Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

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The European Climate, Infrastructure and Environment Executive Agency (CINEA)

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Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

I

Netherlands Case Study:

Assessing the economic and the ecological impacts, costs and benefits of spatial plans for the North Sea

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July 2021

The European Climate, Infrastructure and Environment Executive Agency (CINEA)

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Geographical context

The Greater North Sea, situated on the continental shelf of north-west Europe, is one of the world's busiest maritime areas. It opens into the Atlantic Ocean to the north and, via the English Channel to the south-west, and into the Baltic Sea to the east. The Greater North Sea (including its estuaries and fjords) has a surface of about 750 000 km^2 and a volume of about 94 000 km^3, with depths not exceeding 700m. The seabed is mainly composed of mud, sandy mud, sand and gravel. The variety of marine landscapes, i.e. fjords, estuaries, sandbanks, bays, or intertidal mudflats, is important for biodiversity which, in turn, can sustain the social system including economic activities.

The Greater North Sea is surrounded by densely populated, highly industrialised countries. Major activities in the North Sea include fishing, the extraction of sand and gravel, and offshore activities for the exploitation of oil and gas reserves, including the laying of pipelines. One newly emerging activity is renewable energy, mostly from offshore windfarms. In terms of shipping, the North Sea is also one of the most frequently traversed sea areas of the world, and the coastal zone of the Greater North Sea is heavily influenced by recreation and also by run-off from land-based activities, including agriculture.

Biological systems in the Greater North Sea are rich and complex. Approximately 230 species of fish are known to inhabit the area. Some 10 million seabirds are present at most times of the year and several marine mammal species occur regularly over large parts of the North Sea.

This case study considers the marine spatial planning (MSP) process applied in the Dutch Exclusive Economic Zone (EEZ), which covers 57 000 km^2, almost 8% of the Greater North Sea. A key issue for the Dutch MSP process is the siting of offshore wind facilities and their impacts. The case study describes part of the process to guide the planning of offshore windfarms while balancing the demands for space from renewable energy with those for sustainable food (primarily fisheries) and nature conservation (N2000 areas).

Cross-cutting issues addressed in the case study

Here it is important to distinguish between (1) the overall Dutch MSP process which was primarily about cross-sectoral participation and (2) the focal point of this case study involving the application of specific tools as part of the science-policy interface in this process. The latter took place in the period from February to June 2020, when the government requested scientific bodies covering the socio-economic and natural sciences to perform a first assessment of different scenarios for the spatial plans of the North Sea that emerged from the overall process.

Methods and tools addressed

This case study outlines the overall MSP process in the Netherlands, but its focus is on the science-policy interface and more specifically work that (as part of the overall stakeholder participation process) was intended to evaluate the socio-economic and environmental consequences of the various MSP scenarios through a "Trial Integrated Assessment" (called hereinafter the "Trial IA"), which involved the application of three specific tools: a *Mental model*, *Cumulative Impact Assessment (CIA)* and *Cost-benefit analysis (CBA)*. The results of the project were intended to show how MSP could support the achievement of Dutch policy objectives for the North Sea including increased energy from renewables, i.e. offshore wind, while considering trade-offs with food production,

i.e. fisheries, and environmental conservation, also in light of the requirement to achieve and maintain good environmental status (GES) set by the EU's Marine Strategy Framework Directive.

Key conclusions and recommendations

With the overall MSP process the Dutch government succeeded in bringing together parties that usually do not actively cooperate with each other, like fisheries organizations, environmental NGOs and windfarm developers. The Trial IA brought-in scientific knowledge and analysis, albeit at a later stage with the North Sea Agreement stakeholder participation process already well underway.

The government's initial request was for a Trial IA to give a first indication of the potential socio-economic and environmental consequences of alternative options for the long-term spatial planning of the Dutch part of the North Sea – in particular, alternatives for the siting of wind power – and the requirements for the knowledge base for further analysis. It was hoped that this would help to identify best spatial planning solutions. Due to gaps in data and methods this was not possible and, therefore, the study was complemented by a separate expert analysis for a spatially explicit assessment of the potential ecological impacts of alternative options. This fairly crude expert analysis confirmed the findings of the CIA: differences in the economic and ecological impacts between the various alternative options were not sufficiently distinctive to be able at present to identify a preferred spatial planning scenario for the North Sea.

The Trial IA was part of an adaptive planning cycle where the Trial IA should be considered as a preliminary *assessing* step which, as part of the stakeholder participation process, generated an input into what can then be considered the next cycle. In particular, the outcome helped to identify the knowledge base requirements that need to be further developed. The Trial IA succeeded in revealing the shortcomings of the current CIA. It is assumed that these can be (partly) circumvented once the best information that is currently available is incorporated in the CIA.

The government (has) put great effort in bringing sectoral and NGO stakeholders to the table at an early stage of the process, with the science sector present as well. However, the MSP process was conducted under great time stress resulting in, according to the scientists involved, only preliminary results which need to be reconsidered at a later stage of the process. The latter is also foreseen in later phases of the process, such as when the actual locations for new windfarms will have to be decided upon.

Probably the main lesson learned from this case study is that the application of the 5-step MSP process to clarify between both parties (i.e. the client/policy and science) where and how this Trial IA fitted in the overall MSP process could have avoided several misunderstandings between the science and policy partners and hence benefitted the process. From the application of the Trial IA in a preliminary *assessing* step it has become clear what knowledge needs to become available in a future *developing* step to ascertain (or at least improve the chances) that the CIA could have distinguished between the alternatives for siting wind power and hence provided guidance for the MSP.

The recommendation is therefore to make sure all parties are aware of the process and how specific meetings/analyses/projects fit into this process. Pertaining to the analytical tools, this case study has shown the dependency of the assessment tools, such as CIA and CBA, on adequate information in the knowledge base. The mental model proved useful to clarify with the client which sectoral activities could be considered in the assessment: on this basis, key activities were included for analysis in the Trial IA.

1. INTRODUCTION

This case study was carried out as part of the *Study on integrating an ecosystem-based approach into maritime spatial planning*, a project for the European Commission (DG MARE and EASME)[1]. The case study is part of the marine spatial planning (MSP) process applied in the Dutch Exclusive Economic Zone (EEZ) and the territorial sea to guide the planning of several activities, with a focus on offshore windfarm developments. The case study outlines the overall process, mostly a cross-sectoral participation process, and then focuses on the involvement of science, in particular through a project that employed several analytical tools that can support the ecosystem-based approach (EBA).

The case study describes and evaluates the extent to which ecosystem-based approaches (EBA) were applied and it draws lessons to be learned from this case study that can guide future EBA-MSP initiatives. The case study relates to the key elements of the practical approach used in the overall study, including the five key steps for an EBA-MSP and several of the methods/tools that are proposed as part of this approach.

At the core of this case study is the Trial Integrated Assessment (IA), conducted via the "*Kentallen analyse*" project (Roebeling et al., 2021a), which took place in the first half of 2020: the Trial IA aimed to provide insight into the economic and ecological effects of four future spatial scenarios on the North Sea usage functions. This project was part of a larger process (see Chapter 2 and in particular Figure 3), including parallel studies, expert workshops, webinars and meetings: where needed and possible, this case study report refers to the larger process. The case study describes the lessons learned in terms of process and notably the applications of the following tools: *mental model*, *cumulative impact assessment (CIA)* and *cost-benefit analysis (CBA)*. (These and other terms are briefly explained in the glossary, Annex I.) It also describes the cross-cutting processes of stakeholder participation.

Links with other projects and processes

The Trial IA has a direct link with a separate Dutch project on the cost-benefit analysis of further development of offshore wind in the Dutch sector of the North Sea. In parallel, Statistics Netherlands (CBS) has been investigating whether and how natural capital accounts can be prepared for the Dutch continental shelf (DCS). In 2019, CBS prepared a report on *Natural capital accounts for the North Sea: The physical SEEA EEA accounts* (CBS, 2019), to test the development of the physical System of Environmental Economic Accounting (SEEA) – Experimental Ecosystem Accounting (EEA) for the Dutch part of the North Sea.

Steps and timeline

The work for this case study consisted primarily of desk research, a review of relevant sources of information, and of interviews to collect key information from national policy makers two representatives of the Ministry of Infrastructure and Water Management, specifically in *Rijkswaterstaat*, an executive agency of the Ministry in charge of water management and water safety.

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[1] The project was contracted by the Executive Agency for Small and Medium-sized Enterprises (EASME), which in 2021 became The European Climate, Infrastructure and Environment Executive Agency (CINEA)

The case study authors

The authors of this case study report also worked on the Trial IA. This report presents the views of the authors alone. It has been revised following comments from officials of the European Commission (DG MARE) and of the Dutch MSP authorities.

2. DUTCH MSP PROCESS

2.1 Dutch Policy Framework for the North Sea

The Dutch EEZ of the North Sea is part of the southern North Sea. It is intensely used. In the future, higher demand for offshore renewable energy and for sand to strengthen the coast is foreseen. In order to avoid conflicts with the environment and between users, in 2005 the Dutch government introduced a new spatial planning framework for the coordination of these developments. Maritime Spatial Plans have been developed since 2009, and at a regular interval of 6 years these plans are revised based on new knowledge and experience acquired, as well as to address new societal demands. Section 2.2 provides an overview of legislation that is currently in place.

As the underlying legislation has to be renewed – notably, the existing Water Act of the Netherlands is to be replaced by and subsumed into a new Environmental and Planning Act – a North Sea Programme is current underway. This includes formulation of future visions for the North Sea (North Sea 2050 Spatial Agenda) and the preparation of the Marine Spatial Plan for the period 2022-2027. Stakeholders are strongly involved. A review of the developments in the last two decades as well as the aims for the future marine spatial planning in the Dutch part of the North Sea is given by de Vrees (2019).

The North Sea Programme is described in more detail in Section 2.3. The Trial IA project was part of the North Sea Programme and the overall Dutch MSP process. Background information on Trial IA is given in section 3.2.

2.2 Key legislation

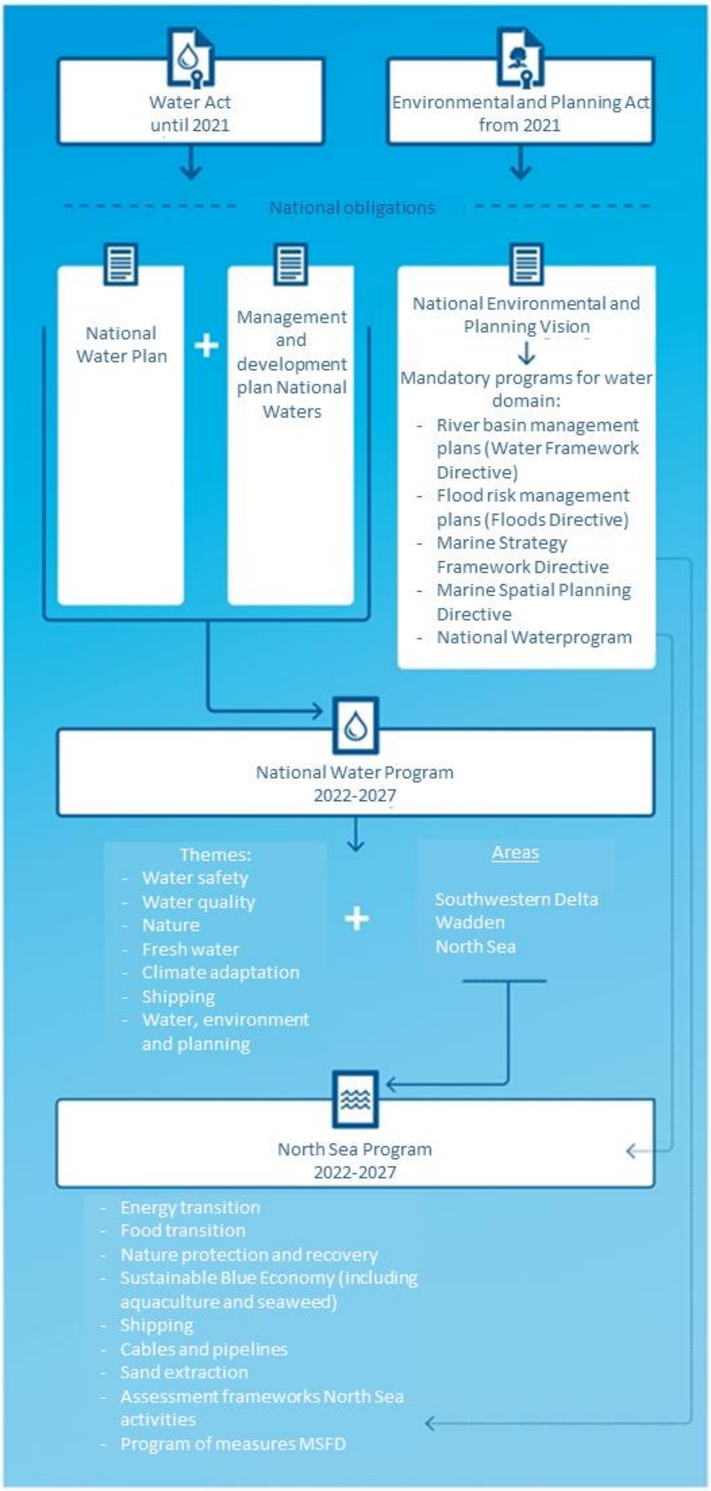
2.2.1 European legislation

Several EU Directives would appear to apply directly: obviously the MSP Directive, and this refers to synergies with other EU legislation such as Strategic Environmental Assessment (SEA) Directive (2001/42/EC); the Marine Strategy Framework Directive (MSFD) (2008/56/EC); the “Nature Directives”, i.e the Birds Directive (BD) (79/147/EC) and the Habitats Directives (HD) (92/43/EEC); the Water Framework Directive (WFD) (2000/60/EC). A key policy document, the EU 2020 Biodiversity Strategy (COM(2011) 244) and its follow-on, the EU Biodiversity Strategy for 2030 (COM/2020/380) are also important.

