loss. This problem has been particularly acute in Thailand, where extensive areas of mangrove were replaced with aquaculture ponds during the 1980s–2000s. Mangrove cover was reduced from 370,000 ha in 1961 to 167,500 ha in 1996, around half of which was due to aquaculture.

Many of the shrimp ponds created in Thailand during the 1980s–2000s have proved unsustainable due to disease outbreaks and up to 70% are now thought to be abandoned. While research documenting mangrove carbon stock losses due to land-use change has been steadily growing over the past half-decade, little attention has been paid to understanding the fate and stability of the remaining carbon pools (previously sequestered and stored carbon) following pond abandonment.

To address this knowledge gap, in a recent open access paper, Elwin et al. (2019) quantified ecosystem carbon stocks of a mangrove forest and 12 abandoned shrimp ponds, which were formally mangrove forest, on an island situated on Thailand's southern Andaman Sea coast (Koh Klang; 7.78° N, 99.08° E). The authors assessed ecosystem carbon stocks using biometric and soil coring methods along transects to determine aboveground (tree) and belowground (root + soil) carbon pools. Using a 22-year chrono-sequence approach, the study aimed to assess whether, and at what rate, carbon stocks were recovering after ponds had been abandoned. Abandoned ponds of different ages (10–22 years) were compared with natural reference mangrove sites.



In addition, abandoned ponds under Ecological Mangrove Restoration (EMR) projects were sampled in order to examine the impact of rehabilitation of abandoned shrimp ponds on ecosystem carbon stocks.



Figure 26. Mangrove forest on Thailand's Southern Andaman Sea coast (photo credit: Angie Elwin).



The study shows that shrimp aquaculture results in a huge loss of carbon, with up to 65% of soil carbon and up to 70% of ecosystem carbon lost when mangroves are converted for aquaculture. However, this study demonstrates that carbon is preserved in deeper soil layers of some abandoned ponds, and that carbon accumulates in the surface soil layer after pond abandonment. Along the studied chrono-sequence of abandoned pond sites, the authors found the effect of land-use change on soil carbon pools is most substantial in the near surface soil layer (0–15 cm depth). They also found a positive developmental trajectory for carbon pools in the upper soil layer, which they associate with natural mangrove regeneration. The findings indicate that as mangrove trees colonise abandoned ponds, they contribute to the soil carbon building process.

The work demonstrates that the carbon sequestration capacity of mangrove forests may improve in abandoned shrimp ponds over time in areas exposed to tidal flushing as mangroves re-establish. Further, that the carbon stored in the surface soils of ponds may be comparable to natural mangrove forests 22 years after ponds are abandoned.

Further information

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Flat oyster aquaculture and restoration in offshore environments

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The flat oyster (Ostrea edulis) is indigenous to Europe and once formed large reefs spreading out along almost all European coastlines. For centuries, these oysters supported flourishing ecosystems and supported oyster fishery. Roman literature describes the collection of oyster spat (attached juveniles) from rocks and grow-out in ponds. Unfortunately, multiple factors, such as overfishing since the 18th century, cold winters in the 1960s and outbreaks of disease (e.g. Bonamia) in the 1980s devastated wild oyster reefs resulting in collapse of the stock. This, in turn, made both harvesting of wild stocks and aquaculture of O. edulis impossible in the most traditional rearing areas. Recently, renewed interest in the flat oyster has boosted the number of restoration and aquaculture projects throughout Europe.

In recent years several policy measures have opened possibilities for restoration of flat oyster reefs. The Belgian marine spatial plan 2020-2026 excluded bottom fishery from large areas assigned to offshore energy generation. Some of these areas overlap with the historical distribution of flat oyster reefs and are already protected under the Natura 2000. Additionally, the Belgian state aims to restore the gravel beds, the historical habitat for flat oysters, framed within the Belgian implementation of the Marine Strategy.

Even though natural colonisation of substrate by flat oyster is preferred, introducing juveniles or adults can facilitate the restoration process, thereby increasing restoration success. The presence of a reproductive oyster population is therefore a condition sine qua non. There are only a few wild live specimens in the Belgian part of the North Sea and the larval presence can be increased by culturing flat oyster though restoration projects.

Within the H2020 project on 'Multi-use platforms and co-location pilots boosting cost-effective, eco-friendly and sustainable production in marine environments', UNITED, five multi-use pilot demonstrators will provide evidence that the development of multi-use platforms or co-location of different activities in a marine and ocean space is a viable approach for oyster restoration. The Belgian pilot demonstrator aims at boosting reef creation through native oyster aquaculture in the offshore wind farms. Viable aquaculture systems will be developed for oyster cultivation in high energy offshore environments while scouring protection material, used to stabilise wind turbine pillars or underwater cable crossing, will be upgraded to support larval settlement and reef building.

An important output of this project will be the development of modelling tools for restoration. A metabolic growth model for flat oyster will be coupled with a population model and a larvae distribution model. These tools will allow evaluation of shellfish restoration scenarios.

