



D8.4: Summary of the engagement with industries and authorities in the MERCES Business Club

Marine Ecosystem Restoration in Changing European Seas MERCES

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1 Summary

The creation of a focused cluster of business, policy, local planning and science interests, embedded within a Horizon 2020 project, has been a successful approach, especially in bringing together many Small to Medium-sized Enterprises across Europe, which otherwise would have little knowledge of each other's activities. Businesses in the MERCES Business Club report a significant change in the last 5 years in tenders for coastal engineering to include elements of marine ecosystem restoration. In addition, there are distinct signs of Blue Growth in the increased turnover and in the number of people employed by companies in marine ecosystem restoration over the same period. The number of companies this has occurred in is limited, but it is clear companies that are more entrepreneurially minded have thrived in their marine ingenuity. Some companies have developed new lines of business that show considerable promise for the future, notably in relation to new wind farms of fixed and floating turbines. By publishing the best case studies in marine ecosystem restoration on the MERCES website the project has made a focal point for European business projects, as seen by the many hits for the MERCES website in search engines. The expansion of the webinar series to engage with all maritime States in the United Nations Environment Programme (UNEP) has broadened the visibility of the MERCES project and of European businesses internationally. The webinar series has proved to be a vital tool in publicising the project. By focusing on issue-led webinars covering business and policy interests, as opposed to just scientific results, has allowed a broad audience to be stimulated and engaged with. Attendance at the webinars has been excellent. The production of business-focused newsletters has allowed industry-specific issues to be put centre stage. At the start of the MERCES project one paper cited in the proposal captured the situation at that time in its title "When will engineers learn ecology and when will ecologists learn engineering?" At the end of the MERCES project it is clear there are growing tenders and projects demanding the combination of engineering and ecological skills, especially in addressing methods of marine ecosystem restoration at the 'industrial scale'.

2 Approach

2.1 General

MERCES Work Package 8 focused its work in three major tasks:

- Task 8.1 - Engage with and promote European businesses online by highlighting 'live' business-led case studies in marine ecosystem restoration.
- Task 8.2 - The publication of an annual business-focused newsletter.
- Task 8.3 - The organisation of issue-led webinars on marine ecosystem restoration.

This report deals with the first task (Task 8.1) on how the MERCES project engaged with industry and promoted expertise by European companies and research institutions, including the MERCES partnership, to the wider world. Other MERCES Work Package 8 Deliverables

describe the work undertaken in the newsletters (MERCES Deliverable D8.2) and in organising the webinars (MERCES Deliverable D8.3). The three tasks were all closely interrelated and cross references to the newsletters and webinars are contained in this report.

2.2 Engage with and promote European businesses: the ‘Business Club’

At the start of the MERCES project, the Work Package 8 team faced a severe challenge in how to stimulate Blue Growth in an industry that was only just being born. A first major task was to learn which industries might have an interest in marine ecosystem restoration. To achieve this, it was decided to form a cluster of like-minded interests in what was termed the MERCES ‘Business Club’. One challenge was to broaden the horizons of companies that could become involved in marine ecosystem restoration. While terrestrial restoration activities have been fairly well advanced for a number of years, there have been very few successful cases of restoration in the marine environment. The MERCES project, therefore, became a trailblazer, perhaps best shown at the 8th World Conference of the Society for Ecological Restoration (SER) in September 2019, attended by over 1000 delegates, when MERCES organised a special symposium on marine ecosystem restoration as part of the Conference; this was the first time that the topic had been considered at the SER World Conferences.

Prior to the MERCES Kick-Off Meeting in June 2016, WP8 co-leaders held Skype video conference calls with other MERCES WP leaders to stress the importance of all MERCES partners contributing to the Blue Growth aims of Horizon 2020. A template was devised to capture the existing links MERCES partners had with industries whose interests included marine ecosystem restoration. The template produced by WP8 offered examples of businesses that might benefit from greater facilitation on topics related to marine ecosystem restoration. This proved to be very useful and a number of MERCES partners (included as co-authors in this report) provided new leads and comprehensive lists of potential Business Club contacts. Several MERCES partners helped to make initial approaches to potential MERCES Business Club members in their own language.

Searches were made for a wide variety of companies that might be interested in future business opportunities in marine ecosystem restoration. Work started by reviewing European companies that were active as part of the World Ocean Council (WOC). DSES attended the industry-led WOC conference on Sustainable Ocean Management during the first 6 months of the MERCES project (Rotterdam, 30 November to 2 December 2016). The conference included elements on how industry could contribute to the UN Sustainable Development Goals. New contacts were made through the European Network of Maritime Clusters (ENMC).

Although it was difficult for the MERCES Business Club to engage with large companies, because of their well-established markets in Europe and overseas, it became apparent that the networking offered by MERCES was of particular interest to Small and Medium Sized Enterprises (SMEs). SMEs do not have large marketing departments. While several SMEs are members of national maritime clusters, such as the Pôle Mer Méditerranée and Pôle Mer Bretagne Atlantique maritime business clusters in France, the clusters in other countries do not generally meet the needs of SMEs because they are focused primarily, or exclusively, on shipping, especially in European countries with less well-developed maritime businesses. The

interests of smaller businesses are often overshadowed by the concerns of large, well established business sectors. The MERCES Business Club, therefore, focused its efforts on marine planning consultants, carbon trading consultants, dredging companies, coastal engineering consultancies, inshore fisheries commissions, regional coastal planning authorities, renewable energy companies, seafood companies, offshore survey and monitoring companies and deep-water oil and gas.

While engaging with businesses, it became apparent at an early stage that some were having difficulty in developing their portfolios because local regulating authorities were unaware of 1) the possibilities offered by marine ecosystem restoration and 2) the economic and environmental health benefits that might accrue restoring the marine environment. The MERCES Business Club, therefore, expanded its remit to include environmental advice bodies to national and local government departments and to engage with European Regional Seas bodies, such as HELCOM, and the United Nations Environment Programme (UNEP).

In order to form a new business cluster in the new topic of marine ecosystem restoration, it was concluded that the only way to get ‘buy in’ to the Business Club was to make individual and personal approaches to named individuals (where possible) in each company. General text for use in different business sectors, such as coastal engineering or environmental management companies, was generated and then personalized for each potential contact using details about the company’s work (as detailed on their websites). This was a labour intensive approach, but one which proved successful, with over 300 companies from all European maritime nations signing up to the MERCES Business Club (see MERCES Deliverable D8.1); a success rate of about 50%. One problem encountered was that at the start of such an innovative project as MERCES, there were very few outputs from the project to refer to, other than the nascent website. This may have influenced the reaction by some companies because they had very little information to make a decision on as to whether to engage with the project.