The MSP Directive specifically refers to the need to follow the SEA Directive for plans that are likely to have significant effects on the environment. It calls for an ecosystems-based approach and contains provisions on public participation. The SEA Directive sets out a stepwise process – including screening, scoping and the preparation of an environmental report. It should be noted that, while the Directive sets certain requirements for these steps, it does not set out the process in details. For example, the SEA Directive does not formally define the scoping process – its organisation is at Member States' discretion – and the only obligation is that authorities with specific environmental responsibilities and that are likely to be concerned by the environmental effects of implementation plans and programmes are consulted on the scope of the environmental Report. While the SEA Directive does not specifically refer to other EU legislation, 2013 guidance published by the European Commission highlights the role that SEA can play in supporting the implementation of biodiversity legislation as well as policies such as the Biodiversity Strategy[2]. The SEA Directive also has a clear link to the Directive on Environmental Impact Assessment (EIA) (which in turn is cited under the MSP Directive). When a plan is approved, projects identified or allowed under the plan will be prepared. For example, new offshore wind farms can be proposed for designated areas. For many types of projects, including wind farms, an EIA needs to be conducted to analyse the potential consequences and to find alternatives if necessary.

[2] See: https://ec.europa.eu/environment/eia/pdf/SEA%20Guidance.pdf

FIGURE 1: DUTCH POLICY FRAMEWORK FOR THE NORTH SEA



Source: [https://www.noordzeeloket.nl/beleid/interdepartementaal/idon-nieuwsbrief/nr-33/ruimtelijke- programmering-waterdomein/](https://www.noordzeeloket.nl/beleid/interdepartementaal/idon-nieuwsbrief/nr-33/ruimtelijke-programmering-waterdomein/)

The MSFD was adopted with the objective to protect and preserve the marine environment, prevent its deterioration and restore the environment in areas where it has been adversely affected. Both the MSP Directive and MSFD identify policy goals related to ecosystems that need to be considered in maritime spatial plans, including good environmental status under the MSFD as well as the goals of other EU environmental legislation and policies. The EU adopted the BD in April 1979 with the objective to commit to the protection of all wild bird species naturally occurring within the EU. The HD was adopted in May 1992 with the objective to conserve natural habitats and wild fauna and flora in the European territory of the Member States to which the treaty applies. The EU BD and HD require the Member States to implement two main sets of provisions. The first set of measures requires Member States to establish a strict protection regime for all wild European bird species, plus other endangered species listed in Annex IV of the HD, both inside and outside protected sites. The second set requires the designation of core sites for the protection of species and habitat types listed in Annex I and II of the HD and Annex I of the BD, as well as for migratory birds. Together, these designated sites form part of a coherent ecological network of nature areas, known as the European Natura 2000 Network.

2.2.2 National legislation

In the Netherlands, MSP is included in the Water Act (Figure 1). Under the Water Act, the policy framework is elaborated in the *National Water Plan* and *the Management and Development Plan for the National Waters*, including the *Policy Document for the North Sea* as an independently readable appendix. The *Policy Document for the North Sea* includes the Netherlands' Maritime Spatial Plan and reflects the Dutch Government's policy choices for the North Sea (Figure 1). The Dutch National Government acted in accordance with the requirements of the MSP Directive when formulating the *North Sea Policy Document* (Platjouw, 2018). The spatial policy is development oriented, leaving room for changes and adaption, but with an agenda made by the national government to fulfil the agreed objectives, such as the urgency to find space for renewable energy at sea (de Vrees, 2019).

Every six years, the *National Water Plan* and related documents are revised. The first *National Water Plan* was published in 2009 and the second, for the period 2016–2021, was adopted in December 2015, including the *Policy Document for the North Sea*[3]. Despite intensive consultation processes, not all stakeholders are always satisfied with the result. The biggest challenge for the near future is to find solutions for the societal demands that also can be supported by the fishing sector (de Vrees, 2019).

The Dutch Water Act will be replaced by the Environment and Planning Act (hereafter EPA). The EPA will not only replace the Water Act, but many other existing legislative acts concerned with environmental law. Although the EPA has already been adopted (Staatsblad, 2016, 156), it will not enter into force before all necessary implementing legislation is adopted (expected in 2022 (Oude Elferink, 2020)). The *National Water Programme 2020-2027* (NWP), and as part of it the revised *Policy Document on the North Sea*, is being prepared under the legal regime of the Water Act. The NWP 2022-2027 is the successor to the *National Water Plan 2016-2021* and the *Management and Development Plan for National Waters 2016-2021*, thereby merging these two plans and anticipating to the new EPA that includes the NWP as one of its instruments.

The NWP 2022-2027 provides the integral framework for central government water policy. It describes the main outlines of the national water policy and management for the period 2022-2027 (including North Sea policy) and provides a perspective to 2050. The transitional provisions in the EPA provide for the NWP 2022-2027 to be divided into a

[3] The Dutch Ministry of Infrastructure and the Economy and The Dutch Ministry of Environmental Affairs, 2015

number of mandatory programmes, including the *Programme of Measures* of the *Marine Strategy* (under the MSFD) and the *maritime spatial plan* (under the MSP Directive).

The *Policy Document on the North Sea*, part of the NWP, see (Figure 1) is part of the Dutch implementation of the Paris Climate Agreement plus national accords included in the Dutch Climate Agreement. The Document also implements the EU's MSFD and international frameworks for the marine environment such as the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention'). The *Policy Plan on the North Sea* is a spatial plan in accordance with the requirements of the MSP Directive, and it also contains the Programme of Measures under the MSFD.

A broad range of sectoral and national maritime interests are affected by the *Policy Document on the North Sea*:

- Mobility system/ shipping;
- National security and military activities;
- Energy supply;
- Water safety and climate resilience;
- Food and agro production;
- Cultural heritage, landscape and nature;
- Nature and biodiversity;
- Fishing.

The key legal Acts that govern these interests and activities are listed in Table 1.

TABLE 1: DUTCH LEGISLATION AFFECTING THE NORTH SEA

Dutch legislation applicable for the North Sea (English)	Dutch titles of the legislation
Shipping Traffic Act	Scheepvaartverkeerswet
Prevention of Pollution from Ships Act	Wet voorkoming verontreiniging door schepen
Water Act	Waterwet
Environment and Planning Act (EPA)*	Omgevingswet
Soil Protection Act	Wet bodembescherming
Mining Act	Mijnbouwwet
Mining Decree	Mijnbouwbesluit
Basic Registration of Subsurface Act	Wet basisregistratie ondergrond
Earth Removal Act	Ontgrondingenwet
Spatial Planning Act	Wet ruimtelijke ordening
Laws of environmental Conservation	Wet milieubeheer
Environmental Impact Assessment Decree	Besluit milieueffectrapportage
Environmental Law General Provisions Act	Wet algemene bepalingen omgevingsrecht
Nature Conservation Act	Wet natuurbescherming
Fisheries Act	Visserijwet
Heritage Act	Erfgoedwet
North Sea Installations Act	Wet installaties Noordzee

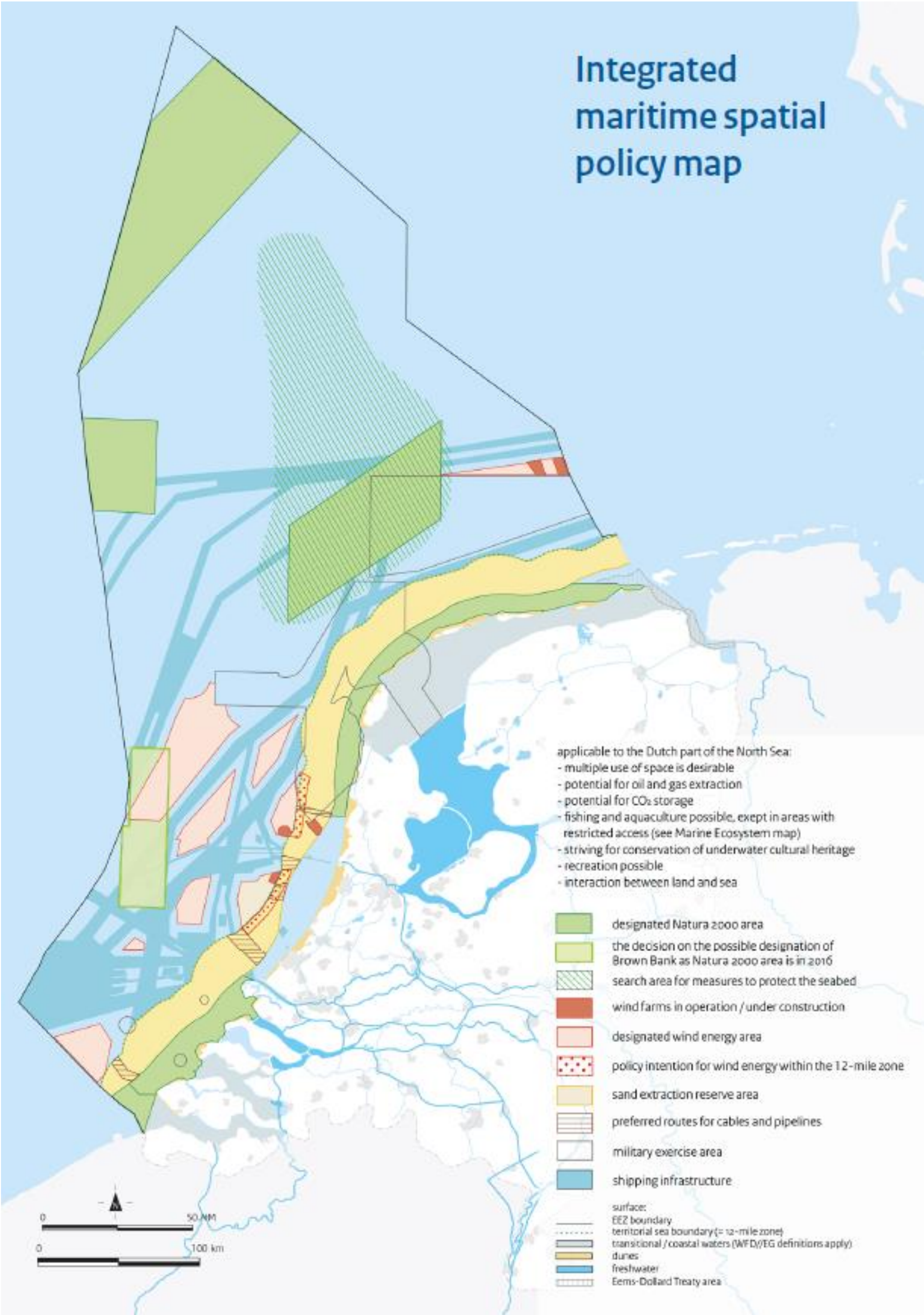
Dutch legislation applicable for the North Sea (English)	Dutch titles of the legislation
Offshore Wind Energy Act	Wet windenergie op zee
Wreck Act	Wrakkenwet
Maritime Accidents Control Act	Wet bestrijding maritieme ongevallen
Statutory Act establishing an exclusive economic zone	Rijkswet instelling exclusieve economische zone

Source : Oude Elferink, 2020

* The EPA was adopted in 2016 and is expected to enter into force in 2022. The EPA will replace (parts of) other laws, i.e. Water law, Earth Removal Act, Nature Conservation Act, Environmental Law General Provisions Act, Public Works Management Act, Soil Protection Act, Laws of environmental Conservation, Spatial Planning Act, Wreck Act, Heritage Act and Mining Act.

The 2015 maritime spatial plan allocated a large share of the Dutch EEZ to these different activities (see Figure 2 below). The upcoming and revised MSP, however, will – as already indicated – have to accommodate further sectoral policy needs, and in particular those related to renewable energy: consequently, the plan will need to find additional space for offshore windfarms.

FIGURE 2: INTEGRATED MARITIME SPATIAL POLICY MAP



Source: The Dutch Ministry of Infrastructure and Economy and The Dutch Ministry of Environmental Affairs, 2015

Responsible authorities

In the Netherlands, the Dutch Ministry of Infrastructure and Water Management is responsible for MSP by managing and coordinating the Integrated North Sea Policy (European MSP Platform, 2020). The Interdepartmental Directors' Consultative Body North Sea supports the Minister when it comes to elaborating the Integrated North Sea Policy and is considered to be the lead planning agency. Other ministries represented in this body include the Ministry of Economic Affairs and Climate; the Ministry of

Agriculture, Nature and Food Quality; Ministry of Internal Affairs; Ministry of Defence; Ministry of Education, Culture and Science; and the Ministry for Finance.

The box below summarises the authorities and the planning documents for MSP in the Netherlands.

MSP authorities and legislation in the Netherlands

Planning at national level

- The Central Government's North Sea Policy sets out a framework for the spatial use of the North Sea in relation to the marine ecosystem (as part of the governance structure for integrated maritime policy).
- The North Sea Policy document applies to the Dutch EEZ and the non-administratively classified Territorial Sea.
- The National Water Plan explicitly mentions land-sea interaction.