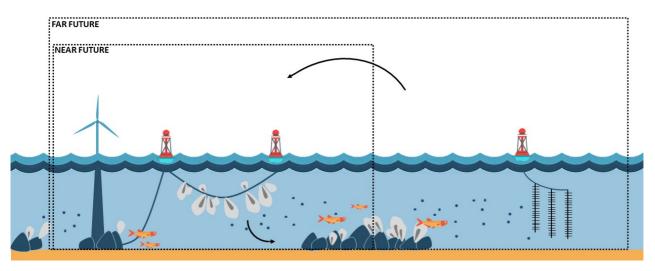


Figure 27. An illustrative overview of the Belgian pilot demonstrator within the H2020 UNITED project.

Further information

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Is there economic value from tourism for coral reef restoration?

Billett D. - Deep Seas Environmental Solutions Ltd

In September 2018, fourteen serving heads of government joined together to form the High Level Panel for a Sustainable Ocean Economy (HLP) (https://www.oceanpanel.org/). The HLP has commissioned a number of 'Blue Papers' summarising solutions for the sustainable development of ocean economies. One of these papers, published in 2019, "The Expected Impacts of Climate Change on the Ocean Economy" addresses how aspects of 'blue' economies in marine fisheries, aquaculture and reef tourism may change in relation to climate change in years to come.

Marine and coastal tourism was the second-largest ocean-related economic sector in 2010, second only to offshore oil and gas. Ocean tourism includes beach tourism, recreational fishing, swimming, snorkelling, sports diving, whale watching, and cruises. The collective direct value of ocean tourism is estimated to be \$390 billion (2010) of which some \$36 billion (annually) is related to coral reef tourism. Ocean tourism is projected to be the most important marine industry by 2030. In terms of employment, marine and coastal tourism is second only to the collective marine fisheries, aquaculture and food processing sector. Coral reef tourism is a major source of income in many coastal developing nations and island states. In the Maldives, Palau, Bonaire, the Turks and Caicos Islands, and the British Virgin Islands, coral reefs support over one third of all tourism value and 10% or more of the entire GDP.

Understanding the full value of coral reefs to tourism provides an important incentive for sustainable reef management. Two different benefits from reef tourism can be identified: i) local "reef-adjacent" value (such as the provision of sandy beaches, sheltered water, food, and attractive views) and ii) "on-reef" value (in-water activities such as diving and snorkelling directly related to the coral reefs). Maps of value assigned to specific coral reef locations around the world show considerable spatial variability across distances of just a few kilometres. Some 30% of the world's reefs are of value in the tourism sector, providing 9% of all coastal tourism value in the world's coral reef countries.

Periods of extremely high ocean temperatures, stimulating coral bleaching events, are expected to increase in frequency, intensity, duration and spatial extent. This will reduce coral-associated fish diversity and numbers with a negative impact on visitors' perceptions and therefore cause economic losses. Ocean warming may also affect other major draws for tourism such as whales, sharks and turtles.



Climate change will produce significant economic losses from tourism for many developing nations. It is estimated that a decline in coral cover by 1% through climate impacts decreases direct coral on-reef tourism value by 3.8%. The projected economic losses, however, can also provide an indication of the gains which might be made by restoring healthy coral reef ecosystems. So restoring coral reef ecosystems could, in some cases, increase direct on-reef economic benefits by comparable amounts. In addition, there will be indirect benefits from coral reef restoration for fisheries, off-reef tourism and storm/erosion protection.

Coastal tourism in the vicinity of coral reefs is not always benign: negative impacts can be created by diving and snorkelling and poorly planned coastal development, such as dredging, building on intertidal spaces and increasing pollution. Tourism, however, may be a less significant threat than, say, fishing, land-based run-off or coral bleaching, and may even help to reduce some threats, notably over-fishing, by offering financial or social incentives for sustainable management. Many visitors to coral reefs already have heightened environmental awareness and reef visitation can both help to fund and to encourage coral reef conservation and restoration e.g. building artificial reefs for sports diving and coastal erosion management. The perception of reef proximity, even for non-reef users, may be an important draw.

The benefits of tourism to local economies, and the use of financial contributions from tourists for conservation and restoration, are not restricted to coral reefs. Tourism may provide a high-value, low-impact use of mangrove forests as mangrove tourism attracts tens to hundreds of millions of visitors annually and is a multi-billion dollar industry.



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The value of marine ecosystem restoration - Financing coastal resilience by combining nature-based risk reduction with insurance

Billett D. - Deep Seas Environmental Solutions Ltd

The ecosystem service values provided by nature to protect real estate and human lives in coastal areas are frequently ignored. Likewise, the value in restoring ecosystems and their services are often overlooked; projects are not instigated because of lack of funding. In a recent paper Reguero et al. (2020) examine ways in which ecosystem restoration costs in the coastal zone are related to reducing the risks from storms, erosion and flooding and the savings to be made in insurance costs. The authors come from an interesting mix of backgrounds in nature conservation, marine science, reinsurance and international development.

The paper notes that "Pre-hazard mitigation is cost effective, but both the public and private sector struggle to finance up-front investments in it." The authors observe that risk transfer (insurance) and risk reduction (hazard reduction) are often decoupled in disaster risk management. By aligning environmental and risk management goals, ways of financing nature-based solutions for coastal protection could be generated by public and private partnerships. In particular, the authors analysed how the hypothetical restoration of coral reefs might relate to reductions in insurance, although they note that the work could be applied to a wide variety of nature-based restoration and risk reduction projects in the coastal zone, such as for salt marshes, mangrove forests, seagrass meadows and oyster reefs.