2.3 Business Club industries

Major industry areas targeted by the MERCES Business Club included:

- coastal zone management
- flood defence, ports and harbours
- civil and coastal engineering
- decommissioning of North Sea oil rigs
- offshore oil and gas
- oil spill response and clean up
- fisheries
- aquaculture
- offshore energy

- organisations promoting ecotourism
- dredging
- deep-sea mining
- shipping
- law partnerships
- suppliers of monitoring technologies and services
- local and regional authorities
- applied research institutions
- regional seas organisations
- government departments for the environment, conservation and nature
- government agencies
- technology transfer offices
- environmental NGOs
- marine environmental consultancies.

There were no withdrawals during the MERCES project from those companies who joined the Business Club, and new members joined the Business Club, particularly following each webinar (see MERCES Deliverable D8.3).

A dedicated email account was set up for the Business Club portal in June 2017 to process all the communications with Business Club members (merces@deepseasolutions.co.uk) (MERCES Milestone MS29).

2.4 Ensuring continued engagement

The search for, and review of, websites relating to marine environmental companies across Europe allowed Work Package 8 to build up a view of the most innovative and successful ecosystem restoration projects in progress at that time. This coincided with the production of the first MERCES business-focused newsletter (MERCES Deliverable D8.2). Companies were invited to submit case studies of their work for the first edition of the newsletter. In order to give greater visibility to the newsletter submissions, they were also promoted as case studies on the MERCES Business Club website. This was accomplished in collaboration with WP9 as part of the formal launch of the MERCES Business Club (MERCES Milestone MS30) (see Business Club Case Studies tab on the MERCES website). The aim was to make the MERCES website a key resource for anyone searching for information on marine ecosystem restoration, and therefore leading people into the work of European companies, research institutions and the MERCES project. The way in which the MERCES website appears prominently in any enquiry

for ‘marine ecosystem restoration’ in on-line search engines in 2020 indicates that this was a successful strategy.

A database was created of all organisations contacted based on individuals and e-mail addresses published on a company’s website. In some cases contact was attempted through online contact forms, but these for the most part had a poor response with very few companies acknowledging receipt of the invitation to interact with the MERCES project. For those contacts who replied positively, a note was made of their business and scientific interests, where appropriate and their role in the company. The list of contacts was used to alert them of webinars and to invite their input to the MERCES newsletters and case studies.

In addition, the contact list was used to further the work of the other MERCES Work Packages where consultation with businesses and policy makers was needed. This included working with 1) HCMR (MERCES Partner 3) to invite anonymous contributions from MERCES Business Club members to the MERCES WP 7 survey (in early 2018) on the social acceptance of ecosystem restoration actions in the marine environment, 2) MERCES WP3 to publicise the training course on ecosystem restoration in the Mediterranean Sea, and 3) alerting the MERCES consortium to funding opportunities in marine ecosystem restoration and courses, such as the Delft University of Technology’s on-line webinars on ‘Building with Nature’. In September through to December 2019 WP8 worked with WP7 to produce a questionnaire for business contacts on attitudes within industry to private finance for marine ecosystem restoration. The questionnaire was sent to a) 112 targeted MERCES Business Club members (a mixture of about 50% companies and 50% scientific policy makers and research institutions), b) attendees at MERCES webinar 2 on *Private Finance in Marine Ecosystem Restoration*, c) companies who had submitted case studies to the MERCES Business Club, and d) 29 selected company and policy attendees at UK Environment Agency meeting on Restoring Estuarine and Coastal Habitats in the NE Atlantic (chosen from a contact list of about 100 attendees at the conference).

3 Interactions with businesses and policy makers

Below we provide short summaries of the different concrete activities undertaken by the Business Club, described in chronological order since the start of the project.

3.1 Restoration and seabed mining

In the first six months, WP8 held a number of business meetings with Equinor (previously known as Statoil), Norway. The outcome was that Equinor provided additional funding to the MERCES project (WP4) by supporting a PhD student, Julien Marticorena, on “*Ecological COConnectivity between active and inactive sites: REcolonization dynamics and Functional links (eCOREF)*”. The project is supervised jointly by Dr Marjolaine Matabos and Dr Jozee Sarrazin (Ifremer - MERCES Partner 6, WP4) and Dr Eva Ramirez Llodra (NIVA- MERCES Partner 17, WP8). The PhD funding led to additional support by Equinor for an eighteen-month post-doctoral study at Ifremer on “*Ecological connectivity and functional links between hydrothermal active and inactive sites in view of potential SMS mining in the deep sea*”. Equinor also

sponsored MERCES Webinar 3 on ‘*Marine Ecosystem Restoration in Deep Waters*’ (MERCES Deliverable D8.3).

3.2 Coastal blue carbon

DSES attended a WP1 meeting in Haarlem, The Netherlands (November 2016) to interact with MERCES participants and develop the new lines of interest for the Business Club. From discussions at the meeting, WP8 broadened its scope for the Business Club to address the benefits of marine ecosystem restoration in carbon storage by salt marshes, seagrass meadows and mangrove forests and the importance of ‘Blue Carbon’ storage to companies advising Governments on carbon trading as well as to insurance companies assessing the risks associated with the trading arrangements.

3.3 Salt marshes and coastal protection

In order to gain direct experience of an active restoration mission, DSES made a site visit (August 2016) to an ongoing project, started in 2014, on the Steart Peninsula, Somerset, UK, where more than 400 hectares of low-lying cattle-grazing farmland had been converted into an intertidal salt marsh. The aim of the project was to use natural methods of flood defence to provide a long-term and cost-effective solution to protecting homes and farming livelihoods, taking into account possible sea level rises of over one metre over the next 100 years. Through a nature-based solution, multiple additional ecosystem benefits, such as for fisheries, carbon storage, water quality, tourism and conservation, were recognised. Following extensive consultation with local communities the UK Environment Agency appointed the Wildfowl and Wetland Trust (WWT) NGO to manage the scheme and achieve the conservation objectives. Businesses were involved from the start of the restoration project with the environmental consultancy ‘CH2M HILL’ advising on how and where to build an intertidal creek system. Van Oord Dredging and Marine Contractors [Van Oord] undertook the engineering work. Monitoring of the salt marsh now includes drones, light detecting and ranging systems (LIDAR) and in situ current meters provided by SMEs.

There is interest in extending the salt marsh area to compensate for loss of salt marsh habitat in the Severn estuary owing to new flood defences, port expansion plans and the creation of new schemes for renewable energy (e.g. tidal barrages). ‘Building with Nature’, sometimes referred to as ‘Nature-Based Solutions’, is a major growth area in marine ecosystem restoration business. DSES wrote an article on the Steart Marshes for the first MERCES Newsletter (November 2016) and the restoration project was featured again in the second and fifth (business-focused) MERCES newsletters in May 2017 and April 2020.