National MSP authority

- Interdepartmental Directors' Consultative Body North Sea led by the Ministry of Infrastructure and Water Management.

Source: European MSP Platform, 2020

2.3 North Sea Programme

The *North Sea Programme 2022-2027*, commissioned by the Interdepartmental Directors Committee for the North Sea (*Interdepartementaal Directeuren Overleg Noordzee*, IDON), is developed by the Minister of Infrastructure and Water Management (I&W) in collaboration with the Ministers of Agriculture, Nature and Food Quality (LNV), Interior and Kingdom Relations (BZK) and Economic Affairs and Climate (EZK) as far as the policy areas of these departments are concerned (see Table 2). By matching relevant subjects to departmental expertise areas, working groups were defined for the following topics:

- Strengthening marine ecosystems (lead LNV and I&W),
- Sustainable use of the North Sea (lead I&W);
- Transition towards sustainable energy (lead EZK);
- Transition to sustainable food supply (lead LNV):
- Sustainable blue economy (lead LNV): and
- Spatial planning (lead I&W and BZK).

Relevant stakeholders were invited to participate in these working groups. New in this Programme is the integration of the management plans (often implemented by *Rijkswaterstaat*) with the policy plans.

TABLE 2: ORGANISATION OF THE NORTH SEA PROGRAMME 2022-2027

Organisation	Role
Interdepartmental Directors North Sea Consultative Body (IDON)	Coordinates North Sea policy making. Commissioner who requested a North Sea Programme 2022-2027
Minister of Infrastructure and Water Management (I&W)	Coordinator North Sea Programme 2022-2027
Ministers of: • Agriculture, Nature and Food Quality (LNV) • Interior and Kingdom Relations (BZK) • Economic Affairs and Climate (EZK)	Working group leaders: • Strengthening marine ecosystems • Sustainable use of the North Sea • Transition towards sustainable energy • Transition to sustainable food supply • Sustainable blue economy • - Spatial planning
Stakeholders: • energy sectors (oil&gas; wind energy; etc.) • sand extraction • shipping and ports • fisheries and aquaculture • recreation sectors (coastal) • nature and environmental organizations	Participants

Development of *North Sea Programme 2022–2027*

The Interdepartmental Directors North Sea Consultative Body (IDON) stated in their Plan for development of a *North Sea Programme 2022-2027* (In Dutch: *Plan van aanpak Programma Noordzee 2022-2027*) that it aimed to offer insight and clarity to all stakeholders for the North Sea, and that it would be developed in cooperation with the stakeholders as well as via consultation of a broader audience (IDON, 2019).

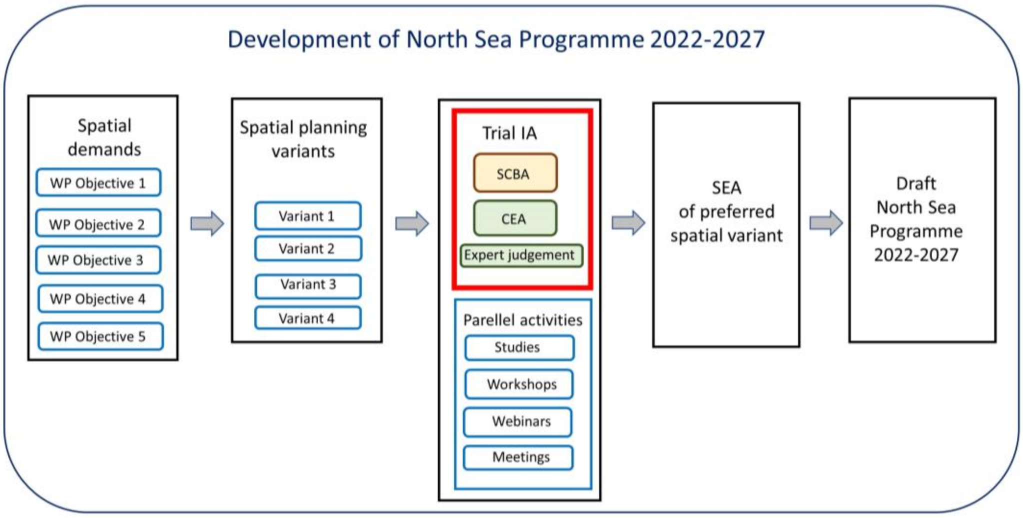
The following steps were planned in a time frame in the process of the development of the North Sea programme 2022-2027 (see 3):

- For each work package, the spatial demand is compiled in cooperation with relevant stakeholders. These work packages comprise (in Dutch): Reinforce the marine environment (*Versterking Marien Ecosysteem*), Sustainable Use (*Duurzaam gebruik van de Noordzee*), Transition to renewable energy (*Transitie naar duurzame energie*), Transition to sustainable food (*Transitie naar duurzame voedselvoorziening*), and Sustainable Blue Growth (*Duurzame Blauwe Economie*).
- This information is fed into work package "Spatial Planning" (RO). Logical variants are combined in cooperation with the stakeholders involved in the before mentioned individual work packages. These variants are tested, and then possible new variants may be composed. Work package "Spatial planning" (werkpakket RO) produces 3 to 4 variants.

- These 3 to 4 variants are then assessed in the Trial IA for their consequences. There is interaction with NZO/stakeholders allowing intermediate adjustments of parts of the variants.
- The information of these variants will be supplied to a SEA (in Dutch: *PlanMER*) in which the variant emerging as the preferred variant will be subjected to a more detailed CBA and CEA[4] than in the Trial IA.

The Trial IA, the focus of this case study, is outlined in red in Figure 3.

FIGURE 3: SCHEME FOR THE DEVELOPMENT OF THE NORTH SEA PROGRAMME 2022-2027



Source: Based on information from IDON (2019).

3. KEY ACTORS

3.1 Societal background

To understand the background of the Trial IA, and its position in policy making at large, a brief historical sketch of the development of policies for offshore wind energy is needed. In 2013, the Dutch Energy Agreement for Sustainable Growth ("*Energieakkoord*"; SER, 2013) was approved by more than forty organisations – including central, regional and local government, employers and unions, nature conservation and environmental organisations, and other civil-society organisations and financial institutions. The Energy Agreement contained four quantitative long-term objectives:

- a savings in final energy consumption averaging 1.5% annually, meaning a 100-petajoule (PJ) saving in energy by 2020;
- an increase in the proportion of energy generated from renewable sources from 4% (2013) to 14% by 2020;
- a further increase in that proportion to 16% by 2023; and
- the creation of 15,000 jobs.

[4] The terms CEA (cumulative effect assessment) and CIA (cumulative impact assessment) are often used interchangeably within the literature and the same applies to this report. However the use of CIA could be preferred as the ultimate aim is to assess impact (i.e. as the change in state of the receptor, sensu Piet et al. (2021)

Note that in the Energy Agreement, offshore wind energy is not explicitly mentioned.

In later reports and policy documents, including the "*Energierapport*"[5] (2016), the "*Energieagenda*"[6] (2016) the "*Routekaart Windenergie op Zee*"[7] (2018) and the "*Integraal Nationaal Energie- en Klimaatplan 2021-2030*"[8], the foundations for a long-term energy policy up to 2050, including the development of offshore wind energy, were laid-out. The "*Routekaart Windenergie op Zee 2030*" quantifies how offshore wind energy should develop until 2030:

- Approximately 1GW was already installed at the time of writing
- An additional capacity of 3.5 GW was already planned in the period up to 2023
- Between 2024 and 2030, an additional capacity of 7GW should be installed.

This large-scale deployment of offshore wind energy needs to be embedded in the overall regulatory context, including spatial and environmental policies. The 2030 *North Sea Strategy* was developed and it required, in line with the intentions of the new "*Omgevingswet*" (Environment and Planning Act), a broadly supported, participatory process. In the original planning, the *2030 North Sea Strategy* would have been ready in the summer of 2018, outlining the strategic challenges (including timing, areas of tension and opportunities) with the related key options for national (and international) investment, knowledge and cooperation agendas. However, the negotiations on a North Sea Agreement overtook this strategy.

Over the period 2018-2020, a fierce debate on the future on the North Sea, and the role, responsibilities and rights of its current and future users, took place in the Netherlands. Whereas before this period, the further development of offshore wind was mostly seen as a technological and financial challenge, the debate showed that it would have an impact on other users of the sea and also that the ecosystem effects of its large-scale deployment required further attention.

The tensions between these different interests and the underlying societal functions – and in particular those among energy, food and nature – are visualised in Figure 4, taken from de Vrees (2019).

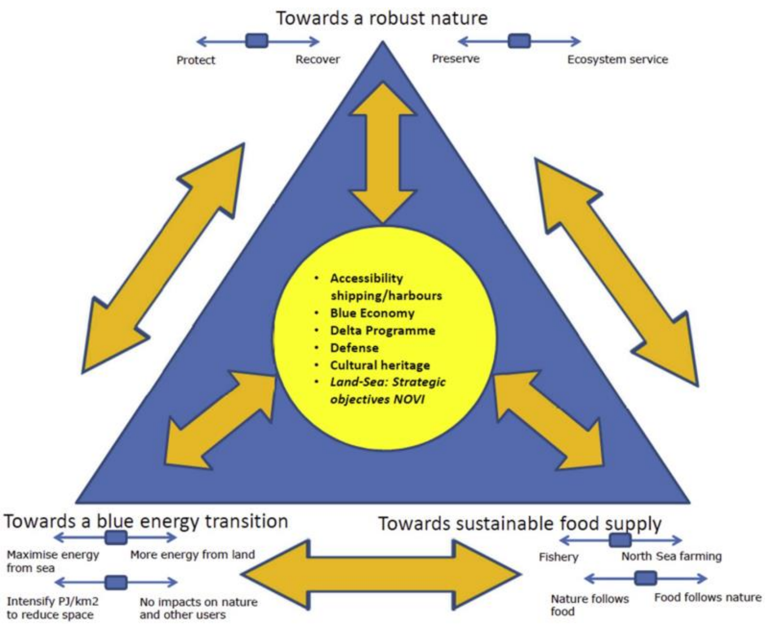
[5] https://energieakkoord.ser.nl/Uploaded_files/Documenten/283-energierapport-transitie-naar-duurzaam18januari2016ID284.pdf

[6] https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2016Z23255&did=2016D47582

[7] https://www.rijksoverheid.nl/documenten/kamerstukken/2018/03/27/kamerbrief-routekaart-windenergie-op-zee-2030

[8] https://www.rijksoverheid.nl/documenten/rapporten/2019/11/01/integraal-nationaal-energie-en-klimaatplan

FIGURE 4: TENSION BETWEEN ENERGY, FOOD AND NATURE



Source: de Vrees, 2019

The debate culminated in the signing of the North Sea Agreement (on June 19, 2020; OFL, 2020) by most of the stakeholders concerned. This North Sea Agreement describes agreements between government and stakeholders on the future activities on the North Sea over the period up to 2030 and thereafter. The list of signatories to the North Sea Agreement is provided below (see Table 3). Two fisheries organisations participated in the negotiations: the Dutch Fishermen's Union (*Nederlandse Vissersbond*) and "*VISNed*" (representing the Dutch cutter fisheres). After consulting its members on the draft text, the "*Nederlandse Vissersbond*" concluded they could not support the agreement. "*VISNed*" indicated that they support the agreement but, given the disunity in the sector, they chose not to sign either.

TABLE 3: SIGNATORIES TO THE NORTH SEA AGREEMENT

Category	Organization
National government	Minister of Infrastructure and Water Management (I&W)
	Minister of Agriculture, Nature and Food Quality (LNV)
	Minister of Economic Affairs and Climate (EZK)
Energy sector	Netherlands Wind Energy Association (NWEA)
	Netherlands Oil and Gas Exploration and Production Association (NOGEPA)
	Energie Beheer Nederland (EBN)
	TenneT
Non-governmental organisations	Stichting de Noordzee
	WWF Nederland
	Greenpeace
	Natuur & Milieu
	Vogelbescherming Nederland

Category	Organization
	Natuurmonumenten
Sea ports	Havenbedrijf Rotterdam N.V.

Source : OLF, 2020

3.2 Background to the project

The *Trial IA* project was commissioned in the context of the *North Sea Programme 2022-2027*, which describes current uses and future developments in the North Sea as well as the relationship with the marine ecosystem. In the development of the *North Sea Programme 2022-2027*, an extensive participatory process was set in motion to define a set of agreements for the spatial plan of the North Sea over the long term (a 2040-2050 time horizon). The *North Sea Programme 2022-2027* aimed to provide insight and clarity to all stakeholders concerned with the North Sea, and it was intended to be drawn-up in collaboration with these stakeholders (see Table 2) as well in consultation with the wider public. During the period from February to June 2020, a government initiated interactive process of joint fact-finding with stakeholders took place, in which different scenarios for the spatial plans of the North Sea were created, assessed and evaluated in an iterative fashion.

In order to support these discussions, there was a need to obtain insight into the expected advantages and disadvantages of these scenarios for the various stakeholders. Given the short turn-around time of these iterations, the Trial IA project aimed to provide an indication of the economic and ecological costs and benefits of spatial plans for the North Sea, to support the iterative and interactive marine spatial planning process (see Roebeling et al., 2021a).

The future scenario for spatial planning of human activities in the Dutch part of the North Sea is characterised by (see Table 4) a large extension of windfarms from 1 GW to 11,5 GW in 2030 and subsequently about 40 GW in 2040/2050, an almost complete decrease in oil and gas extraction, a 39% increase in shipping, an extension of aquaculture/mariculture to 400 km^2 (co-use in windfarms), a 60% increase in sand extraction, an extension of nature areas according the North Sea Agreement (version April 2020) and a change in fishing areas depending on the developments in other use functions.