Developing countries will be disproportionally the most affected and vulnerable to increased coastal erosion and flooding hazards caused by climate change. There is an urgent need for small island states and low lying coastal areas to adapt to and manage these coastal risks. At present a large proportion of the losses which occur are uninsured and "many governments and public utilities are overexposed and underinsured against these risks". One problem is finding the funding for mitigation measures while natural catastrophe losses mount up producing, according to the World Bank, a growing global protection gap, particularly for tropical coastal nations.



In their cost-benefit analysis Reguero et al. (2020) conclude that "Under conservative assumptions, 44% of the initial reef restoration costs would be covered just by insurance premium reductions in the first 5 years, with benefits amounting >6 times the total costs over 25 years." This demonstrates that 'resilience insurance solutions' have the potential to scale up investments in marine ecosystem restoration by overcoming trade offs between spending on hazard mitigation or insurance. "Savings in insurance premiums can ... be seen as a resilience dividend." "There are likely many coastlines where reef restoration costs could be fully covered by premium reductions".

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On the valuation of coastal restoration in the UK

Tich R. - Iodine SPRL

Cost-benefit estimates of natural capital

The Natural Capital Committee has reported evidence on the economic case for investment to protect and improve natural capital in England (https://www.gov.uk/government/publications/natural-capital-committee-research-investing-in-natural-capital). The research aimed to identify a set of ambitious natural capital protection and improvement investments that are likely to be most beneficial to society, and an economic case for why they should be undertaken. There are of course many possible reasons for protecting and improving natural environments: the use of economic evidence is not intended to replace but rather to complement alternative arguments.

Ten broad investment options were identified. An example of one, saltmarsh restoration, was explicitly focused on coastal restoration (Investments in demersal fisheries, and in shellfisheries, were also identified as potential priorities). The evaluated/suggested option was restoration of 22,000ha of saltmarsh, representing a 54% increase in the total resource. This is primarily land that is already susceptible to flooding/sea-level rise, but to manage the realignment of defences and ensure creation of sustainable saltmarsh habitats would require five times more managed realignment activity each year to 2030, realigning approximately 450km overall. The costs of this realignment and re-engineering of retreated embankments was estimated at £1.7bn. However, the benefits were estimated at £2.4bn (present value over 50 years). These include avoided flood defence costs of £285m, carbon sequestration of around £1bn, and habitat value of around £1.1bn. That habitat value includes ecosystem services of flood control, non-consumptive recreation, amenity and aesthetic services, and biodiversity protection.



These cost and benefit estimates illustrate the broad alternative approaches to estimating values:

- Costs per ha were estimated based on actual cost data and areas of habitat created from average outcomes/predictions for recent UK managed realignment projects, leading to an estimate of £50,000/ha
- Avoided costs of flood defence are based on assumptions about reduced expenditures due to new structures being protected by the saltmarsh, again based on existing scheme evidence and estimated as ongoing savings of £33;000/year for every km of realigned coast
- Ecosystem service increases are valued using value transfer from a meta-analysis function (Brander et al 2008; EEA 2010). This provides a bundled value controlling for various characteristics (wetland type and size, population, income, source study features and so on). Meta-analysis allows statistical estimation of values based on a rich evidence base, using dummy variables to control which ecosystem services are included in the valuation. The central predicted value here was £1,343 per ha per year for new saltmarsh.
- Carbon sequestration is valued separately using estimated rates of sequestration per ha per year, valued using official UK government figures for non-traded carbon sequestration. These values are not based directly on damage estimates, but rather on the abatement costs implied by the carbon emission targets to which the UK is committed.

Adding this all together, the study estimated a net present value of £1.2bn over 50 years: benefits of £2.9bn minus costs of £1.7bn, giving a benefit: cost ratio of 1.7, suggesting this would be a rather beneficial use of public funds.

Corporate natural capital accounting

Natural capital accounting brings environmental and economic data together to answer several key questions in an organised format. The balance sheet, and changes to it over time, give a picture of the benefits natural capital assets provide and how sustainably they are being managed. This is generally envisaged at a national level, but is increasingly common at the organisational level, with accounts developed for specific landholdings and companies.



	Answer these questions to	generate these accounting outputs
1	What natural capital assets does the organisation own, manage, or depend on?	Natural Capital Asset Register records the stock of natural capital assets (their extent, condition and spatial configuration). These indicators help determine the health of natural capital assets and their capacity to provide benefits.
2	What flows of benefits do the assets produce, for the organisation and for wider society?	Physical Flow Accounts quantify the benefits the assets deliver in physical terms. The changes in the quantity / quality of the assets and their benefit provision over time are also shown. The provision can change due to maintenance activities or external providers outside the control of the organisation.
3	What is the value of the benefits and to whom do they accrue?	Monetary Flow Accounts estimate the economic value of the benefits in monetary terms and discounts the projected future flow of these benefits to provide the present value (PV) for the assets. This uses data from actual markets and other (non-market) values. There are physical and monetary sub-accounts for each of the main benefits evaluated.
4	What does it cost to maintain the assets and benefit flows?	Natural Capital Maintenance Cost Account details the costs of management activities required to sustain the capacity of the natural capital assets to provide benefits over the long term.
5	What's the net impact of the business on natural capital?	Natural Capital Balance Sheet compares the present value (PV) of asset benefits to the PV of maintenance costs. Where understanding and evidence allow, calculation of assets and liabilities take account of expected changes to future costs and benefits of management, and external factors such as population growth or climate change.
6	How is the impact changing over time?	Statement of Changes in Natural Capital Value shows the difference from the previous balance sheet in terms of changes to the quality, quantity or value of the assets and liabilities.