3.4 Oil rig decommissioning

DSES attended a workshop organized by the INSITE North Sea programme at the University of Edinburgh under the auspices of the EU sister project ATLAS (February 2017). INSITE (INfluence of man-made Structures In the Ecosystem) is a major industry-sponsored project providing funding for independent scientific knowledge on the influence of man-made structures (oil rigs and other structures) on ecosystems in the North Sea. An article on the role of man-made structures in enhancing connectivity and the restoration of ecosystems in the North Sea

was provided for the MERCES Newsletter. This theme was picked up by MERCES WP6 (Legal Governance and Policy) in an analysis as to whether the marine ecosystem restoration agenda might start to challenge the prevailing approach to the decommissioning of oil rigs and pipelines in the North Sea, which is to remove the structures and the cuttings piles completely (Ounanian et al., 2019). Many of the subsea structures have been colonised by hard substrate fauna, which have largely disappeared from the region owing to the impacts of extensive bottom trawling. Turning some of the rigs, where appropriate, into reefs to protect the hard substrate fauna might improve the health of the North Sea. Indeed, offshore windfarms within the waters of the Netherlands are placing artificial oyster reefs in and around the turbines for this purpose. The value of industry structures in the ocean has been explored in detail in MERCES WP4 (Restoration of deep-sea habitats) with studies on the faunal colonisation of offshore structures (Gates et al., 2019). This work is influencing international discussions of the ecological issues and offshore structure decommissioning (Fowler et al., 2019). The issue of ‘Rigs to Reefs’ was featured in MERCES Webinar 3 and in the first business-focused newsletter (May 2017). DSES contributed to a paper arising out of the Edinburgh meeting on “Data challenges and opportunities for environmental management of North Sea oil and gas decommissioning in an era of blue growth” published in *Marine Policy* (Murray et al., 2018).

3.5 Restoration and economy

DSES presented the work of the MERCES Business Club at a meeting organized by the Office for Economic Cooperation and Development (OECD) at the Stazione Zoologica, Naples on “*Innovation for a sustainable ocean economy: linking economic potential and marine ecosystem health through innovation*” (October 2017). The meeting included a special session on “*What prospects for a marine ecosystem restoration industry driven by science and innovation?*” DSES made a presentation on “*Marine ecosystem restoration and the economy of the oceans*” and IMAR-Uaz made one on “*Prospects for future deep-sea restoration activities*”. The OECD were enthusiastic about the ideas presented in developing their programme for “The Ocean Economy in 2030”, particularly in relation to the rigs into reefs issue. Owing to Governments having to contribute 50% of the costs of decommissioning offshore structures the issue of rigs to reefs could be of significant economic importance to politicians, businesses and tax payers in Europe over the next 10 years. Other economic benefits from the restoration of salt marshes, seagrass meadows, mangrove forests and coral reefs highlighted in the OECD presentation (carbon trading, fisheries enhancement, flood defence, water purification and sports diving tourism), but also restoration of deep-sea areas, may take longer to be realized.

3.6 Links with national and international organisations

Throughout 2017, NIVA, UTARTU and DSES continued to develop the Business Club links with the International Council for the Exploration of the Seas (ICES), the International Seabed Authority (ISA), the European Joint Programming Initiative – Oceans (JPI-Oceans), OECD and the INTERREG COMPLETE (Baltic Sea invasive species) project on joint policy-business issues. NIVA presented a talk “*MERCES - Marine Ecosystem Restoration in Changing European Seas*” at a seminar organized by the Norwegian Directorate of Environment at the Institute of Marine Research, Flødevigen, Norway (October 2017). Dr Ramirez Llodra followed

up contacts made at the meeting with a number of Norwegian Marine National Parks and the Norwegian Directorate of Environment.

3.7 Coral restoration

In December 2017, DSES, together with other MERCES partners, participated at the European Coral Reef Symposium which included special sessions on 1) the restoration of coral ecosystems and 2) new molecular genetic methods to assist in the recovery and resilience of shallow-water coral reefs. The latter session included talks on the use of ‘assisted evolution’ to improve the thermo-tolerance of zooxanthellae algae associated with corals. This new method may lead to greater resistance of corals to bleaching events caused by climate change and was featured in the second MERCES business-focused newsletter (May 2018). Following the Symposium, new contacts joined the MERCES Business Club and contributed case studies for the MERCES website.

A number of different issues relating to marine ecosystem restoration were highlighted during the European Coral Reef Symposium.

1. While restoration is required for habitats damaged by direct human impacts, restoration actions may be required also to overcome indirect human impacts associated with climate change, such as the effects of Typhoon Haiyan (2013) on mangrove forests in the Philippines and the impacts of increased hurricane activity on Caribbean coral communities.
2. Seaweed farms may have a financial incentive to contribute to the conservation of natural seaweed habitats through ecosystem restoration and the creation of new marine protected areas. This subject was addressed by Wageningen University and Research (WUR) in MERCES on how private finance might be used for the restoration of kelp forest ecosystems (MERCES webinar 2).
3. Destructive fishing practices using explosives are becoming more common in areas which have no long-term tradition of local community resource management. The demand for seafood meals in the western Pacific Ocean is driving unsustainable fishing methods. New management approaches are required involving greater marine ecosystem restoration, funded possibly by the richer nations in the Pacific region which are driving the demand for the seafood.
4. There is greater awareness of the value of ecosystem services and of ‘getting better value’ from coastal ecosystems by calculating the financial values of all ecosystem services to reach good management decisions.
5. There is a need to develop 3D mapping technologies to monitor coral reef ecosystem health and recovery.
6. Restoration methods need to find the right balance between 1) the costly [in terms of person effort and salaries] laboratory rearing of corals and 2) the size at which the corals can be planted out and will survive in the natural environment. Laboratory-based restoration methods also need to ensure that genetic diversity is maintained to increase resilience in natural populations; in some cases laboratory methods are reducing genetic diversity by using too many clones from the same initial coral fragments.

Work by Van Oord Dredging and Marine Contractors, The Netherlands, was presented at the European Coral Reef Symposium on 1) developing mobile containerized laboratory facilities for culturing corals in remote locations in developing countries, capacity building of local communities in ecosystem restoration methods and the ongoing use of the mobile facilities by local communities for long-term ecosystem restoration goals. This work is featured as a case study on the MERCES web site and in MERCES business-focused newsletter 2 (May 2018). In addition to the work by Van Oord, DSES and UTARTU developed case studies with 1) Ecocean, France, on restoring coastal fisheries using artificial reefs in ports, harbours and marinas, and 2) Bureau Waardenburg, The Netherlands, on the use of biodegradable materials for the creation of shellfish reefs and the reinstatement of seagrass meadows.