TABLE 4: GLOBAL CHARACTERISTICS OF THE FUTURE SCENARIO AND ITS PLANNING VARIANTS

	2017	2040/2050
Windfarms	1.0 GW	39.5-40.5 GW
Oil and Gas extraction	161 platforms	5 platforms
Shipping		+39%
Aquaculture/mariculture	1 km^2	400 km^2
Sand extraction	25 million m^3	40 million m^3
Nature & biodiversity	Current nature areas	According to North Sea Agreement
Fishery	Fishing area dependent on development of other use functions	

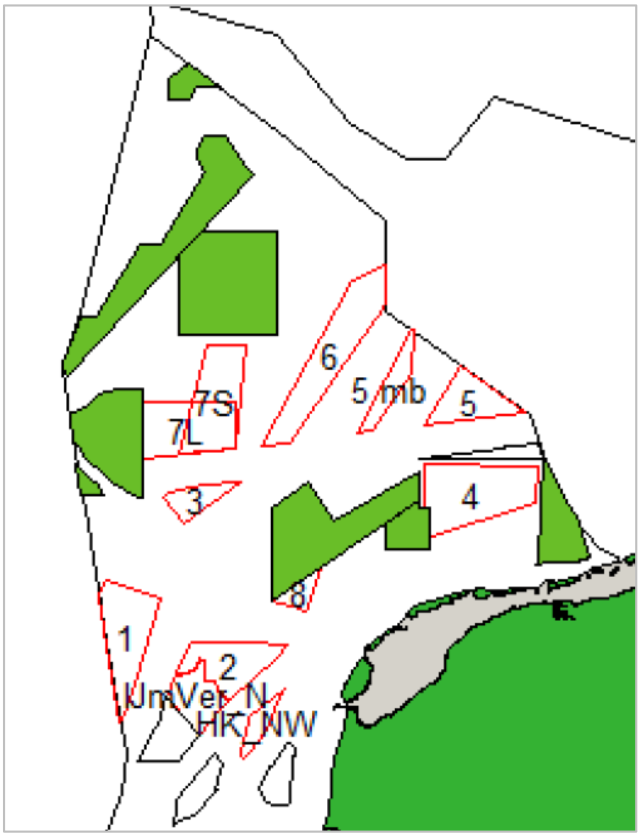
There are four spatial planning variants for the future scenario based on the choice for windfarm locations and concomitant capacity to include (see Table 5). In work sessions with stakeholders and representatives of the government identified eight new offshore windfarm locations (see Figure 5). These locations also differ in surface area (extent) and intended installed capacity for wind energy generation. Only part of these windfarm locations are required to deliver the additional 28-29 MW (after 2030) in order to meet the target of approx. 40 GW in 2040/2050. Four different spatial planning variants were identified that differ in their positioning in the Dutch EEZ, i.e. primarily south (Variant 1), a mixture of both south and north (Variant 2), primarily north (Variant 3) and primarily coastal (Variant 4). Further details can be found in Roebeling et al. (2021a).

TABLE 5: CHARACTERISTICS OF THE FOUR MSP VARIANTS (GW ESTIMATE BASED ON 10 MW/KM2). FOR THE OFFSHORE WINDFARM LOCATIONS, SEE FIGURE 5.

Offshore windfarm location	GW	Variant 1	Variant 2	Variant 3	Variant 4
1	9	9	9		
2	7 (+3)	7 + 3	10		7+3
3	3	3			
4 a)	13				13
5	6	6	6	6	6
6	20		4	13	
7	10			10	
8 b)	1,5				
Total	55 + 3 + 13 (if a) + 1,5 (if b)	28	29	29	29

a) Location 4 is only a realistic option if there is an alternative for the military exercise area;
b) Location 8 cannot be combined with location 2.

FIGURE 5: THE DIFFERENT SCENARIOS FOR THE LOCATION OF OFFSHORE WINDFARMS THAT WERE ASSESSED BY THE TRIAL IA. GREEN AREAS ARE DESIGNATED (PLANNED OR AGREED) N2000 AREAS



Source: Deetman et al. (2020)

To assess the socio-economic consequences, a Cost-Benefit Analysis (CBA) was applied (following Strietman et al., 2019), that included the following sectors: oil and gas, maritime transport, windmill construction, windmill exploitation, fisheries, aquaculture and sand extraction. To assess the ecological costs and benefits, Cumulative Impact Assessment (CIA) was used (following Jongbloed et al., 2019), considering the ecosystem components birds, sea mammals, fish and benthic.

Results from the Trial IA showed large economic and environmental impacts when moving from the current situation (2017) to all four future scenarios (2040/2050), due to the significant changes in sectoral activities (strong growth in wind energy vs. strong decrease in oil & gas and fisheries) and corresponding environmental pressures (see Roebeling et al., 2021a). However, small differences in economic and environmental impacts between future scenarios (2040/2050) were observed, due to the relatively small differences between scenarios (i.e., mainly differences in the location of windfarms).

Given these small differences in results between future scenarios for 2040/2050, separate follow-up studies on the impacts of a wide range of alternative future scenarios for this timeframe were commissioned during the period September to November 2020. Differences between scenarios were determined by the location of wind farm areas and, thus, not by the total capacity (GW) of wind farms.

Follow-up studies included a Levelized Cost of Energy (LCoE) study for new wind farm areas after Roadmap 2030 (BLIX, 2020b), a study on the socio-economic values of fisheries in these new wind farm areas (Deetman et al., 2020) and a cost-benefit study on off-shore hydrogen production (NSE, 2020). These results were, amongst others, used in a separate project (Roebeling et al., 2021b) which assessed the economic impacts of these alternative future scenarios (2040/2050) on a limited number of sectors (windmill construction, windmill exploitation, fisheries and maritime transport) and excluded an assessment of the environmental impacts. While that separate project is not the focus of this particular case study, it shows how the planning process developed after the Trial IA.

3.3 Feedback from policy-makers

The role and usefulness of the Trial IA (conducted via the '*Kentallen analyse*' study) in the overall Dutch MSP process was the topic of an interview with two key national policy-makers (coordinator of the spatial planning process on the North Sea; Trial IA North Sea project leader). This interview included questions about the larger North Sea spatial planning process, the role of the Trial IA in relation to other/parallel studies and activities, the usefulness of the insights obtained from the Trial IA, the usefulness of the Trial IA for stakeholder information/engagement and, finally, the opportunities for improvement. The information from this discussion is provided in the following tables, with the answers to the five questions that were the main topics shown in blue.

1. The Trial IA was part of a larger process, including parallel studies, expert workshops, webinars and meetings. Please indicate the studies and activities that were developed in parallel during the marine spatial planning process for the North Sea that took place in the first semester of 2020.

Studies	• De economische en ecologische effecten van inrichtingsvarianten voor de Noordzee tot 2040/2050 (WEcR, 2020) • Study into Levelized Cost of Energy of seven new wind zones and IJmuiden Ver (BLIX, 2020a) • Expert inschatting van nieuwe windparkzoekgebieden op de Noordzee voor verschillende soortgroepen (WMR, 2020)
Workshops	• Expert workshop 'Natuur en windenergie' (04-02-2020) • Expert workshop 'Windenergie' (19-02-2020)
Webinars	• Webinar 'Kentallenanalyse Programma Noordzee' (11-06-2020)
Meetings	• Noordzeeoverleg (including discussion results Trial IA; monthly) • Interdepartementaal Directeuren Overleg Noordzee (IDON; monthly)

2. What insights did (expected/additional obtained) and didn't you (expected/desired but not obtained) derive from the Trial IA?

Expected or additional obtained insights	Expected or desired but not obtained insights	Recommendations
• Expected to obtain insight in the ecological and economic consequences (advantages and disadvantages) of different spatial planning scenarios for the North Sea	• Ecological analysis was not spatially explicit and economic analysis required the inclusion of additional cost items (e.g. related to shipping safety and landing costs). Hence, it turned out that the differences in ecological and	• Additional research needed to i) assess the spatially explicit ecological impacts of spatial planning scenarios for the North Sea and ii) assess the economic impacts of the inclusion of additional costs items for the spatial planning

Expected or additional obtained insights	Expected or desired but not obtained insights	Recommendations
	economic impacts were relatively small across spatial planning scenarios for the North Sea	scenarios for the North Sea
• Expected that, based on these insights, a preferred spatial planning scenario for the North Sea could be identified	• Hence, differences in impact were not sufficiently distinctive to identify a preferred spatial planning scenario for the North Sea	• Need for an integrated assessment framework that can provide an optimal spatial planning scenario – i.e., one that balances ecological, economic and social values

3. How useful was the Trial IA for informing the iterative and interactive marine spatial planning process for the North Sea?

Advantages	Disadvantages	Recommendations
• Gave insight in the ecological and economic impacts of different spatial planning scenarios for the North Sea • This provided stakeholders a good basis for discussion on results and trade-offs • This resulted in the definition of i) alternative spatial planning scenarios for the North Sea and ii) the identification of research gaps and future research avenues	• Ecological impacts were difficult to assess and compare • The ecological analysis showed that each scenario had its advantages and disadvantages • The study analysed relative differences, whereas some stakeholders expected absolute values	• Improve presentation of results to better communicate with stakeholders • Need for framework that allows to assess the overall ecological impacts • • Present results in absolute and relative terms, so that stakeholders can better understand the results

4. In the marine spatial planning process and Trial IA for the North Sea, what worked well (drivers) and what did not work so well (obstacles)?

	What worked well?	What didn't work so well
Marine spatial planning process	• Intensive discussions with stakeholder groups in meetings, workshops and webinars	• Stakeholders that expected not to benefit from the spatial planning scenarios for the North Sea, looked for arguments to frustrate the process • COVID-19 complicated the stakeholder engagement process

	What worked well?	What didn't work so well
Trial IA	• Provided information on the multiple ecological and economic impacts of different spatial planning scenarios for the North Sea • Resulted in discussion amongst stakeholders and subsequent definition of alternative spatial planning scenarios for the North Sea • Resulted in the definition and execution of (short-term) follow-up studies	• The Trial IA was not sufficiently detailed (economic impacts) or spatially explicit (ecological impacts), due to data and knowledge gaps, to identify a preferred spatial planning scenario for the North Sea • COVID-19 complicated the stakeholder engagement process
	• Provoked and initiated a lively political discussion ...	• ... that, however, partly coincided with the dynamics and politics surrounding the definition of the North Sea Agreement

5. For future marine spatial planning processes and Trial IAs for the North Sea, what would you recommend next time?

Marine spatial planning process	• More intensive than what was done is not possible, with such strong differences in opinions and interests among stakeholders. In the end it is a policy driven process where consensus cannot be reached and the government will have to decide.
Trial IA	• To analyse and assess not only relative changes but, in order to create believe and recognition, also analyse and assess absolute changes • To be able to assess in a more detailed and spatially explicit fashion the ecological and economic impacts of marine spatial planning scenarios • To have an integrated assessment framework that provides a ranking and guides the selection of spatial planning scenarios

4. EBA PRINCIPLES, METHODS, TOOLS AND CROSS-CUTTING ELEMENTS

4.1 To what extent was EBA integrated in MSP

This section provides a brief review how the EBA steps and principles were addressed in the Dutch MSP process and in particular in the Trial IA. It draws on the steps and principles elaborated in the context of the overall *Study on integrating an ecosystem-based approach into maritime spatial planning* (the identification of five EBA steps in turn draws on Schmidtbauer Crona (2017), and that of EBA principles draws on Long et al. (2015).

There is no reference to specific steps in the design of either the overall Dutch MSP process, but several can be recognized in how the process was conducted so far. Moreover, although the Trial IA did not explicitly consider the EBA principles, several of them were clearly addressed in the overall MSP design and planning.

Table 6 shows how EBA principles were addressed in the Trial IA. It also shows briefly how the principles were addressed in the overall process and in cross-cutting steps: for this, it draws on de Vrees (2019), which clearly shows that the MSP process started with a *defining step* firmly embedded in a stakeholder involvement process. The Trial IA exercise can be considered a somewhat premature *assessing step* with the purpose of feeding into the stakeholder process in order to obtain feedback that then shapes the *developing step* so that a more robust *assessing step* can be conducted in a next cycle of the MSP process. If this interpretation is correct, several smaller sub-cycles resulting in a gradual improvement of the knowledge base and the science capacity to inform decision-making took place before moving to a final decision and to the *implementation step*.

TABLE 6: HOW CAN THE OVERALL DUTCH MSP PROCESS AND SPECIFICALLY IN THE TRIAL IA BE FITTED TO THE STEPWISE MSP PROCESS? NOTE THIS WAS NOT IN THE DESIGN OF THE DUTCH MSP PROCESS.