Table 2. Key questions and natural capital accounting outputs for assessing and monitoring natural capital assets and their management over time.

Natural capital accounting brings environmental and economic data together to answer several key questions in an organised format (Table 2). The balance sheet, and changes to it over time, give a picture of the benefits natural capital assets provide and how sustainably they are being managed. This is generally envisaged at a national level, but is increasingly common at the organisational level, with accounts developed for specific landholdings and companies.

Uses and attitudes to the use of valuation evidence

In neoclassical economics, 'total economic value' (TEV) represents all the ways that goods and services influence individual utility. This is revealed through the decisions or preferences of individuals, acting under their budget constraints, and expressed as their 'willingness to pay' (WTP). At a societal level, TEV represents the aggregate of these individual values, either as a simple sum or using weighting criteria, in particular to reflect income/wealth distributions and the diminishing marginal utility of income. For a particular ecosystem or natural 'asset', TEV can be thought of as the sum of all the ways the ecosystem functions, ecosystem services and goods influence the utility of individual humans, as reflected by their WTP values. Integrating over time, using discounting to convert future values to present day equivalents, gives the net present value of these flows. Assuming calculable risk about future flows, these values are generally expressed as expected values, and cost-benefit analysis (CBA) compares the expected values of different courses of action. Other treatments and decision rules may also be used, for example to implement some degree of risk-aversion in the calculations.

If nothing else, this provides a useful framework for thinking about ways that humans might value aspects of nature. Although the framework is grounded in individual preferences, it nevertheless provides space both for non-selfish preferences (non-use values: existence, altruistic, bequest) and also for uncertainty about future preferences and uses (option and insurance values). In a similar way, the ecosystem services framework, often combined with the TEV framework, provides a useful checklist of ways in which natural systems provide benefits to humans. These values and benefits are not an exhaustive representation of natural values, but rather provide a minimum set of things to consider.

Further information

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Algal Forest Restoration In the MEDiterranean Sea (AFRIMED)

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AFRIMED (Algal Forest Restoration In the MEDiterranean Sea) (http://www.afrimed-project.eu/) (2019-2022) is a project funded by the European Maritime and Fisheries Fund. AFRIMED has just concluded its first year, and held its first annual meeting in Marrakesh, Morocco, from 17th to 19th February 2020 (Figure 28). AFRIMED aims to preserve 'natural capital' by developing new ecosystem restoration techniques for damaged and degraded macroalgal forests in the Mediterranean Sea while supporting sustainable blue growth development.



Figure 28. First Annual Meeting held in Marrakesh, Morocco, from the 17th to the 19th of February 2020.

The main AFRIMED actions for 2020 include:

- Determining the locations of present and past Cystoseira macroalgal forests and those sites most important for restoration: historical and current data of Cystoseira spp. distribution along Mediterranean coasts have been merged after months of mapping activities (Figure 29). Critical anthropogenic and ecological factors of species degradation have been assessed. The resulting information and maps will be used to identify priority areas in need of restoration across the region. At the same time, because climatic change is expected to impact the distribution and health of the different Cystoseira spp., mesocosm experiments have been carried out to determine the vulnerability and tolerance of specific biological traits of each species to drivers of environmental change across the Mediterranean basin.
- Undertaking hands-on training and pilot actions in key countries bordering the Mediterranean Sea: following months of preparations, AFRIMED will coordinate concrete pilot actions of active restoration (e.g. the planting of juveniles raised in the laboratories) at 8 or 9 study sites, identified during the first annual meeting, in different settings and MPAs. In this regard, the partners from EU, Albania, Morocco and Tunisia will attend a specialised technical workshop in Menorca in April-May 2020 in order to develop and adopt common protocols for each site. Information concerning progress in the fieldwork and restoration actions at each site will be shared on AFRIMED social media (AFRIMED_eu on Facebook and Twitter).
- Ecosystem Services: Macroalgal forests are important in supporting biodiversity and food webs in the coastal zone. Their loss is leading to a decrease in critical ecosystem services, such as fisheries nursery grounds, and a reduction in the capacity of the oceans to sequester carbon dioxide and help mitigate climate change. Consequently, in-depth discussions were held at the Annual Meeting (Figure 30) to address 1) the diversity of ecosystem services offered by Cystoseira at various scales (e.g. site level depending on settings to local and/or higher levels), 2) suitable indicators of success of the restoration actions and 3) ways to quantify changes in ecosystem services that arise through restoration interventions. This will allow the cost-effectiveness of each restoration intervention to be determined.