3.8 Restoration in the Mediterranean

A direct approach was made to the MERCES Business Club by the eco-engineering company Ecocean (France) requesting contact details of MERCES partners and other MERCES Business Club partners who might be interested in joining a consortium developing marine ecosystem restoration solutions in the Mediterranean Sea (with European Commission funding). This demonstrates the value of topic-specific clusters, such as the MERCES Business Club, in putting members in touch with each other to develop new research and opportunities in marine ecosystem restoration (e.g. the first attempt towards the restoration of gorgonian populations on the Mediterranean continental shelf, Montseny et al., 2019).

3.9 Blue Economy and Industry workshop

In March 2018, DSES attended a Blue Economy and Industry Dialogue Workshop organised as part of the Oceanology International Exhibition at the London Excel Centre. The workshop was co-sponsored by the European Commission's Marine Resources Unit (DG-RTD) and the US National Oceanic and Atmospheric Administration (NOAA). The workshop sought to promote greater dialogue between industry and research organisations to inform strategic decisions and investments in scientific research and the blue economy, with a focus on the Atlantic Ocean. The workshop was organised by The Maritime Alliance and the BlueTech Cluster Alliance. The BlueTech Cluster is managed by Marine South East, UK and includes a number of regional business clusters, such as Cornwall Marine Network, Pol Mer Bretagne Atlantique and Forum Oceano. Following the workshop, DSES wrote an article on the aims of the MERCES Project for the Marine South East Cluster e-newsletter to increase the visibility of MERCES project in the business sector.

3.10 Deep-sea mining management

DSES made a presentation on the Environmental Management of the Mid-Atlantic Ridge at an event organized by the Pew Charitable Trusts during the 23rd Session of the International Seabed Authority (ISA), in Kingston, Jamaica (August 2017). The talk detailed the need to include marine ecosystem restoration in the development of new Regulations for the exploitation of deep-sea minerals. To follow up DSES attended an EU H2020 MARINA project workshop (<https://www.marinaproject.eu/>) on '*How responsible research and innovation (RRI) can serve to bridge deep-sea mining, sustainability and policy*'. The workshop was held in Lisbon in May 2018. It generated a 'decision tree' of management actions, based on inputs from a wide variety

of stakeholders, including citizens, scientists, business representatives, entrepreneurs, local authorities and policy makers. The decision tree identified the need for contractors and policy makers to adopt the ‘Mitigation Hierarchy’ for environmental management. The Mitigation Hierarchy includes the consideration of ecosystem restoration as a vital step of management. This was linked to work in WP4 addressing mitigation options, including restoration, for deep-sea mining (Cuvelier et al., 2018; Niner et al., 2018; Van Dover et al. 2017)

Taking the results of this workshop forward, and noting that the International Seabed Authority is in the process of formulating Regulations for the exploitation of deep-sea minerals, DSES in collaboration with WP4 wrote a chapter in a book on ‘*Environmental Management in Deep-Sea Mining*’. At that time, the draft ISA Exploitation Regulations made no specific mention that restoration of deep-sea ecosystems should be considered by contractors when applying for an exploitation contract and when submitting their Environmental Impact Statement. The book was published by Elsevier in 2019. At the 26th Session of the International Seabed Authority (February 2020) it was notable that a reference to ‘restoration (where appropriate)’ had now been included in the draft ISA Regulations and was remarked upon by several of the ISA Council Members during their meetings (Earth Negotiations Bulletin Vol 25 No 221 Page 2, <https://ran-s3.s3.amazonaws.com/isa.org/jm/s3fs-public/files/documents/enb25221e.pdf> (Wednesday 19 February 2020).

3.11 Building with Nature

DSES worked with HCMR in WP1 to review information collected through the MERCES Business Club on marine habitat restoration and ‘Building-with-Nature’ coastal zone projects, contributing a section in MERCES Deliverable D1.3 (State of the knowledge on marine habitat restoration and literature review on the economic cost and benefits of marine and coastal ecosystem service restoration) and a subsequent publication in *Marine Policy*.

3.12 High-level meetings

As part of joint work between WP8 and WP4, IMAR-UAz gave a presentation on “*Towards the integration of deep-sea ‘restoration agenda’ into policy objectives*” at a joint MERCES/ATLAS/SponGES side event during a high-level ministerial and scientific event “A New Era of Blue Enlightenment” held in Lisbon, July 2017. The event launched a new European Union–Brazil–South Africa partnership in the Atlantic Ocean. Similarly HCMR made a poster presentation “*Key concepts for ecological restoration in the deep-sea*” at the SER-Europe 2018 Conference on ‘Restoration in the Era of Climate Change’ in Reykjavik, Iceland (September 2018). MERCES project partners were the sole contributors to a special session on coastal and marine restoration, with talks on “Stakeholder perceptions on marine restoration” (HCMR), “Restoring macroalgal *Cystoseira* forests” (UB) and the MERCES project (UNIVPM). HCMR attended the ICES Annual Science Conference, Hamburg (September 2018), an ICES meeting in Copenhagen (November 2018) and the Biodiversity Protection Community PANACeA Ecosystem-based responses to Mediterranean biodiversity challenges event for key public and private players, Rome, Italy (May 2019) promoting the MERCES project and the Business Club at each of these meetings.

3.13 Restoration and tourism

CSIC contacted several recreational diver associations, in particular PADI and DAN. CSIC is in discussion to develop citizen science monitoring and restoration activities and to expand activities related to ecosystem restoration and sports diving/tourism economic benefits. PMF-ZAGREB continued to follow up contacts in Croatia to encourage the submission of case studies and images to MERCES.

3.14 Links with UN

In June and December 2018, the Business Club contact list was expanded to include UN Government contacts with responsibilities in coastal and marine environmental management. Online lists of National Focal Points for the United Nations Environment Programme were used to identify key Government personnel of 137 States worldwide. The Government officials were contacted several times between 2019 and 2020 to publicise the MERCES webinar series and to ask the representatives to extend the invitation to the webinar through their national networks. Details of the MERCES archived webinars and the newsletters were given also. The aim was to promote the work of the MERCES project and its European Business Club members to a wide variety of countries, especially developing countries, which might benefit from their knowledge and expertise. Developing countries appeared to be receptive to MERCES contact, judging by the many and varied attendees at the MERCES webinars (MERCES Deliverable D8.3). This initiative gave the MERCES project good visibility internationally and it is hoped the contacts made will allow blue growth opportunities for European SMEs offering services in marine ecosystem restoration.