MSP steps and transversal processes	EBA principles	How this was tackled in the North Sea case study
Overall Dutch MSP process		
Defining	Decisions reflect Societal Choice	Policy objectives drive the Dutch MSP process. Adaptation is required when policy objectives change.
	Appropriate Spatial and Temporal Scales	The temporal scale is determined by the requirement to focus the assessments on the period 2040/2050. This is realistic as this reflects the time before the current plans for offshore windfarms materialize. The spatial scale is determined by the detail of the information on the future locations of sea-based sectoral activities (such as for offshore wind).
	Distinct boundaries	The boundary of the North Sea case study is defined, i.e. Dutch EEZ and the territorial sea, but only covering the offshore areas not coastal zone and the estuaries. From a jurisdictional perspective it makes sense to only cover the Dutch EEZ. From the ecological impact assessment within the Trial IA, it appears that the coastal zone with 1Nm and the estuaries were excluded as only the relevance for the MSFD was considered.
The Trial IA		
Developing	Ecological integrity and biodiversity	Addressed via the use of a Mental model and Cumulative Effects/Impacts Assessment (CEA/CIA).
	Appropriate Spatial and Temporal Scales	When developing the knowledge base for the ecological assessments, it became clear that much of the ecological information was not available at the spatial scale required.
	Consider ecosystem	Addressed via the use of a Mental model and Cumulative Effects/Impacts Assessment.

MSP steps and transversal processes	EBA principles	How this was tackled in the North Sea case study
	connections	
	Account for dynamic nature of ecosystems	Not addressed.
	Recognise coupled SES	Although both the social and ecological system were covered with, respectively, the CBA and the CEA/CIA (see subsequent models & tools sections), this did not truly represent a coupled social economic system (SES) where feedbacks between the two would exist: in the Trial IA's analysis, sea-based sectoral activities impact the marine ecosystem, though ecosystem functioning and quality do not impact sectoral activity.
	Consider cumulative impacts	Cumulative ecological impacts of the activities via pressures on ecological components and biodiversity on the North Sea were assessed with an existing CEA tool covering a broad scope but not were spatially explicit. This served the developing process as well as the preliminary assessment process. The outcome of the CEA has revealed important knowledge gaps and provided focus on more refined defining and assessing, including spatially explicit information on new offshore wind areas and sensitive ecological components. Cumulative economic impacts in the CBA approach were assessed through aggregation of sectoral impacts, considering sea-based sectoral activities and land-based sectoral activities that supply goods and services to these sea-based sectoral activities.
Assessing	Inter-disciplinarity	With the application of the CBA and the CEA/CIA (see subsequent models & tools sections), both the socio-economic and natural sciences were covered.
	Sustainability	All dimensions of sustainability were addressed with the environmental (healthy sea), social (safe sea) and economic (profitable sea) societal goals, as set out in the national *Integrated Management Plan for the North Sea 2015*.
	Recognise coupled SES	Although both the social and ecological system were covered with respectively the CBA and the CEA/CIA (see subsequent models & tools sections), this did not truly represent a coupled SES. Extension of the applied CEA/CIA to also include ecosystem services together with some valuation of their contribution to human wellbeing could have addressed this.
	Consider cumulative impacts	See above. Assessment of cumulative economic impacts as well as ecological impacts were carried out, but only on an exploratory level. This can be repeated after alterations and improvements in the definition and developing steps. So there are possibilities to cover this with CEA/CIA.
Future steps		
Implementing	Acknowledge uncertainty	As implementation has not occurred yet, these steps cannot be evaluated.
	Apply the Precautionary	

MSP steps and transversal processes	EBA principles	How this was tackled in the North Sea case study
	Approach	However, the MSP process is explicitly designed to be adaptive because this is required by legislation, and the evaluation of performance of the system or the implementation of the actions and policy is planned. Moreover, the MSP should be adjusted in the case of
	Appropriate Monitoring	
	Adaptive Management	of a new government direction with new policy objectives or changes in developments from outside (de Vrees, 2019).
Follow-up	Appropriate Monitoring	
	Adaptive Management	To these ends, continuous monitoring and regular evaluation are embedded in the process.
Cross-cutting elements		
Stakeholder mobilisation	Stakeholder involvement	This is explicitly considered and discussed. The Trial IA formed part of the North Sea Programme 2022-2027, to be drawn-up in collaboration with these stakeholders as well in consultation with the wider public.
Governance and institutional set-up	Use of Scientific Knowledge	Clearly, scientific knowledge is embedded in the process. As it is only at the start of the process, it is too early to determine the uptake of scientific conclusions and recommendations.

It should be noticed that the CBA in the Trial IA-study was situated somewhere in between in the process for the North Sea Programme 2022-2027. Therefore the CBA was dependent on the choices made in the preceding phase.

4.2 Tools and cross-cutting elements

This section describes which tools were applied in the Trial IA and highlights how the information available determined their application. Also, their role in the transversal process of stakeholder involvement was specifically considered.

4.2.1 Mental model

Mental models represent the way in which people understand the world around them. Cumulative Effects Assessment (CEA) (see section 4.2.3) require a mental model (or sometimes referred to as linkage framework) which connects the different categories of human/economic activities-pressures and ecosystem components through impact chains. This is carried out in the CEA tool that was applied in the Trial IA study.

Sectors involved in the CEA as part of the Trial IA

It should be realised that a mental model can always be **applied** and the comprehensiveness depends on its complexity in terms of the level of detail of the sectors and their activities, or of the ecosystem, or of the extent to which ecosystem services or the full social-ecological system are considered. A first selection of at least 10 types of activity from the many involved in the Dutch North Sea was made in the NSP process preceding the conduct of the Trial IA study.

At the start, the Trial IA focused on the inclusion of these sectors. However, the carbon capture and storage (CCS) sector and the tourism and recreation sector were omitted from the mental model because of insufficient data access. This was discussed and agreed with RWS. Several types of fisheries are present, and they vary considerably in both economic value and ecologic impact. Three categories were distinguished and used in the CEA: bottom fishery, pelagic fishery and gillnet fishery. The resulting set of activities which were included in the CEA is listed in Table 7. Pressures and ecological components are also part of a mental model and listed in the same table. However, the selection of pressures and ecologic components was not discussed among RWS/I&W, stakeholders and Wageningen Research (WR). The selection of the relevant pressures and ecological components was only made by WR and used in the CEA. This is described in section 4.2.4).

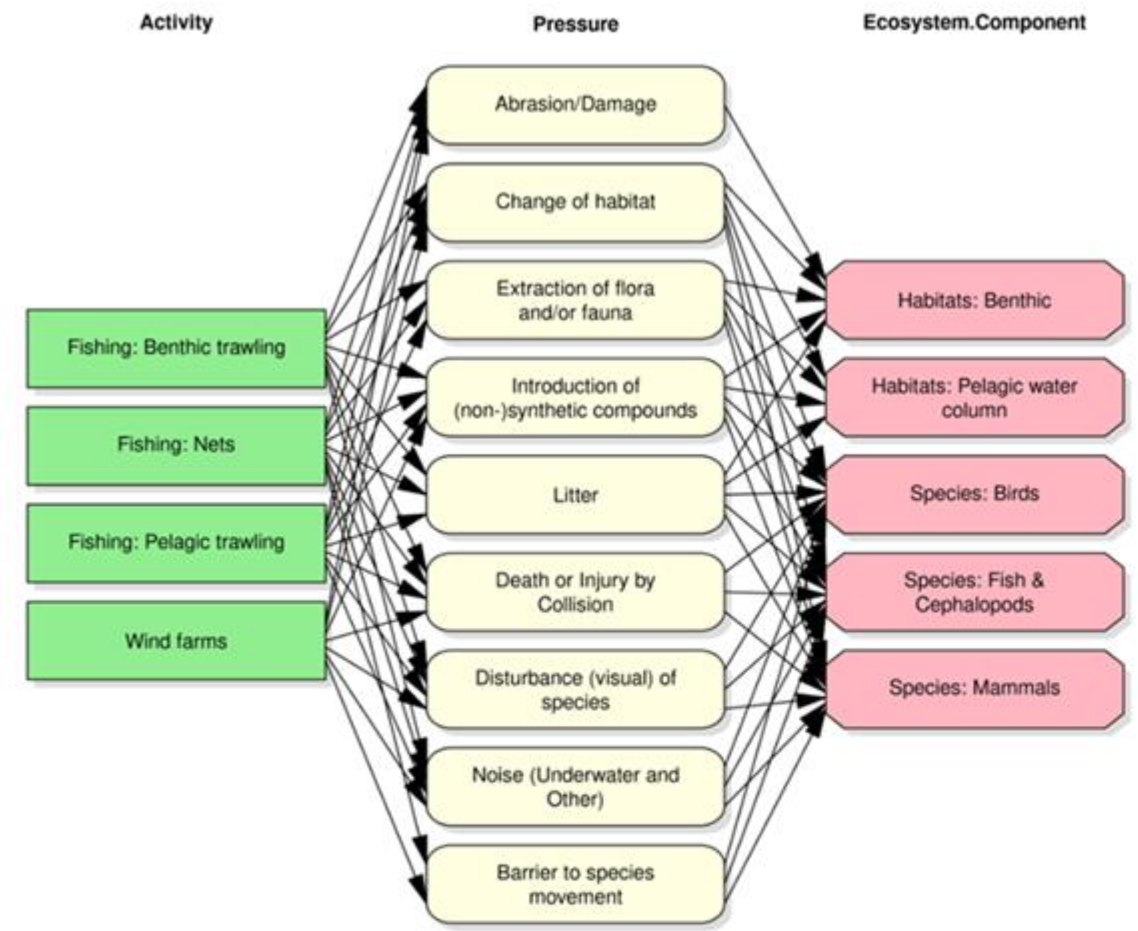
TABLE 7: ACTIVITIES, PRESSURES AND ECOLOGICAL COMPONENTS INCLUDING THE MENTAL MODEL AND THE CEA FOR THE NORTH SEA CASE STUDY

Activities
Aquaculture
Fishing: Benthic trawling
Fishing: Nets
Fishing: Pelagic trawls
Oil and Gas
Sand extraction
Shipping
Telecoms and Electricity
Wind farms
Ecological components
Birds
Fish
Mammals
Habitat Pelagic water column
Habitat Sublittoral sediment
Habitat Littoral sediment
Habitat Circalittoral rock and other hard substrata
Pressures
Abrasion/Damage
Artificialisation of habitat
Barrier to species movement
Change of habitat structure/morphology
Changes in input of organic matter

Changes in Siltation
Death or Injury by Collision
Disturbance (visual) of species
Electromagnetic changes
Extraction of flora and/or fauna
Input of light
Introduction of genetically modified species
Introduction of Microbial pathogens
Introduction of non-indigenous species
Introduction of Non-synthetic compounds
Introduction of Radionuclides
Introduction of Synthetic compounds
Litter
N&P Enrichment
Noise (Underwater and Other)
pH changes
Selective Extraction of non-living resources: substrate
Smothering
Total Habitat Loss
Translocations of species (native or non-native)
Water abstraction
Water flow rate changes

Figure 6 visualises the output of the mental model for the Trial IA; for clarity, the sectoral activities are limited to fishing and wind farms and only their main pressures and potential impact on ecosystem components are presented.

FIGURE 6: ILLUSTRATION OF THE MENTAL MODEL FOR THE TRIAL INTEGRATED ASSESSMENT CONFINED TO FOUR OF THE NINE SELECTED SECTORAL ACTIVITIES: FISHING AND WIND FARMS, THEIR MAIN PRESSURES AND THEIR POTENTIAL IMPACT ON THE ECOSYSTEM COMPONENTS



Prior and during the Trial IA, RWS and the ministries of I&W and LNV explored the pros and cons of the **scenario variants** with the stakeholders in a joint fact-finding process. The scenario variants consist of combination of activities which vary in the intensity, total spatial extent and spatial allocation of some of these activities at the North Sea. In 2040/2050. It was foreseen that this stakeholder process may lead to the adjustment of the scenario variants that would be analysed in the Trial IA study.

The mental model is suitable to compare multiple variants within the same framework. The result of the Trial IA was used in discussions with stakeholders in order to select a number of variants that were presented for the strategic environmental assessment (SEA) (In Dutch: *Plan MER*) for the *National Water Programme*. During the execution of this SEA, the aim will be to decide on a preferred variant. For this preferred variant another and more comprehensive SEA will be carried out. This is at a later stage than the Trial IA that is described in this North Sea case study report. The mental model should be applied during various stages in the North Sea Programme process.

In the Trial IA, there were limited discussions on the mental model (the societal base/SES) and the knowledge base. Presumably these discussions already took place in the preceding stage of the NSP process: Wageningen Research was not included in the preceding phase of the NSP; it can be recommended to link the execution of the MSP steps and treat this as an integrated process.

The applied CEA-tool does not have the possibility to conduct spatially specific impacts. The tool does not work with spatial distribution of activities, pressures and ecological components on the North Sea. Furthermore, this information will not be available for the complete spectrum of activities, pressures and ecological components. A solution to both problems was found in commissioning an extra study. This was an expert opinion assessment of new offshore wind farms on species groups in the Dutch North Sea (also mentioned in section 0). This study served the aim of distinguishing between impacts of the spatial variants of new offshore wind farm areas. However, it is clear that important knowledge gaps exist and these are identified in both reports: the Trial IA report and the Expert opinion report. In addition, it can be concluded that there is a strong need for a spatially specific and quantitative CEA method that can be applied for the North Sea. When that is developed, it could be incorporated in **a tool for MSP**. Which would allow to evaluate scenarios for MSP based on CEA and other EBA principles.

For spatial tools, data availability might be limiting implementation. See also CEA in section 4.3. In the Trial IA, this was not considered by all parties beforehand, and there was too little opportunity to apply this while conducting the study due to the tight NSP time frame. There may still be opportunities to improve parts of mental model and other parts of MSP and tools and apply in the remaining phases.