Figure 29. Mapping activities in Sazan Karaburuni MPA, Albania.



Figure 30. Discussions on ecosystem services and stakeholder involvement.



- Stakeholders: Despite the best efforts to conserve and sustainably manage marine ecosystems in the Mediterranean Sea, attempts to mitigate human threats and to halt biodiversity loss and habitat degradation are generally proving to be inadequate. This is particularly true in coastal habitats, where the effects of multiple stressors are causing widespread loss of critical coastal habitats. Moreover, as the development of the blue economy sectors accelerates across Europe, it is vital that the resilience of marine and coastal ecosystems is maintained and restored in order to allow economic growth to be achieved in a sustainable manner. The needs of decision-makers and managers, the opportunities provided by private companies and scientific knowledge are strictly interconnected to reach these objectives. Therefore, AFRIMED is engaging with stakeholders to develop a shared vision of the restoration of marine forests and promote the multitude of benefits it provides. This will help develop and implement relevant strategies/initiatives, create "buy-in" from local communities, develop partnerships and prepare the ground for future investments in marine coastal restoration. Actions include the creation of a "business club" for sharing opportunities and building consensus for the restoration actions and holding dedicated information sharing events. In this regard, profiting from the experience gained in MERCES and the strong collaboration between the two projects, the AFRIMED Business Club (BC) is already open (http://www.afrimed-project.eu/? page id=1599) and the first representatives of the business sector have been engaged. AFRIMED and its BC aims will be presented at the European Maritime Day 2020 (14-15 May 2020, Cork, Ireland) during the Workshop 'Innovative EMFF projects' organised by the European Commission's EASME (https://ec.europa.eu/ maritimeaffairs/maritimeday/en/workshops).
- Stakeholder survey: AFRIMED is conducting a survey of stakeholder expectations from a restoration project (https://forms.gle/8QVTfMQYntCsYoGp7). The results of the survey will be presented during a symposium dedicated to marine ecosystem restoration at the next European Conference of the Society for Ecological Restoration SERE2020 (https://sere2020.org/) to be held in Alicante (Spain) between 31st August-4th September 2020.

Further information

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"The science we need for the ocean we want": The role of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) in promoting Marine Ecological Restoration

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State of the world's marine environment and the imperative for ecological restoration

Today's ocean is a troubled ocean, particularly the coastal zone. Many species and the livelihoods of millions of people are under threat from habitat destruction and biodiversity loss, marine and land-based pollution, unsustainable fishing, and climate change. The ocean is experiencing increasing cumulative impacts of multiple pressures. Restoring and protecting oceans and coasts can contribute significantly to strengthening the resilience and adaptive capacity of both natural and human systems to climate change and other threats.



Figure 31. Restoring marine ecosystem services by restoring coral reefs to meet a changing climate future. Source: https://www.adaptation-undp.org/projects/ Mauritius-Seychelles-Marine-AF.

The hope of science: Marine Ecological Restoration as a harbinger for meeting SDG14 targets

'Ecological Restoration' attempts to return a degraded ecosystem to its historical pristine state. However, ecosystems are always in a state of flux, and so restoration aims to reinstate natural ecological progression (Society for Ecological Restoration, 2019). The concept of Ecological Restoration has gained prominence in theory and practice in fisheries (Huvenne et al 2016; Williams et al. 2017), coastal land reclamation (Weinstein 2008; Zagas et al. 2010; Bayraktarov et al. 2016; Yannick and Carel 2019), coral reefs (Williams et al. 2017), and even in the deep sea (Van Dover et al. 2014).

New methods are required for accelerating the recovery of ecosystems that have been degraded, damaged, or destroyed in order to meet the UN Sustainable Goal 14 (SDG14) conservation targets. With the advent of the UN Decade of Ocean Science and Sustainable Development, it is argued that embracing and advancing the utility of Marine Ecological Restoration (MER) can help to accelerate marine conservation and protection objectives of the Decade, and propel continued support particularly for SDG14.2 (Protect and restore ecosystems) beyond 2020.

The role of the United Nations Decade of Ocean Science for Sustainable in developing capacities for Marine Ecological Restoration

Transferring scientific advice to political leaders in order to take science-based ocean conservation and protection actions remains elusive. One of the core objectives of the UN Decade of Ocean Science and Sustainable Development is to improve the transfer of scientific knowledge to regions and groups with inadequate capacity and capability, particularly in the Small Island Developing States and the Least Developed Countries. However, capacity building in ecological restoration has been recognised to be an essential component for improving outputs in large-scale restoration efforts (Soto et al. 2017). Therefore, the Decade, in its quest to "mobilise resources and technological innovation in ocean science needed to deliver key societal outcomes", can play a crucial role in building the capacity of scientist, institutions and industries to develop innovative science, techniques and tools to restore degraded marine ecosystem,





Figure 32. A volunteer diver prunes some staghorn coral to be replanted by a group of volunteers during a University of Miami's coral restoration program 'Rescue a Reef' expedition. (Pedro Portal/Miami Herald/TNS via Getty Images).