3.15 Developing technology

In November 2018, DSES attended the Marine Autonomy and Technology Showcase at the National Oceanography Centre (NOC), Southampton to follow up on autonomous methods for monitoring the marine environment during restoration activities. This conference proved to be an eye-opener into the rapid advances being made in remote and autonomous monitoring of the environment by defence interests and in key offshore industries, such as the oil and gas sector. For example, BP stated that it intended to make all its subsea interventions autonomous by 2025. The use of autonomous vehicles for ecosystem monitoring following restoration measures is therefore a real possibility in the short term.

3.16 Oyster restoration

In January 2019, DSES attended a lecture on the Essex Natural Oyster Restoration Initiative (ENORI). From this talk the ENORI project provided a case study for the MERCES web pages and an article for the MERCES business-focussed newsletter 3 (May 2019). This also led to the submission of a further article on the Solent Oyster Restoration Project for MERCES business-led newsletter 4 (April 2020).

3.17 Links with Society for Ecological Restoration

In July 2019, WP8 contacted the Society for Ecological Restoration (SER) to archive the MERCES webinars in the SER Restoration Resource Centre. There were very few items in the

Resource Centre on marine ecosystem restoration, so these webinars are making a significant contribution in reaching a wider international audience (MERCES Deliverable D8.3). Additionally, MERCES provided significant input to the new revised SER International Principles & Standards for the Practice of Ecological Restoration.

3.18 Restoration of coastal areas

DSES attended a conference at the Natural History Museum, London on ‘Restoring Estuarine and Coastal habitats in the North East Atlantic’ (July 2019). The Minister for Coastal Development in an opening address stressed the importance of being aware of the multiple ecosystem services in the coastal environment and their importance to health and well-being of people. Contacts were made with future MERCES webinar speakers and with a wide range of ecosystem restoration projects including an industry-led project by the Glenmorangie Whisky Distilling Company restoring oyster beds to improve water quality in the vicinity of the distillery.

3.19 Links with the Blue Carbon Initiative

In September 2019, DSES attended the ‘Blue Carbon Initiative’ Science Group Meeting in Copenhagen, Denmark, (<https://www.thebluecarboninitiative.org/news/2019/11/25/bci-scientific-working-group-meets-in-copenhagen-denmark>) including a dedicated session organised by Silvestrum Climate Associates (MERCES Business Club member) and Åbo Akademi University, Finland (MERCES WP2 Co-Chair) on marine ecosystem restoration. The meeting had a wide variety of presentations on the importance of mangrove forests, tidal marshes, seagrass meadows and macroalgal growths in the global carbon cycle. Details were given on carbon losses owing to anthropogenic impacts and ecosystem degradation (Nordic and others), as well as the possibilities of restoring the ecosystems under a range of climate change scenarios.

3.20 Sustainable Ocean Summit

In November 2019, DSES attended the Sustainable Ocean Summit (SOS) Conference on ‘*Investing in Ocean Futures: Finance and Innovation for the Blue Economy*’ Paris, France organised by the World Ocean Council. The Summit is a major draw for a wide variety of companies involved in ocean business including ocean data and technology, aquaculture, ocean energy, submarine cables, seabed mining, cruise tourism and fisheries. Particular attention was given to ‘*Investing in the Blue Economy: The Role of Institutional Investors, Banks and Investment Firms in Ocean Sustainable Development*’ and ‘*De-Risking Investment in the Blue Economy: The Role of the Ocean/Maritime Legal and Insurance Communities*’. DSES contributed a presentation on ‘*Environmental Impact Assessments for Deep-Sea Mining*’ as part of a dedicated session on ‘*Ocean EIA: Solutions, Best Practices and Collaboration for Assessing Threat, Risk and Impacts to High Seas Biodiversity*’. The presentation stressed the importance of using the Mitigation Hierarchy, and especially restoration measures, in the management of the oceans, and not just for ocean mining.

4 Outcomes and Developments in Business

This section provides a brief overview of where progress in marine ecosystem restoration now stands in some of the more important businesses sectors identified by the MERCES project (and listed above). The section highlights responses provided by some of the MERCES Business Club companies and individual discussions held with them.

4.1 Coastal habitats

Many of the MERCES Deliverables contain details of developments in the restoration of marine habitats and the need to consider the value of a wide variety of ecosystem services, such as flood and erosion protection, fisheries enhancement, tourism, improving water quality and carbon sequestration, when reaching decisions on coastal management. In WP2, a focus was made on methods of transplanting seagrass in association with bivalve reefs to provide protection and ways of accumulating sediments for the seagrass. Key to this was the use of biodegradable structures to assist initial colonisation of both the seagrass and the mussels and oysters.

The biodegradable structures, known as BESE-elements, were developed in 2014 for the purpose of shellfish reef restoration by a consortium of companies led by Bureau Waardenburg BV (https://www.buwa.nl/en/advice_nature_environment.html), The Netherlands. During the period of the MERCES project the use of BESE-elements was extended by Bureau Waardenburg to restoration of foundation species in other temperate ecosystems, such as salt marshes and peat bogs. In 2017 interest in BESE-elements picked up across Europe, in the Western Atlantic and in Australia. As Bureau Waardenburg reported in MERCES business focused newsletter 4 (April 2020) “Thanks to the MERCES network, the restoration of seagrass with BESE-elements was tested throughout Europe. At the same time trials for restoring shellfish reefs and mangroves in the tropics were started, as were temperate trials with Submerged Aquatic Vegetation (SAV), fish habitat, riparian vegetation and dune vegetation.”

Interest in biodegradable structures has developed over the last 4 years, so much so that a separate company BESE Ecosystem Restoration Products (<https://www.bese-products.com/>) was formed in 2019. The company aims to aid the restoration of ecosystems worldwide, through knowledge transfer and the application of new innovative technical solutions, without the use of permanent artificial materials such as plastic. The company now has 50 projects on 4 continents working on 11 different ecosystems (MERCES business-focused newsletter 4 – April 2020). Turnover and the number of staff employed have doubled since the BESE-elements were first created.

Both Van Oord Dredging and Marine Contractors [Van Oord] (<https://www.vanoord.com/>), The Netherlands, and Ecocean, France, noted an increase in demand for integrated solutions to coastal and offshore projects over the last 5 years. Van Oord has created multi-disciplinary teams to devise combined engineering and environmental, nature-based solutions. Van Oord’s development of a containerised and portable coral nursery facility (Reef-Guard) was featured in the second MERCES business-focused newsletter (May 2018). More recent work by the company in developing industrial-scale solutions to coral reef restoration, an approach that might be particularly useful in addressing the increasing occurrence of coral bleaching events from climate change, was featured in MERCES webinar 5.