Participation of stakeholders

The Trial IA for the North Sea was a part of the process that will end in a new North Sea Programme. The Dutch authorities designed the sequence with all steps, intermediate products and final products, connected stakeholders, tools, etc. (see section 0). That implies that EBA-principles could have been or will be applied at different stages in the process. WR was not involved in some of the stages preceding the Trial IA. So, here this analysis cannot be complete: this case study is limited to the Trial IA and information that will be provided by the persons that are interviewed for the North Sea case study report (see sections 3.3). In the webinar with the stakeholders some remarks were made by stakeholders with respect to the mental model choices that were made (see section 4.2.3).

Relevant ecological components involved?

In the CEA four ecological component groups were included: seabirds, fish, marine mammals and habitats (see Table 7).

In the Expert opinion study, a somewhat different set of ecological components was considered: seabirds, seals, harbour porpoise, bats, fish and reef-building benthos species. This was based on the potentially high vulnerability of certain species and habitats for offshore wind farms – or in the case of the reef-building benthos species – more opportunity for development, due to protection against bottom trawling fishery. In the webinar it was suggested to add the group of migratory birds to this selection.

The CEA tool is suitable to include more species groups and more habitats. For instance, for the Dutch North Sea pelagic and demersal fish species can be discriminated and linked to different fishery groups. As habitat types, sublittoral sediment, littoral sediment, circalittoral rock, other hard substrate and the pelagic water column can be chosen.

For the Trial IA, the researchers of WR chose to aggregate all habitats defined in the CEA into one group of seabed habitats. That aggregation is easier to understand for stakeholders. This aggregation, and the reasons behind it, were discussed and agreed with the steering group. During the consultation meeting/webinar with the stakeholders, a question was raised about the aggregation of habitats in only one group (see section

4.3). It is believed that the person who raised this question wished to distinguish among some habitat types. That is possible with the CEA-tool as described before.

Future scenarios

In the Programme North Sea preparation process, shortly before and during the period that the Trial IA study took place, the government organised an interactive process of joint fact-finding with stakeholders to design and evaluate different variants for the spatial planning of human use in the North Sea. Four variants for 2040/2050 were distinguished based on global locations of the potential wind farm areas with areas in the south (*Combinatie Zuid*), a mixture of energy clusters in south and north (*Mix Energiehubs*), areas mainly in the north (*Combinatie Noord*) and areas with smaller distance to the coast (*Dichtbij Energievraag*).

During the Trial IA, there was a shift in the focus of the project to the long-term. At the start, future scenarios were focused on two years: 2030 and 2040/2050 without application of (spatial) variants for those years. WR conducted an economic and ecologic analysis for those years and presented intermediate results. Soon after, RWS requested an analysis of the four variants for 2040/2050, whereas analysis for 2030 was of less interest. The results for the Trial IA reported in Roebeling et al. (2021a) only comprise the reference situation (2017) and the future situation (2040/2050) with its four variants. For 2030, some data are provided for developments in some sectors, but an assessment was not carried out for the situation in 2030.

EBA-principles involved

The following observations, beyond the information in Section 4.1, can be made:

- **Ecological integrity and biodiversity**: this was not explicitly considered in the analysis and the process, except for the approach that the spectrum of ecological components was included in the mental model (framework) and the CEA was chosen to cover ecological integrity and biodiversity.
- **Consider ecosystem connections**: this was partly considered in the analysis, namely only in the expert opinion for some species. However, it did not receive attention in the process.

WR experience overall

The fine tuning has not taken place in the Trial IA, but may have been taken into account in the SEA with an extensive social cost-benefit analysis (SCBA) and CEA scheduled in the following phases of the North Sea Programme 2022-2027 (NSP). From the Trial IA and the discussions with the steering group and the stakeholders in the webinar, WR concludes that there is a need to fill in the major knowledge gaps as well as a need for the development of a practical tool for MSP including a CEA tool and spatial detail. The latter would be very helpful to structure presentations and discussions.

4.2.2 Cost-Benefit Analysis

As outlined in Section 0, the Trial IA aimed to provide an indication of the economic and the ecological costs and benefits of spatial plans for the North Sea (see Roebeling et al., 2021a). The CBA described in this section focused on the costs and benefits for economic sectors, without a consideration of environmental costs and benefits.

To assess the economic costs and benefits of the current situation (2017) and the future scenarios (2040/2050) for the North Sea, the Economic Impact Assessment (CBA) approach was used (following Strietman et al., 2019). The economic impact is assessed by i) determining the economic size of the relevant sectors in the current situation (2017), ii) estimating the expected growth of the sectors for each of the future scenarios (2040/2050) and, finally, iii) determining the economic size of the sectors in the future scenarios. The economic size per sector was calculated for sea-based sectoral activities as well as for related land-based sectoral activities that supply goods and services to these sea-based sectoral activities. Sectors considered comprised: oil and gas, maritime transport, wind turbines construction, wind farms exploitation, fisheries, aquaculture and sand extraction. Economic indicators included gross production value, value added and employment.

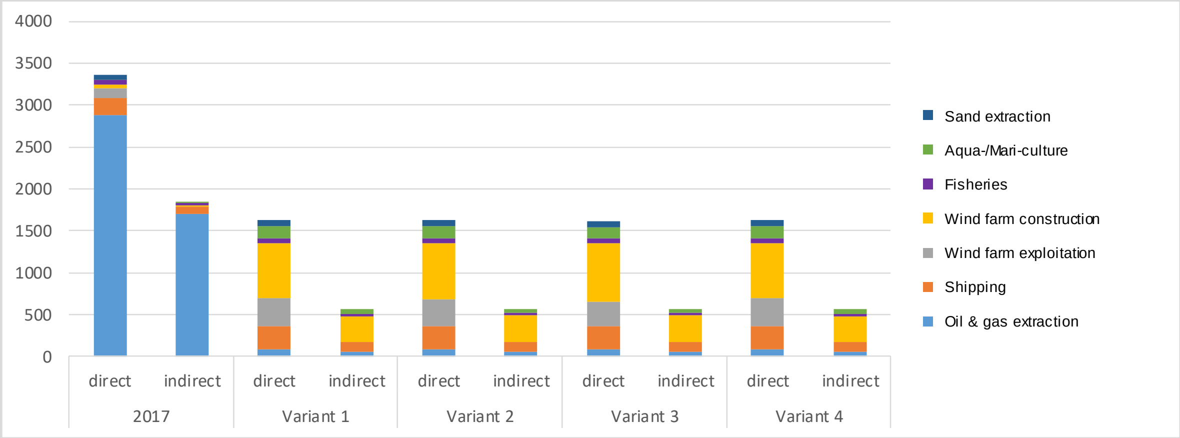
The temporal scale comprises a comparative static analysis of the current situation (2017) and the future scenarios (2040/2050). The spatial scale coincides with the Dutch part of the North Sea (Dutch EEZ), considering sea-based sectoral activities as well as land-based sectoral activities that supply goods and services to these sea-based sectoral activities. Land-based sectoral activities that process goods and services from these sea-based sectoral activities were not considered.

Coupled social economic system (SES) perspectives were considered through sea-based sectoral activities that impact the marine ecosystem, based on their size (area), pressure and spread of pressure. There was, however, no feedback from the ecological system to the social system – i.e. the functioning and quality of the marine ecosystem and corresponding supply of marine ecosystem services and values are considered constant in the CBA (only dependent on size).

Cumulative economic impacts in the CBA approach were assessed through aggregation of sectoral impacts, considering sea-based sectoral activities and land-based sectoral activities that supply goods and services to these sea-based sectoral activities. However, land-based sectoral activities that process goods and services from these sea-based sectoral activities were not considered. Also, various macro-economic aspects were not considered in the CBA. In particular, these included the uncertain impacts of the Brexit, the development of sectoral activities in other parts of the North Sea and, as already mentioned above, the uncertain impacts on the land-based sectoral activities that process goods and services from these sea-based sectoral activities. Follow-up studies have been developed since, such as in relation to fisheries (Deetman et al., 2020) and wind parks (BLIX, 2020; Roebeling et al., 2021b).

The outcome of the CBA revealed that future variants show a major shift in the relative economic importance of the various uses between 2017 and 2040/2050 (Figure 7). Wind farm operation, wind farm construction and aqua/mariculture would become uses with a relatively high economic importance, shipping and sand extraction retain their economic importance, fisheries show a decline in economic importance, and oil and gas extraction would become uses with no significant economic value. With regard to employment, there is a diversified picture emerging in the variants, in which multiple user functions contribute substantially to employment on the North Sea.

FIGURE 7: DIRECT AND INDIRECT VALUE ADDED (IN MILLION €) OF THE VARIOUS USES, IN 2017 AND IN 2040/2050 DEPENDING ON THE MSP VARIANT (FOR EXPLANATION SEE SECTION 3.2)



Source: Roebeling et al., 2021a: p.39

The differences in economic effects between the future variants 2040/2050 are relatively small (Figure 7), which is the result of the small differences between the variants – i.e. only variation in the location of windfarm areas. For the economic effects, this means that there are relatively small differences (compared to the total values of all uses) in construction costs, differences in yield and landing costs (cables) of the windfarm areas that, together, make up 28 GW.

4.2.3 Cumulative Impact Assessment

As mentioned before, the Trial IA aimed to provide an indication of the economic as well as the ecological costs and benefits of spatial plans for the North Sea (Roebeling et al., 2021a). To assess the ecological costs and benefits of the current situation (2017) and the future scenarios (2040/2050) for the North Sea, the Cumulative Impact Assessment (CIA) approach was used (following Jongbloed et al., 2019).

WHAT WAS DONE IN THE CEA AND WHAT WAS THE RESULT OF IT?

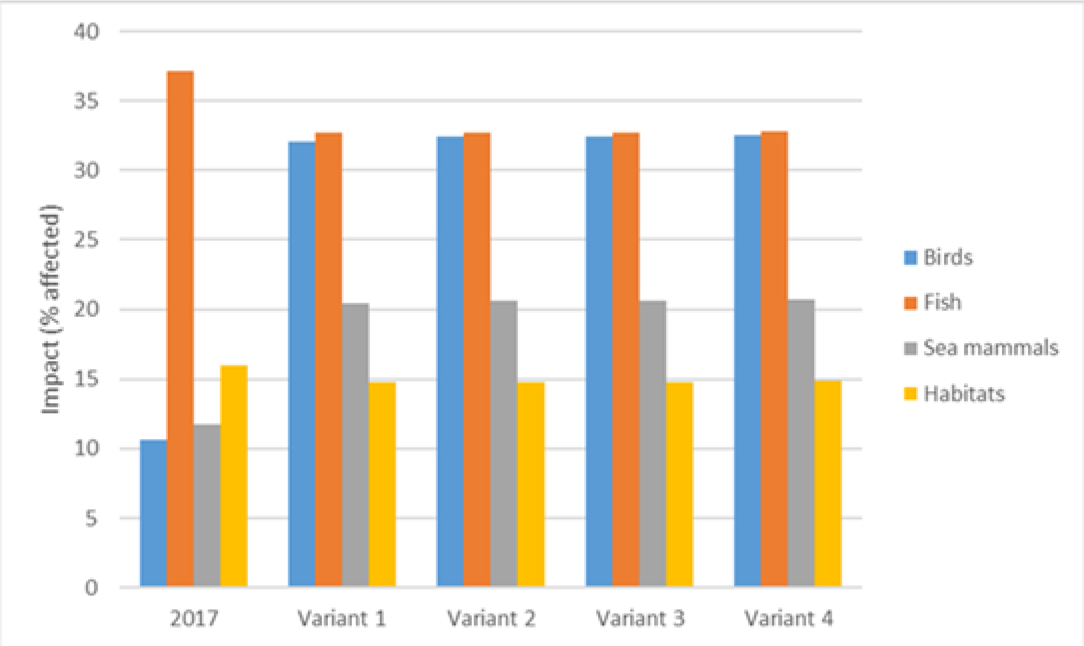
Before describing the application and the outcome of the ecological assessment within the Trial IA, the choice of environmental assessment methods should be concluded. There are four main types of environmental assessments serving different purposes with overlapping spatial and strategic scales (see Annex 2). For new and comprehensive spatial plans there is often a need to start ecological assessment on a high strategic level and to follow it across sequential decision-making levels (Partidario 2000; Tamis et al., 2016): an overarching approach covering different purposes and assessment levels would be beneficial. In the NSP, SEA and CEA are the required type of methods and indeed these are requested by IDON. For the Trial IA, only the CEA was applied.

In the Trial IA, to get an indication of the direction of the ecological effects of the considered spatial planning variants, the CEA calculated the difference in the impact of human/economic activities on ecosystem components (fish, seabirds, marine mammals and habitats) between the present situation (2017) and the (hypothetical) future situations (2040/2050). This provided insight into the influence of various policy measures and spatial planning variants on ecological and biodiversity effects.

The input information needed to feed the CEA included data on the spatial extent and intensity of human/economic activities in the Dutch EEZ of the North Sea: this was provided by the Rijkswaterstaat (RWS) / Ministry of Infrastructure and Water Management (I&W) / Ministry of Agriculture, Nature and Food Quality (LNV) and the stakeholders via the joint fact-finding work compiled in the work packages and variants (mentioned in section 2.2). In addition, information was derived from several published sources (e.g. Matthijsen et al. (2018, 2019), CBS (2016, 2019), Ecorys (2018), PWC (2018) available at Wageningen Economic Research. A reference situation (2017) and two time horizons (2030 and 2050) with variants were considered.