Specific areas where the Decade can enhance MER capacity at process, tactical and operational levels include:

- The use of genetic tools to modify organisms in a way to enhance their carbon uptake capacity, thereby removing more CO₂ from the atmosphere.
- Resources and technological innovations required to minimise or repair resulting damage to the deep-sea environment from future deep-sea mining.
- Technical and management capacities for the identification of areas requiring restoration and the enforcement of regulations.
- Promotion and support for capacity-building, training and technology transfer for the planning, implementation and monitoring of ecosystem restoration.

- Building of technical and scientific capacity to support the coordination and cooperation between countries on significant transboundary issues.
- Promotion of programs that enhance the understanding, skills and knowledge base of individuals and organisations and that provide a platform for networking and knowledge exchange.
- Facilitation of activities and programs geared at marine stakeholder needs.
- Securing knowledge and applied experience from diverse sources and disciplines.
- Development of skills for selecting appropriate restoration interventions.
- Inclusion of multiple subjects and skill sets (e.g., social, financial, legal, etc.).

These ten elements of capacity development can help to support restoration professionals and other stakeholders to think holistically in time, space and scale - moving from the scale of a specific marine ecosystem or taxa to the ocean-wide scale where diverse stakeholder interests can be addressed, as well as societal trade-offs and socioecological heterogeneity attained for more effective MER practice. A more holistic approach to MER planning and implementation will require the UN Decade of Ocean Science and Sustainable Development to synergize with its sister "UN Decade for Ecosystem Restoration" (2021-2030) in order to effectively accomplish ambitious ocean conservation and protection targets worldwide. Integrated coastal and marine management approaches such as Marine Spatial Planning and Integrated Coastal Zone Management are also veritable in upgrading marine ecosystem restoration, using different socio-ecological-concepts.

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The UN Decade on Ecosystem Restoration: An opportunity for marine and coastal ecosystems

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2020 is being dubbed the 'super year' for nature. It's the year in which we have an unprecedented opportunity to redefine our relationship with the natural environment. Global awareness is increasing on the myriad of challenges that our shared marine environment faces, and coastal communities around the world are increasingly willing to take action to combat the massive ecological degradation that we are witnessing. There has never been a more urgent need to restore damaged ecosystems, and nature-based solutions are being recognised as critical for addressing global development goals and national priorities, from climate change mitigation to food security. Citizens globally are becoming increasingly alarmed by the climatic and environmental changes taking place around them, but action on ecological restoration presents an opportunity to provide a positive response to our collective malaise and to address the UN Sustainable Development Goals.



Figure 33. United Nations Environment Programme Headquarters in Nairobi (photo credit: Gabriel Grimsditch).





Figure 34. Great Barrier Reef (photo credit: The Ocean Agency).

In recognition of this urgency, the United Nations General Assembly in March 2019 proclaimed 2021–2030 as the UN Decade on Ecosystem Restoration (see https://www.decadeonrestoration.org/). From the "super year for nature", we will enter the "decade on ecosystem restoration", and this presents an opportunity for education, awareness-raising and investment in the restoration of marine and coastal ecosystems. The UN Decade on Ecosystem Restoration website points out that "on land, this involves the restoration of at least 350 million hectares of degraded landscapes by 2030, realising up to US\$9 trillion in net benefits and alleviating poverty in many rural communities. A target for coasts and oceans has yet to be set."

Globally we have lost between 19 and 50% of live coral cover, a third of seagrass meadows, a third of mangrove forests, 40% of saltmarshes and up to 85% of oyster reefs since the early 19th century. The potential for ecological restoration in the coastal space is huge and can provide important benefits to people and the environment.

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The IUCN estimates that as much as 812,000 hectares of lost or degraded manarove areas in 106 countries and territories show potential for restoration, with over half a million hectares of these considered to be 'highly restorable'. Restoring mangroves would not only lead to increased carbon sequestration, as mangroves are among the most carbon-rich ecosystems globally, but also to increased fisheries productivity and shoreline protection. Coral reefs are another extremely valuable ecosystem where advances are being made in the ecological restoration space. A UNEP analysis showed that scenarios with healthy coral reefs would deliver additional economic benefits amounting to US\$34.6 billion and US\$36.7 billion between 2017 and 2030 in the Mesoamerica Reef and the Coral Triangle regions, respectively. Urgent action on climate change and a 'decarbonised' global economy are critical for the future survival of coral reefs, coupled with investments in protecting resilient coral reefs from pollution, overfishing and other destructive activities. Increasingly it is also being recognised that active restoration of reefs may need to be part of the solution given the losses of coral witnessed in high value reef sites. Ambitious large-scale restoration techniques using coral larval dispersal are being piloted in the Great Barrier Reef in the wake of back-to-back bleaching events that caused so much mortality in this iconic ecosystem.

Challenges still exist around the cost-efficiency and scalability of many technologies for coastal ecosystem restoration; however, the UN Decade on Ecosystem Restoration provides a great opportunity for governments, the private sector and civil society around the world to catalyse investments and to prioritise the restoration of coastal and marine ecosystems.