Ecocean noted that a sharp focus was needed in planning marine ecosystem measures to provide operational solutions to the market. The company had worked with ecologists, entrepreneurs and decision-makers, specializing in the marine environment and ecological restoration, to produce a comprehensive guide on the “*Ecological Restoration of Fish Nurseries in Shallow Coastal Areas in Mediterranean Basin: Guidelines and Principles*” (Lenfant et al. 2016). The report recognises that returning ecosystems to their original pristine state is technically impossible in most cases. Rather, ecological restoration can be used to improve or return habitats to a satisfactory ecological state by enhancing or reinstating essential functions, while at the same time supporting associated economic activities. The Guide presents the fundamental aspects of the ecology of shallow coastal areas and all of the major issues and challenges that currently exist in the Mediterranean region. It provides a foundation for starting a restoration project and sheds light on public policy investments in this domain.

Van Oord noted that while it is apparent that Government regulators are changing their approach to consider the additional benefits in building with nature, there is still a ‘flawed market’, or reluctance perhaps, for regulators to pay for the additional planning and consideration of the supplementary, and greater total, benefits (monetary, environmental and cultural) that might arise from building with nature. As discussed in MERCES webinar 2 on private finance in marine ecosystem restoration, there is a need for a better approach to the financing of combined engineering and environmental projects, especially those funded by Governments. Different Government Departments will have different interests, which collectively might realise a much more successful and beneficial project. However, joined up action between Government Departments is sometimes difficult to achieve. One solution is for tenders, which are usually very specific, to allow (contrary to current practice) the most economically advantageous tender (EMVI) to be considered, even if it is not the cheapest, if it proposes additional and separate costed benefits that would arise if the particular approach stipulated by a tender was altered.

In some European countries approaches to integrated coastal management are being developed, such as through the EcoShape Foundation (<https://www.ecoshape.org/en/>) in the Netherlands and the REACH (Restoration of Estuarine and Coastal Habitats in the NE Atlantic) initiative in the UK <https://ecsa.international/sites/default/files/docs-event/2019/190927-reach-conference-output-full-length-final.pdf>. Through integrated networks of Government departments, businesses, scientific institutions and NGOs new ways of utilising and enhancing ecosystem services are being used to meet environmental, societal and economic aims. The networks are also able to address barriers to adopting nature-based solutions, such as dealing with uncertainty in how nature will respond to engineering interventions, expressing and valuing the multiple benefits of ecosystem services, how to generate income from multiple beneficiaries of coastal schemes, and overcoming legislative limitations.

One potential major benefit from the restoration of coastal habitats such as salt marshes, seagrass meadows and mangrove forests comes from the role of these habitats in accreting sediment and with it carbon and nitrogen. The international Blue Carbon Initiative (BCI) (<https://www.thebluecarboninitiative.org/>) held its first European Blue Carbon Science Steering Group meeting in Copenhagen in September 2019. It included a special session on the restoration of blue carbon habitats co-organised by Christoffer Bostrom co-leader of MERCES WP2. The BCI is a coordinated, global program focused on mitigating climate change through

the conservation and restoration of coastal and marine ecosystems. The BCI not only addresses one key aspect of the MERCES project of what restoration lasting measures can be put in place that take climate change into account, but also the value of ecosystem restoration in mitigating climate change. This aspect received little attention at the time the MERCES project started, but it now offers a distinct area of Blue Growth for companies advising on 1) methods to restore and enhance marine ecosystems to capture more carbon, which despite the small area they might cover as just as important as tropical rain forests, and 2) how the captured carbon might be used in carbon trading markets. A recent example is the Ecoshape project 'Building with Nature Indonesia' led by Witteveen+Bos of The Netherlands (<https://www.witteveenbos.com/>), which is restoring mangrove forests (<https://www.ecoshape.org/en/projects/building-with-nature-indonesia/>).

MERCES webinar 4 highlighted the importance of marine ecosystem restoration for sequestering nitrogen in seagrass meadows, in addition to carbon, and the importance of nitrogen sequestration in improving the quality of coastal waters. Similarly MERCES has highlighted the way in which projects restoring European native oysters have also improved water quality (e.g. through the European Native Oyster Restoration Alliance (NORA, <https://noraurope.eu/>). The various projects on oyster restoration, two of which have been featured in MERCES business-focussed newsletters, have stimulated joined up management of the coastal zone between local authorities, NGOs, scientific institutions and local fishermen. In one case, the Dornoch Environmental Enhancement Project (DEEP) (<https://www.glenmorangie.com/en-int/partnerships>) the work has been instigated and led by one of Scotland's major whisky distilleries. Other oyster restoration projects are situated around new offshore windfarms, such as Van Oord's work creating artificial reefs in Eneco's Luchterduinen wind farm in the North Sea. This may go some way to reintroducing habitats in the North Sea lost following more than a century of bottom trawling in the region.

Creative solutions to the restoration of kelp forests were evident in MERCES webinar 3 where part of the cost of the restoration, which involved the eradication of voracious sea urchins, was covered by a company which collected the urchins to cultivate in the laboratory for their roe and sell this to the seafood industry. This novel approach was covered further in MERCES business-focused newsletter 3 featuring the company Urchinomics (<https://www.urchinomics.com/>) which has created many new jobs in its land and sea-based sea urchin ranches.

The above examples demonstrate that through marine ingenuity, and combining the skills of engineers and ecologists, novel technologies and solutions to restoring marine ecosystems can be found. This can best be seen perhaps in Ecocean reporting that their income from restoration-related projects has increased about 5-fold in the last 5 years and has resulted in 5 new jobs being created. Ecocean also note a positive signal in the number of new competitors that are appearing in this sphere of business. Ecocean see new market segments appearing in marine ecological restoration, the development of ecoengineering for offshore floating wind farms and ecological moorings.

4.2 Blue finance

A common issue relating to all ecosystem restoration projects is one of ‘Who Pays?’. The issue was addressed in MERCES webinar 2. During the period of the MERCES project a number of new European companies have been formed to address the issue. As described above Blue Finance was the main focus of the Sustainable Ocean Summit (SOS) in Paris in November 2019. The SOS opening remarks by the United Nations Development Programme’s Secretary General set the tone when he mentioned the importance of funding marine ecosystem restoration, especially of shallow-water coral communities. BNP Paribas in another presentation focused on their new programme ‘*Facing up to the climate change and biodiversity challenge*’, and research projects the bank is funding on offshore structures and biodiversity, and on pollution and plastic (<https://group.bnpparibas/en/group/corporate-social-responsibility/environmental-responsibility>).

Ocean funds (e.g. the Oceans Assets Institute - <https://www.oceanassets.org/>) available today have project funds of 15 to 30 million dollars. Most of these fund expect significant financial returns of 7 to 12%. So, while there are new blue finance investment companies, such as Blue Oceans Partners (<https://www.blueoceanspartners.com/>), ecosystem restoration projects are unlikely to attract investment from many ocean funds owing to the lower rates of return that would accrue, and more slowly, from marine ecosystem restoration.