The outcome of the CEA revealed that the future variants increase the impact on seabirds and marine mammals due to wind energy development but decrease the impact on fish and habitats due to decreased fishery activity and the greater space dedicated to protected nature areas and wind farm areas closed for other human/economic activities (Figure 8). Differences among the future variants in effects on nature and biodiversity are small due to small differences among these variants in surface area of the human/economic activities on the NCP of the North Sea. As noted, the CEA method was based on total spatial extent but not on locations which will differ in species density and habitat presence. However, the commissioner (Ministry of Infrastructure and Water Management) was very interested in such a spatial specific assessment for new wind farms search areas and their combinations in the variants.

FIGURE 8: TOTAL IMPACT PER ECOSYSTEM COMPONENT (BIRDS; FISH; SEA MAMMALS; HABITATS) DUE TO ALL USES, IN 2017 AND IN 2040/2050 DEPENDING ON THE MSP VARIANT (FOR EXPLANATION SEE SECTION 3.2).



Source: Roebeling et al., 2021a: p.42

In order to get an indication of the possible effects on nature/biodiversity due to wind energy production in eight potential new wind farm areas, an expert opinion method was applied. WR experts in the field of seabirds, marine mammals, bats, fish and reef-builders were consulted and the results were elaborated in a synthesis report (Jongbloed et al., 2020). The results revealed that for seabirds, harbour porpoise and reef-builders, potential wind farm areas could be distinguished on the basis of their potential effects. For seals, bats and fish, distinctions among the potential wind farm areas concerning potential impacts of wind farms were not well possible. Overall, this expert opinion analysis pointed at a small preference for one of the four future variants, namely Variant 2 (*Mix Energiehubs*). There are important knowledge gaps that reduce the confidence of the assessments with the CEA and the Expert knowledge opinion. A partially spatially specific CEA could reduce these knowledge gaps and improve the confidence of assessments, but this was not possible at the time due to limited time and budget.

What was the opinion of RWS/I&W/steering group on outcome and process?

In the intermediate part of the process, the steering group did not understand the type of results produced by the CEA, and in particular the unity of the predicted impact on nature values. Therefore, WR elaborated the type of result from a relative unity for impact into % affected. That was acceptable for the steering group.
The steering group expected that the influence of spatial information (locations of human/economic activities and location specific densities of species and habitats on the North Sea) could be included in the CEA of human/economic activities, especially the wind farm areas. WR explained that that type of analysis was not offered in the tender because it would not fit into the available frame for time and budget. A solution was found to solve part of the problem by conducting an additional study. This was a consultation of WR experts to compile an assessment of the impact of potential wind farm areas in the Dutch North Sea for species groups, in which spatial information was taken into account (as mentioned in section 4.2.1). The results of these two studies provided a good basis for the webinar with stakeholders and the remainder of the NSP process. In an evaluation, RWS, I&W and Wageningen Research agreed that the problems encountered concerning expectations around the type of results and the time pressure of the Trial IA study may have been prevented by better communication.

What was the opinion of the consultation (webinar) on outcome and process?

Many and very diverse comments, questions and suggestions were made during the webinar with stakeholders and other interested organisations and persons. However, the opportunity was relatively limited, and background information was not shared.

Opinion of WR on outcome and process

The CEA tool applied in the Trial IA, as noted above, was not spatially explicit. That means that it does not use spatial distributions of the activities, pressures and ecosystem components and therefore it cannot provide maps of potential cumulative impact to guide the MSP process. Although it lacks this spatial information, it can indicate the activities and their pressures most likely to compromise achievement of environmental policy objectives. This is what was done in the Trial IA in this stage of the North Sea Programme.

For such a spatial assessment. sufficient input data have to be available for the spatial distribution of activities, pressures and ecosystem components, as well as the sensitivity of ecosystem components for pressures in the North Sea, at least the Dutch part. However, that kind of information is not currently available for part of the pressures and ecological components. In addition, that information is not compiled for the North Sea.

The ecological part of the Trial IA was carried out by a CEA based on qualitative expert judgement-based descriptors. In addition, for the offshore wind sector, a questionnaire was used as a supplementary tool to include information on the spatial distribution of potential offshore wind farms, their pressures, the ecosystem components, as well as the sensitivity of ecosystem components to these pressures.

For the ecological part of the Trial IA, use was made of an existing database for the North East Atlantic and North Sea that was developed in EU two projects – ODEMM and AQUACROSS – and a database for the Dutch North Sea in a study for PBL (Jongbloed et al., 2019), which was very time consumptive. The availability of these databases was an advantage to the Trial IA-project. In addition, for the Trial IA-project, more specific input data for the sectors in the Dutch North Sea in the baseline year and the future scenarios was used. That data resulted from joint fact finding in the Programme North Sea process.

EBA-principles involved

There are 5 EBA principles that can be considered or applied in CEA. They are briefly described below.

- *Recognise coupled SES* (developing): See the description in Table 6 in section 4.1. The conclusion is that extension of the applied CEA/CIA to also include ecosystem services together with some valuation of their contribution to human wellbeing was not addressed in this Trial IA.
- *Consider cumulative impacts*: This was analysed by application of a CEA tool and also in the expert opinion on OWP and species.
- *Inter-disciplinarity*: Most input data for the total spatial extent and intensity of sectors were found in sources that applied inter-disciplinary sources. In addition, input data were supplied by joint fact finding of I&W, RWS, LNV and sectors which preceded the Trial IA. The CEA and Expert opinion on the OWF and species were only carried out by biologists. Methodology and results were discussed with stakeholders in a consultation session (webinar).
- *Sustainability*: This is implicitly considered by assessing different future scenarios and OWF variants (4) concerning the impact on nature values in order to get insight in the most sustainable options. This EBA is also considered in the section mental models (see above).
- *Recognise coupled SES* (assessing): As is described in Table 6, although both the social and ecological system are covered by respectively the CBA and the CEA/CIA (see subsequent models & tools sections), this does not truly represent a coupled SES. Extension of the CEA/CIA applied to also include ecosystem services together with some valuation of their contribution to human wellbeing could have addressed this. However, that was not done in this Trial IA.

4.2.4 Stakeholder involvement

As outlined in Section 0, the Trial IA was part of the North Sea Programme 2022-2027 process. As noted there, departments of several ministries coordinated working groups for relevant North Sea subjects and invited corresponding stakeholders to participate in these working groups.

During the period from February to June 2020, the government initiated an interactive process of joint fact-finding with stakeholders, in which different scenarios for the spatial plans of the North Sea were created, assessed and evaluated in an iterative fashion. To this end, several working group workshops with stakeholders were organised to discuss specific North Sea subjects; monthly meetings with ministries and research providers were held to discuss scenario outcomes and define alternative scenarios; and, finally, a public webinar was organized to consult the wider public about the outcomes of the final scenarios and outcomes.

During this process, over the period February to June 2020, the following knowledge from different scientific areas was developed and used to inform the definition of spatial plans for the North Sea:

- Expert workshop '*Natuur en windenergie*' (04-02-2020);
- Expert workshop '*Windenergie*' (19-02-2020);
- Study into the Levelized Cost of Energy (LCoE) of seven new wind farm areas and *IJmuiden Ver* on the North Sea (BLIX, 2020a);
- Expert assessment of the expected impacts of wind farm areas on species groups on the North Sea (Jongbloed et al., 2020); and
- Assessment of the economic and ecological impacts of spatial plans for the North Sea by 2040/2050 (Roebeling et al., 2021a).

These studies themselves built on relevant previous studies and knowledge.

After June 2020, over the period September to November 2020, the following separate follow-up studies on the impacts of a wide range of alternative future spatial plans for the North Sea was commissioned:

- Study into the Levelized Cost of Energy (LCoE) for new wind farm areas after Roadmap 2030 (BLIX, 2020b);
- Evaluation of the socio-economic values of fisheries in these new wind farm areas (Deetman et al., 2020);
- Study on the costs and benefits of offshore hydrogen production (NSE, 2020); and
- Assessment of the economic impacts of these alternative future spatial plans for the North Sea for the sectors windmill construction, windmill exploitation, fisheries and maritime transport (Roebeling et al., 2021b).

During this process it has become clear that scientific knowledge plays an important role in informing the definition of spatial plans for the North Sea. However, some observations need to be made:

- There is a tendency to commission separate disciplinary studies to assess the environmental, social or economic impacts of spatial plans;
- Available disciplinary scientific knowledge is often not sufficiently developed to adequately inform the spatial planning process (e.g. required spatial and temporal scales; multiple direct and indirect impacts; feedbacks between the social and ecological system components);
- There is a lack of truly integrated approaches that integrally assess environmental, social and economic impacts of spatial plans across consistent spatial and temporal scales; and
- There is a lack of integrating approaches that help weighing multiple partial impacts in an overarching fashion.

5. CONCLUSIONS

The Dutch government (has) put great effort in bringing the sectoral and NGO stakeholders to the table at an early stage as part of the cross-sectoral participation process, with the science sector present as well. However, the Trial IA was conducted under great time stress starting with, according to the scientists involved, a research question that had not matured and, as a consequence, this project was underbudgeted for the question that was ultimately posed. Nevertheless, the outcome of the scientific project met the expectations of the client as it fed stakeholder discussion and identified knowledge gaps.

The Trial IA was, however, part of an adaptive planning cycle where the Trial IA should be considered as a preliminary assessing step which, as part of the stakeholder participation process, generated an input into what can then be considered the next cycle. In particular, the outcome helped to identify the knowledge base requirements that need to be further developed.

The following conclusions and observations can be drawn based on the application of some of the tools proposed for EBA-MSP.

Mental model

In the Trial IA, there were limited discussions on the mental model (the societal base/SES) and the knowledge base. The selection of what were considered relevant sectors was narrowed during the process to include seven main human/economic activities.

Cost-Benefit Analysis

The Economic Impact Assessment (CBA) with the Trial IA produced an indication of the economic costs and benefits of the current situation (2017) and the future scenarios (for 2040/2050) for the North Sea. This assessment included sea-based sectoral activities that impact the marine ecosystem, based on their size (area), pressure and spread of pressure. But the consequences of these impacts on the ecological system and the social system was lacking.

Another limitation was that the CBA was based on an aggregation of sectoral impacts considering sea-based sectoral activities and land-based sectoral activities that supply goods and services to these sea-based sectoral activities. However, land-based sectoral activities that process goods and services from these sea-based sectoral activities were not considered. Various macro-economic aspects were also not considered in the CBA.

Cumulative impacts

A Cumulative Effect Assessment (CEA) was applied to calculate the difference in impact of seven important human/economic activities on ecosystem components (fish, seabirds, marine mammals and habitats) between the present situation (2017) and the (hypothetical) future situations (2040/2050). This provided insight into the influence of various policy measures and spatial planning variants on ecological and biodiversity effects.

The CEA was based on a comprehensive existing database developed over the course of several EU projects. The availability of this database was a big advantage to the Trial IA. In addition, for the Trial IA, more specific input data for the sectors in the Dutch North Sea in the baseline year and for the future scenarios was required, which emerged from joint fact finding in the North Sea Programme process.

The following considerations are made concerning the evaluation of the quality and completeness of the CEA for MSP in this North Sea case study:

- The choice of the CEA method and the design concerning the relevant sectors, pressures, ecological components, scenarios and offshore wind scenarios was partly tuned to the aim of the study and in consultation with the stakeholders.
- The priority topics that the tools have to deal with were considered in Trial IA study.
- The desired assessments and their outputs were not defined together with the government representatives. The CEA-tool within the Trial IA produced an integrated view on environmental consequences of future scenarios with the limitation that these were relative comparisons that were not spatially specific. An ad hoc solution was found in commissioning an extra study. This was an expert opinion assessment to distinguish between ecological impacts of the spatial variants

of potential new offshore wind farm areas. Important knowledge gaps were revealed as well as the need to develop a quantitative and spatially specific CEA tool for the North Sea hat can be applied to evaluate scenarios for MSP.
- The study area is transboundary and close to several borders, which were not considered in this Trial IA-study. However, this may have been considered in the overall process, before and after the Trial IA-study.
- Gathering as much relevant data as possible of relevant activities and ecological compartments was requested by government parties for the Trial IA study phase. The collection of relevant data for the activities of concern was considered in the pre-phase and will possibly also be considered in the post phase. WR used data from an extensive database connected to the CEA.
- Once the results were ready, they were shared in a consultation session (webinar) with stakeholders. However, that opportunity was relatively limited, and background information was not shared.
- Feedbacks from consultations with stakeholders and ideas for new developments can be used to adjust and improve the CEA. The commissioner/steering group may have had too little insight into the complexity and comprehensiveness of the CEA. The time schedule for the Trial IA within the overall process was very tight.

Stakeholder involvement

The Dutch government put great effort in bringing the sectoral and NGO stakeholders to the table at an early stage. Stakeholders were invited to participate in several workshop and working groups, as well as in interactive process of joint fact-finding, in which different scenarios for the spatial plans of the North Sea were created, assessed and evaluated in an iterative fashion. In addition, a public webinar was organized to consult the wider public about the outcomes of the final scenarios and outcomes. However, the exchange of information and interaction between all parties was limited and therefore the assessing step could be improved in the overall process.

Scientific knowledge

The case study also yields some important observations on the current role and status of scientific knowledge in the MSP process:

- Multi-disciplinary scientific knowledge is often not available to adequately inform the spatial planning process (e.g. required spatial and temporal scales; multiple direct and indirect impacts; feedbacks between the social and ecological system components);
- There is a tendency to commission separate studies (i.e. mono-disciplinary) to assess the environmental, social or economic impacts of spatial plans; and
- There is a lack of truly integrated approaches that assess environmental, social and economic impacts of spatial plans across consistent spatial and temporal scales and in an overarching fashion.