Further information

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How river restoration can maintain marine ecosystem components and ensure their sustainable use

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Background

The negative impact of human activities on river environments is indisputable. Dams and other construction, as well as pollution and eutrophication, have deteriorated the hydromorphological conditions and the water quality of many rivers. Migratory fishes use rivers, streams and brooks as spawning and nursery habitats before migrating to the sea. When access to or conditions within these essential habitats are hampered, fish populations suffer and even face extinction.

The Baltic Sea

The long-term neglect of rivers and their fish have destroyed or degraded most of the original salmon and sea trout populations in the Baltic Sea region. In addition to their effects on the ecosystem, these losses also reduce the possibility to use these fish as resources by commercial and recreational fisheries. Swift and effective actions are needed to improve the situation. Healthy fish populations demand free and natural access to suitable spawning and nursery areas. This requirement can be achieved by river restoration. The addition of stones and gravel can help spawning and nursery habitats to recover, while removal of dams or building fish passages will re-establish lost connections between the sea and the riverine spawning sites. When most successful, river restoration not only improves the living conditions of migratory fish but also rehabilitates the entire river ecosystem, with farreaching positive consequences also on the associated marine ecosystem. River restoration is gathering increasing interest and the importance of healthy rivers is starting to be widely acknowledged. However, resources to conduct restoration work are often scarce, making the choice of targets and a wise use of resources important.

The RETROUT project

Within the RETROUT project, fifteen river restoration demonstration cases are being conducted to restore sea trout populations in coastal rivers in Estonia, Lithuania, Latvia, Poland and Sweden (Figure 35). Measures include fishways, biotope restorations, water quality improvement, and dam removal plans. Processes and results from the restoration activity are carefully documented for later evaluation, and to serve as a basis for future river restoration guidelines. In most cases a thorough preparation phase has been completed, and the practical work is ongoing. Restoration measures in Lithuania and Sweden have been finalised and their effect is being monitored.

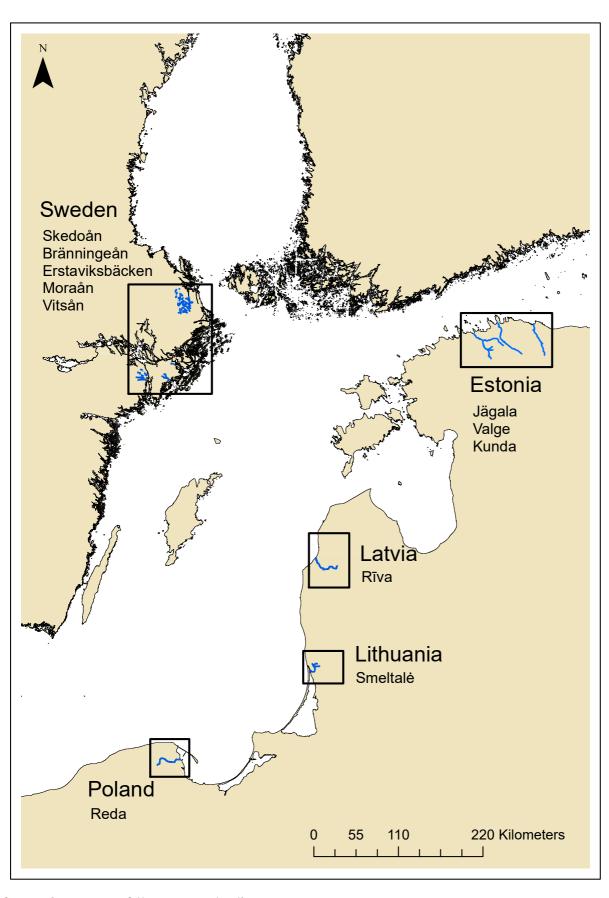


Figure 35. Map of the case studies.



Two case studies

Smeltalė River, Lithuania

The Klaipeda District Municipality Administration held responsibility for the restoration with Klaipeda University providing technical and scientific support. The project consisted of two parts. The first part consisted of recultivation of a surface flow treatment wetland constructed 24 years ago as a system of meandering shallow ponds. Since construction, the wetland system underwent no maintenance and, subsequently, encountered several problems, which were solved within the RETROUT project. This included the removal of excessive sediments from two inactive sedimentation ponds, removing bushes and trees from the area, and restoring artificial weirs between different parts of the wetland. The original purpose of this treatment wetland and recent recultivation of the system is to improve the river conditions through better nutrient retention and an increased self-cleaning capacity of the river.

The second restoration measure was the improvement of trout habitats in Smeltaitė stream, the main tributary of the Smeltalė River. A 500 m section was modified to spawning and juvenile rearing habitats, establishing 550 square meters of new productive river for sea trout (Figure 2). Stones, gravel and logs were added to create three 50 m pool-riffle stretches. According to local experts such habitats are hot spot spawning sites for salmonids and lampreys in lowland streams in Lithuania. The restoration work was finished in September 2019, and two months later all three created spawning habitat sections were used intensively by sea trout. In the rehabilitated river stretches, 13 sea trout nests were built. For comparison, the most productive spawning area in the same stream contained 18 salmonid nests in a similar 500 m section. Also, the largest trout nests (3 x 2.5 m and 4 x 2.5 m) in the Smeltaitė stream were found in the restored area, in very exact locations on microhabitat scale pre-evaluated to be of high priority for sea trout females. One of these sites was constantly occupied for 1.5 months by up to five different trouts, a spawning behaviour which is rather unusual. The success of spawning, and thus the efficiency of the restoration measures, will be monitored by studying emerging trout larvae as well as subsequent juvenile densities, growth and survival.