There are some funds, however, which are trying to align economy with ecology. Althelia funds (<https://althelia.com/>), backed by Mirova, a leading European Responsible Investment Platform, has a 100 million dollar Sustainable Ocean Fund which aims to support projects where there is an opportunity of significant capital growth of about 60% over a period of 5 to 7 years. Projects include coastal protection, the resilience of coastal communities, such as mangroves, sustainable seafood and improving biodiversity by creating business opportunities through tourism. The investors include Conservation International (<https://www.conservation.org/>) and a number of development banks. The IUCN Blue Natural Capital Financing Facility (BNCFF) (<https://bluenaturalcapital.org/>) is similar to the Althelia fund in seeking to protect, restore and enhance natural ecosystems to better support climate change adaptation. It focuses on coastal ecosystems as a priority, including nature-based solutions, marine data provision, marine technology, renewable energy and water quality. Projects have included linking seaweed aquaculture to the management of MPAs and linking shrimp farming to mangrove reforestation actions, such as those pioneered by Ecoshape and Witteveen+Bos. New investment funds are working on similar lines, such as the European Ocean Investment Fund (BlueInvest) <https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1451>).

The creation of MPAs is leading to new approaches in ‘Blue Finance’ to assist in the continued management of the MPA (Pascal et al. 2018a,b). Vivid Economics (<https://www.vivideconomics.com/>), an economic consultancy, was commissioned by the UK Government to model marine-based conservation and coastal economic development finance to manage MPAs set up in 2011 as part of a chain of marine conservation areas. In France the SME Blue Finance (<http://blue-finance.org/>) is offering similar services in Indonesia and the Caribbean. Blue Finance recognised that there was insufficient funding for the expansion and effective management of MPAs, particularly in developing countries. During the last ten years, a

community of investors seeking positive social and environmental returns, in addition to financial gains, have stepped in with Blue Finance to fill the marine conservation financing gap by building a more investable (“bankable”) management structure around MPAs. The main advantages of these partnerships are to improve entrepreneurial approaches to the management of MPAs and, for Governments, to reduce the financial burden on public budgets.

Blue Finance has recently implemented new MPA management schemes in the Dominican Republic for the South East Coral Reef Marine Sanctuary. Finance solutions introduced have covered the up-front capital needs. Revenues have then been created in the MPAs to support the management of the MPA and to provide investor returns through charging access fees to visitors. Other revenue streams being explored include sales of blue carbon credits as well as mechanisms to finance the ecosystem service of coastal protection provided by coral reef and grey infrastructures. Beyond protecting biodiversity, potential benefits include restoring ocean ecosystem services, enhanced resilience to climate change, and providing food and income for local communities by supporting sustainable fisheries and tourism. This approach, which is expected to be transformative for MPAs, sets a precedent for marine conservation actions worldwide.

Ecocean noted that in relation to MPAs in Europe there was a tension that needed to be addressed in the management of MPAs. There are differences in opinion as to whether restoration interventions should be allowed within MPAs. This perhaps depends on the location of the MPA, but if say, income from tourists is to be used in a positive way to improve the health of the marine environment, general guidelines may be required on how certain types of restoration activities might be undertaken within an MPA.

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.

The HLP found that 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. It is projected that climate change will produce significant economic losses from tourism for many developing nations with direct coral on-reef tourism decreasing in value by 3.8% for

every 1% of coral cover lost. This evaluation provides an estimate of the economic benefit that could be realised also by restoring coral reefs (see MERCES business-focused newsletter 4 – April 2020).

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 for lack of funding. Considerable savings can be made in insurance costs through ecosystem restoration in the coastal zone. By aligning environmental management and risk management ways of financing nature-based solutions for coastal protection could be generated by public and private partnerships. This can 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, oyster reefs, kelp forests and coral reefs.

In a cost-benefit analysis Reguero et al. (2020) conclude that “Under conservative assumptions, 44% of the initial reef restoration costs would be covered” by the reduction in insurance premiums 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 the trade offs between spending on hazard mitigation and insurance. “Savings in insurance premiums can ... be seen as a resilience dividend.” “There are likely [to be] many coastlines where reef restoration costs could be fully covered by premium reductions”. The importance of ecosystem services in preventing flooding, however, is just one of many benefits that ‘Natural Capital’ provides. MERCES has featured on salt marsh restoration project in particular in the Steart Marshes (<https://www.wwt.org.uk/wetland-centres/steart-marshes/>) (MERCES business-focused newsletters 1 -June 2017 - and newsletter 4 - April 2020). The ‘Natural Capital’ of the restored Steart Marshes reserve has now been valued as £43.8M/yr.

There are growing examples of restoration projects being funded from several sources including local authorities, businesses, NGOs and, in some cases crowd funding. The case study provided above (section 3.16) about oyster reefs being introduced in and around wind turbines in the North Sea is one instance. This activity is now being progressed by a large consortium of businesses (Blauwwind, Tennet, Eneco and Van Oord), NGOs (North Sea Foundation and Natur et Milieu) and the Dutch Postcode Lottery Dream Fund. In the UK a grant has been awarded in 2020 by the National Lottery Heritage Fund in Scotland for a project to restore native oysters on the mid-Argyll coast. One million oysters will be reared over a period of 5 years to create a large self-sustaining population. The project is supported by the charity Sea Wilding and local volunteer groups. Other oyster restoration projects featured by the MERCES project have been supported by the NGO Blue Marine Foundation (BLUE). The increased interest by national lottery funds to support marine ecosystem restoration is a new development.

WP8 supported WP7 in conducting a survey on “*Financing for marine ecosystem restoration*”. The aims of the survey were 1) to improve our understanding of financing mechanisms for marine ecosystem restoration projects and 2) to determine the private sector’s preferences for the various funding approaches. When asked about the challenges facing businesses in supporting marine ecosystem restoration and conservation it was noted by most respondents that funding is too fragmented in its sources and duration. Some remarked that initial investment costs are

often too high, the areas requiring restoration are too large, the timescales required to see ecosystem improvements are too long and it is difficult to cash out the return. Grants and donations and public-private partnerships are the preferred financial mechanisms, but revenue streams from the use of marine ecosystem services and crowdfunding were also considered useful.

4.3 Deeper waters

Fisheries enhancement through better management of ocean space is a potential growth area in both coastal and deep waters. An early project to feature in the second MERCES business-focused newsletter was the use of suspended artificial reefs below the pontoons of ports and harbours to act as safe havens and nursery areas for fish in order to enhance local fisheries. Ecocean (<https://www.ecocean.fr/home/>) enhanced local fisheries, by creating artificial substrates, called ‘Biohut’, which can be attached to docks, pontoons and seawalls to provide suitable habitats for the fish. Greater than 3000 Biohut reefs have now been installed in a network of 27 French marinas (between 20 to 90 units per marinas) and including commercial ports such as Calais, Port-Vendres and Rotterdam. Ecocean report that they are aware that many more tenders for coastal developments now include requirements to address the restoration of marine ecosystems.

The Biohut concept has now been extended in a potentially important economic direction by Ecocean through installing artificial habitats on floating offshore wind turbines in the Golfe du Lion (Leucate) as reported in MERCES business-focused newsletter 4 (April 2020). Of note in this regard is the announcement of a “World Conference on Floating Solutions” to be held in Rotterdam, 6-8 October 2020 which aims to bring together industry, policymakers, entrepreneurs and researchers to discuss the use of floating structures in offshore and inland waters for sustainable development.

The discussion concerning the decommissioning of oil and gas infrastructure in the North Sea received a full airing within the MERCES community, especially with the publication of papers on the issue by MERCES WP4 and WP6. The issue is highly complex as explained in Ounanian et al. (2019) with a summary in MERCES business-focused newsletter 4 (April 2020). Whatever the outcome, whether complete removal of rigs and their cuttings piles or the use of some structures, even in part, as reefs for hard substrate fauna and fish, there will be opportunities for environmental survey companies and consultancies in monitoring the effects of the removal of the rigs and pipelines, or the use of some as reefs.

4.4 Deep-sea mining

Before the MERCES project started, there had been very little discussion about the need to restore the environment following mining on the deep-seabed (Van Dover, 2014). The issue started to be raised in the final stages of the European Commission’s FP7 project MIDAS (Managing Impacts from Deep-Sea Resource Exploitation) and the results of this discussion were finally published in Cuvelier et al. (2018). The ‘Mitigation Hierarchy’ (Avoid, Minimise, Restore, Offset) is now being applied more widely in ocean environmental management. Niner et al. (2018) highlighted the need for the application of the ‘Mitigation Hierarchy’ in the management of deep-sea mining. In MERCES, WP4 addressed the issue in Da Ros et al. (2019),

Jones et al. (2019) and Billett et al. (2019). Da Ros et al. (2019) concluded that “deep-sea ecosystem restoration could offer an important business opportunity for technological development” and “application of restoration actions in the deep sea may be an opportunity for a new and competitive blue-growth sector”.

On land, the Cross-Sector Biodiversity Initiative (CSBI), which includes the International Council of Mining and Metals (ICMM), has provided practical guidance on how the Mitigation Hierarchy might be applied by extractive industries (CSBI, 2015). While the work to date has focussed on terrestrial impact management, the “principals espoused for one part of the mining business are clearly transferrable to all mining sectors” (Billett et al., 2019), although considerably greater research effort is required to assess if restoration “actions will achieve sustainability goals when applied at broad spatial scales of impact” (Da Ros et al., 2019)

The application of restoration measures is now moving from the early stages of debate in scientific circles to the regulatory regime as shown in very recent records of the International Seabed Authority (ISA), Kingston, Jamaica. The ISA Earth Negotiations Bulletin Vol 25 (221) Page 2 (Wednesday 19 February 2020) describing the comments made by member states of the ISA Council on the draft Regulations for the exploitation of deep-sea minerals highlighted “Views also diverged on whether to refer to the assessment and management of risk of harm as the “protection and preservation” or as the “protection, conservation and, where appropriate, **restoration of the marine environment**” [BOLD emphasis added]. While there is still discussion on whether the restoration of the marine environment following mining should be included in the draft Regulations, it shows that this discussion is gaining visibility and acceptance by some parties to the United Nations Convention on the Law of the Sea.

In Europe, contracts for the exploration of deep-sea minerals have been between the ISA and Institut Français de Recherche pour l'Exploitation de la Mer (France), Federal Institute for Geosciences and Natural Resources (Germany), UK Seabed Resources Ltd (UK), Global Sea Mineral Resources NV (Belgium), InterOceanMetal Joint Organisation (a consortium of eastern European countries and Cuba) and the Government of the Republic of Poland. In addition European companies have interests in ISA contracts with Ocean Mineral Singapore Pte Ltd (Singapore) and Cook Islands Investment Corporation (Cook Islands).

All these companies and organisations require expert scientific advice on environmental management. In some cases this is provided directly by scientific institutions, but in other cases environmental consultancies provide a business focus for the baseline studies and Environmental Impact Assessments (EIAs), such as Blue Globe Solutions (now based in Belgium) for Global Sea Minerals Resources NV. It is likely that some of the other European contractors to the ISA, as well as a number of developing states which have contracts with the ISA, such as Nauru Ocean Resources Inc, Tonga Offshore Mining Ltd and Marawa Research and Exploration Ltd, would benefit from the support of specialist environmental management consultancies. This is a possible growth area for European companies in ocean environmental management in the coming years, including considerations of whether, and how, deep-sea ecosystems might be restored.

5 Concluding Remarks

The creation of a focused cluster of business, policy, local planning and science interests, embedded within a Horizon 2020 project, has been a successful approach, especially in bringing together many Small to Medium-sized Enterprises across Europe, which otherwise would have little knowledge of each other's activities. Businesses in the MERCES Business Club report a significant change in the last 5 years in tenders for coastal engineering to include elements of marine ecosystem restoration. In addition, there are distinct signs of Blue Growth in the increased turnover and in the number of people employed by companies in marine ecosystem restoration over the same period. The number of companies this has occurred in is limited, but it is clear companies that are more entrepreneurially minded have thrived in their marine ingenuity. Some companies have developed new lines of business that show considerable promise for the future, notably in relation to new wind farms of fixed and floating turbines. By publishing the best case studies in marine ecosystem restoration on the MERCES website the project has made a focal point for European business projects, as seen by the many hits for the MERCES website in search engines. The expansion of the webinar series to engage with all maritime States in the United Nations Environment Programme (UNEP) has broadened the visibility of the MERCES project and of European businesses internationally. The webinar series has proved to be a vital tool in publicising the project. By focusing on issue-led webinars covering business and policy interests, as opposed to just scientific results, has allowed a broad audience to be stimulated and engaged with. Attendance at the webinars has been excellent. The production of business-focused newsletters has allowed industry-specific issues to be put centre stage. At the start of the MERCES project one paper cited in the proposal captured the situation at that time in its title "When will engineers learn ecology and when will ecologists learn engineering?" At the end of the MERCES project it is clear there are growing tenders and projects demanding the combination of engineering and ecological skills, especially in addressing methods of marine ecosystem restoration at the 'industrial scale'.

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