AFTER BEFORE

Figure 36. Restoration actions in different sections of Smeltalė River, Lithuania.

Bränningeån, Sweden

RETROUT restorations in Sweden focus on improvement of several smaller riverine habitats. The County Administrative Board of Stockholm, municipalities and an angling organisation in the county are responsible for the work. One of the restored rivers is the Bränningeån. Sea trout spawning and rearing habitats were improved in this river in 2018 by adding 280 tons of natural stone, pebbles and tree trunks at three different river sites. Electrofishing for sea trout parr was conducted before and will be done after the restoration, to enable evaluation of success. In another earlier restored section in the same river, parr densities increased from an original of 7.6 to 30.3 individuals/100 m² in subsequent years. Estimates of parr density are not yet available for the current restoration, but ascending sea trout have been sighted in the restored sections, hopefully indicating a similar positive effect on future trout production from the restoration measures.

With 14 partners from Sweden, Estonia, Latvia, Lithuania and Poland, and including HELCOM, RETROUT is a three-year Interreg project running until September 2020. RETROUT is a flagship project of the EU Strategy for the Baltic Sea Region Policy Area Bioeconomy. It is co-financed by the Interreg Baltic Sea Region Programme under the Natural resources priority field.

Part of the RETROUT project focuses on assessing sea trout stock and river habitat status, and on evaluating river restoration practices to improve trout populations. By improving the environment in rivers around the Baltic Sea and developing destinations and ethical guidelines for fishing tourism, RETROUT promotes development of sustainable fishing tourism.

Further information

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http://www.helcom.fi/helcom-at-work/projects/retrout/

http://extra.lansstyrelsen.se/retrout/en/Pages/default.aspx

Results of the ACCOBAMS survey of abundance and distribution of cetaceans in the Black Sea

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On 5-8th November 2019 the Republic of Turkey hosted the Seventh Meeting of the Parties (MoP7) to the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) in Istanbul, during which the results of a comprehensive survey of the abundance and distribution of cetaceans in the Mediterranean Sea and the Black Sea were presented.

The ACCOBAMS Survey Initiative, active since 2017, is based on a report to EC DG MARE (2014) detailing the most appropriate methodology to standardise and harmonise cetacean monitoring protocols.

The Mediterranean campaign was implemented during the summer 2018. Due to challenging circumstances, boat surveys in Syria and Egypt were conducted in 2019.

The Black Sea campaign was implemented during the summer 2019 through the EU project CeNoBS (see https://accobams.org/main-activites/cenobs-project/ for the full title of the project). This project aims to 1) establish a regional monitoring system to determine the distributions and abundances of cetaceans and 2) determine underwater noise level in dedicated locations on the continental shelf of Member States, in order to achieve Good Environmental Status (GES).

In the Black Sea, monitoring efforts were conducted through:

- Aerial surveys of Bulgarian, Georgian, Romanian, Turkish and Ukrainian waters through the CeNoBS project.
- Aerial survey of Russian Federation Waters was conducted through a collaboration with EU-UNDP EMBLAS + project.







Figure 37. A pod of bottlenose dolphins was near the northern pier of the Port of Constanta, Romania. Photo Costin Timofte - Mare Nostrum.

Data were collected on cetaceans, megafauna species (sea turtles, elasmobranchs, fish, birds), smaller species (plankton, jellyfish), and human activities and pressures (marine litter, shipping activities, fishing activities). The data collected under the ACCOBAMS Survey Initiative (ASI) were made available for a wide variety of conservation, management, outreach and capacity building purposes including:

- The ASI data analysis started in 2018 and the first results on distribution and abundance of cetacean were presented at the MoP.
- Implementation of the ASI capacity building component on cetacean monitoring (collection, preparation, use of data) organised 2 regional workshops in 2018 (precampaign phase) and 4 sub-regional workshops in 2019.
- Several communication support, actions and media coverage tools were developed, in particular during the surveys, ASI events and at national levels.
- Presentations of the ASI and its preliminary results were made at several regional meetings/ conferences and events.
- The implementation of a "Feasibility study and experimentation on the use of drones for cetacean monitoring in the ACCOBAMS Agreement area" started in 2019 through a collaboration between the Israel Marine Mammal Research & Assistance Center (IMMRAC) and Murdoch University.
- The ASI data policy and Term of Use were developed to make ASI data available;
- A call for proposals was launched in September 2019 to recruit an expert to conduct a study on 'Developing proposals for long-term funding mechanism(s) for periodic large-scale cetacean monitoring in the ACCOBAMS Area".

The CeNoBs results of the ACCOBAMS Survey Initiative in both the Mediterranean and Black Seas on improving the mapping of Cetacean Critical Habitats will be presented to the 8th ACCOBAMS Meeting of the Parties. The information will be useful in devising measures to restore and improve the resilience of cetacean populations in these seas.

Further information

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