REFERENCES

- BLIX, 2020a. Study into Levelized Cost of Energy of seven new wind zones and IJmuiden Ver. Report WOZ2180100 (Draft 17-04-2020), BLIX Consultancy, Utrecht, Nederland. 41 pp.
- BLIX, 2020b. Determination of the cost levels of wind farms (and their grid connections) in new offshore wind energy search areas. Report WOZ2180096, BLIX Consultancy, Utrecht, Nederland. 97 pp.

- CBS (2019). Natural capital accounts for the North Sea: the physical SEEA EEA accounts. Centraal Bureau voor de Statistiek (CBS), Den Haag, Netherlands. 50pp.
- Deetman, B., A.Y. Eweg, J.A.E. van Oostenbrugge, A. Mol, K.G. Hamon & N.A. Steins (2020). Wind op Zee zoekgebieden 2030-2050: inzicht in de sociaal-economische waarde van de zoekgebieden windenergie op de Noordzee 2030-2050 voor de Nederlandse visserij. Rapport 2020-125, Wageningen Economic Research, Wageningen, Netherlands. URL: https://doi.org/10.18174/536640
- de Koning, S.; Steins, N.; van Hoof, L. (2021). Sustainability Transitions through State-Led Participatory Processes. The S=case of the Dutch North Sea Agreement. Sustainability 13, 2297.https//doi.org/10.3390/su13042297
- de Vrees, L. (2019). Adaptive marine spatial planning in the Netherlands sector of the North Sea. Mar. Policy, 103418. doi:10.1016/j.marpol.2019.01.007.
- European MSP Platform (2020). Marine Spatial Planning Country Information Netherlands. Accessed on 27 January 2021 at: https://www.msp-platform.eu/sites/default/files/download/netherlands_november_2020.pdf.
- IDON (2019). Plan van aanpak Programma Noordzee 2022 – 2027. Draft document.
- Jongbloed, R.H., J.E. Tamis, P. de Vries & G.J. Piet (2019). Natuur verkenning voor de Noordzee: voorbeeld uitwerking van een Noordzee bijdrage aan de Natuurverkenningen. Rapport C055/19, Wageningen Marine Research, Den Helder, Nederland. URL: https://doi.org/10.18174/479145.
- Jongbloed, R.H., J.E. Tamis & J. Steenbergen (2020). Expert inschatting van nieuwe windparkzoekgebieden op de Noordzee voor verschillende soortgroepen. Rapport C097/20, Wageningen Marine Research, Den Helder, Netherlands. URL: https://doi.org/10.18174/533540.
- NSE, 2020. Memo: offshore waterstofproductie. North Sea Energy (NSE), Alkmaar, Nederland. 3 pp.
- Oude Elferink, A. G. (2020). Identificatie en analyse van relevante regelgeving en beleid in het kader van het project "Beleid en Regelgeving Informatiesysteem Noordzee" (BREIN). Herziening 2020. Available at: https://www.noordzeeloket.nl/publish/pages/122364/brein_herziening_2020_-_eindrapport.pdf.
- OFL (2020). Het Akkoord voor de Leefomgeving. Overlegorgaan Fysieke Leefomgeving, the Hague. Available at https://www.rijksoverheid.nl/documenten/rapporten/2020/06/19/bijlage-ofl-rapport-het-akkoord-voor-de-noordzee
- Piet, G. J., Tamis, J. E., Volwater, J., de Vries, P., van der Wal, J.T. & Jongbloed, R. H. (2021). A roadmap towards quantitative cumulative impact assessments: every step of the way. Sci. Total Environ. 784, 146847. doi:10.1016/j.scitotenv.2021.146847.
- Platjouw, F. M. (2018). Marine spatial planning in the North Sea-are national policies and legal structures compatible enough? the case of Norway and the Netherlands. Int. J. Mar. Coast. Law 33, 34–78. doi:10.1163/15718085-12320075.
- Roebeling, P.C., W.J. Strietman, R.H. Jongbloed, J.E. Tamis, K. Hamon, A. Eweg, S. van den Burg & S. Reinhard (2021a). De economische en ecologische effecten van inrichtingsvarianten voor de Noordzee tot 2040/2050. Report 2021-063, Wageningen Economic Research & Wageningen Marine Research, Wageningen, Netherlands. URL: https://doi.org/10.18174/548296
- Roebeling, PC, van den Burg, S, Strietman, WJ, Hamon, K, Eweg, A & Reinhard, S. (2021b). Aanvullende analyse van de economische effecten van inrichtingsvarianten voor de Noordzee tot 2040/2050. Rapport / Wageningen Economic Research, no. 2021-069, Wageningen Economic Research, Wageningen. URL: https://doi.org/10.18174/548649
- SER (2013). Energieakkoord voor duurzame groei. Sociaal-Economische Raad, The Hague. Available at

https://www.rijksoverheid.nl/documenten/convenanten/2013/09/06/energieakkoord-voor-duurzame-groei.
- Strietman, W.J., K.G. Hamon & A. Mol (2019). De economische effecten van twee toekomstscenario's voor de Noordzee. Rapport 2019-080, Wageningen Economic Research, Wageningen, Nederland. URL: https://doi.org/10.18174/495958.
- The Netherlands Ministry of Infrastructure and the Environment, and The Netherlands Ministry of Economic Affairs (2015). The National Water Plan 2016-2021. Available at: https://www.noordzeeloket.nl/en/policy/noordzeebeleid/nationaal-waterplan/.
- The Dutch Ministry of Infrastructure and the, and Economic and The Dutch Ministry of Environment Affairs (2015). The Policy Document on the North Sea 2016-2021. 120. Available at: https://www.noordzeeloket.nl/en/policy/noordzeebeleid/beleidsnota-noordzee/@166985/policy-document/.

ANNEX 1 GLOSSARY AND ABBREVIATIONS

Term (in English)	Abbreviation (in English)	Explanation (in English)	In Dutch
Activity		An activity, process, or physical works intended to enhance human welfare; alternative terms used are e.g., driver, sector	
Cost-benefit analysis	CBA	An economic technique applied to public decision−making that attempts to quantify the advantages (benefits) and disadvantages (costs) associated with a particular project or policy	Kosten-baten analyse (KBA)
Cumulative Effect Assessment (also Cumulative Impact Assessment)	CEA / CIA		Cumulatieve Effect Beoordeling
Ecosystem component		An attribute or set of attributes of the natural environment; alternative terms used may be valued ecosystem component, ecological component, receptor, indicator	
Environmental impact assessment	EIA		Milieu Effect Beoordeling
Environmental Risk Assessment	ERA		Milieu Risico Beoordeling
Intensity		The relation connecting pressures to activities, considering the type, duration, strength, and (spatial) extent of the pressure; alternative term used may be impact	
Interdepartmental Directors Committee for the North Sea	IDON		Interdepartementaal Directeuren Overleg Noordzee
Marine Spatial Plan	MSP		
Ministry of Agriculture, Nature and Food Quality	LNV		Ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV)
Ministry of Infrastructure and Water Management	I&W		Ministerie van Infrastructuur en Waterstaat (IenW)
North Sea Programme 2022-2027	NSP	Extensive participation stakeholder process that has to produce a set of agreements for the spatial planning of the	Programma Noordzee 2022-2027

Term (in English)	Abbreviation (in English)	Explanation (in English)	In Dutch
		Netherlands North Sea on the long term (2040/2050)	
Numerical		Numerical figure based on experience	Kental
Offshore Wind Farms	OWF		
Pressure		A means by which one or more activities cause or contribute to a change in an ecosystem component or components; alternative terms used may be stressor, impact, effect	
Rijkswaterstaat	RWS		Rijkswaterstaat (RWS)
Sensitivity		The relation connecting ecosystem components to pressures, considering the vulnerability and recovery potential of the ecosystem component; alternative term used may be vulnerability	
Social cost benefit analysis	SCBA	A method to support the decision-making of the national, provincial and municipal governments. Cost-benefit analyses are used for infrastructural projects, and also apply to, for example, area development projects, sustainable energy development and water and nature issues	Maatschappelijke kosten-baten analyse) (MKBA)
Strategic Environmental Assessment	SEA		Plan MER
Trial Integrated Assessment	Trial IA	The SCBA and CEA applied to public decision−making that attempts to quantify the economic and ecological advantages (benefits) and disadvantages (costs) associated with the Netherlands North Sea Programme policy that was subject of this North Sea case study	
Wageningen Research	WR		Wageningen Research

ANNEX 2: ENVIRONMENTAL ASSESSMENT METHODS WITH APPLICATION DEPENDING ON THE AIM OF THE DECISION MAKING

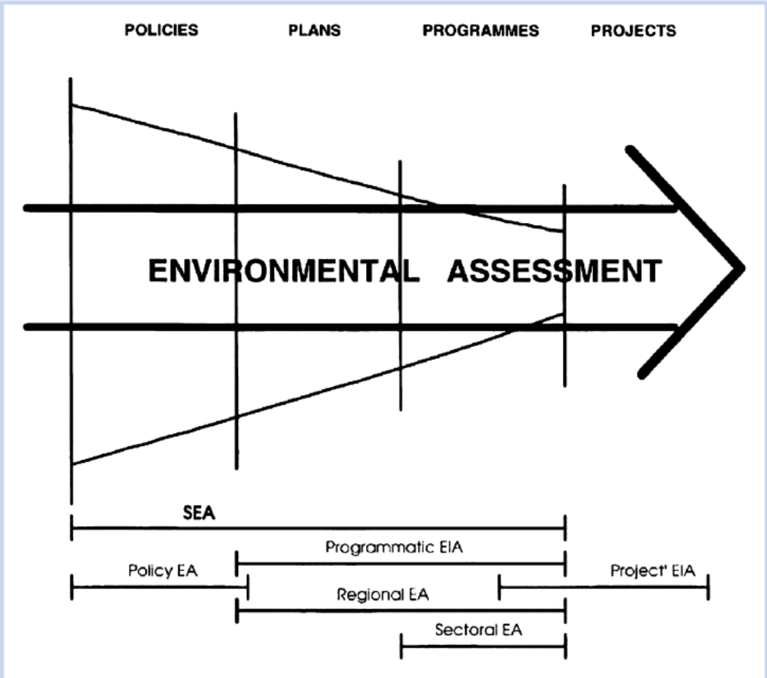


Figure 1. Focusing environmental assessments across sequential decision-making levels (Partidário 2000).

Table 1. Characteristics and options of various environmental assessments

Aspect	Environmental assessments			
	EIA	SEA	CEA	ERA
Purpose	Informing decision makers (permit application)	Informing decision makers, support consultation and governance (environmental policy and management)	Part of EIA or SEA and as stand-alone, providing insight for government and industry	Determining risk of substances (ecotoxicology) and other pressures (e.g., as methodology for CEA)
Decision-making level	Project	Plan, program	Project, plan, policy	Project, plan, policy
Need and/or requirements	Legally required in many countries	Legally required in many countries	Limited as part of EIA	Legally required for substances (ecotoxicology)
Spatial scale	Site, local	Local, regional	Variable, depending on purpose (from site to global)	Variable, depending on purpose (from site to global)
Temporal scale	Present and future	Present and future	Variable, depending on purpose	Variable, depending on purpose
Level of detail (data)	High	Low	Variable, depending on purpose	Variable, depending on purpose

CEA = cumulative effect assessment; EIA = environmental impact assessment; ERA = environmental risk assessment; SEA = strategic environmental assessment.

The figure and the table in this Annex were derived from Tamis et al. (2016)

Tamis, J.E., P. de Vries, R.H. Jongbloed, S. Lagerveld, R.G. Jak, C.C. Karman, J.T. Van der Wal, D.M.E. Slijkerman, C. Klok (2016): Towards A Harmonised Approach For Environmental Assessment Of Human Activities In The Marine Environment. Integrated Environmental Assessment and Management DOI

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Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

II

Baltic Sea cross-border case study on operationalising the green infrastructure concept and addressing land-sea interactions in MSP:

Final Case Study Report

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July – 2021

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LIST OF ABBREVIATIONS

	Specification	Comment
BSII	Baltic Sea Impact Index	Developed by the HELCOM holistic assessment (2010)
CBD	Convention on Biological Diversity	United Nations convention to protect and promote biological diversity
CICES	Common International Classification of Ecosystem Services	System developed by the EEA, see http://cices.eu/
EBA	Ecosystem-based Approach	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way
EBSAs	Ecologically or biologically significant marine areas	Defined according to the scientific criteria adopted by the Conference of the Parties to the Convention on Biological Diversity (COP 9)
EEA	European Environmental Agency	European Union agency
EIA	Environmental Impact Assessment	A process of evaluating the likely environmental impacts of a proposed project or development
EEZ	Exclusive Economic Zone	An area of water and seabed within a certain distance of a country's coastline, to which the country claims exclusive rights for fishing, drilling and other economic activities
EU	European Union	
GI	Green infrastructure	Network of natural and semi-natural areas
GIS	Geographical Information Systems	
GES	Good environmental status	The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive
HELCOM	Helsinki Commission	Environmental Intergovernmental Organisation
HELCOM HOLAS II	HELCOM Second Holistic Assessment of the Ecosystem Health of the Baltic Sea	HELCOM project
HELCOM-HUB	HELCOM Underwater biotope and habitat classification system	Developed as a part of the HELCOM Red List project
ICZM	Integrated coastal zone management	
IPBES	The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services	Independent intergovernmental body established to strengthen the science-policy interface for biodiversity and ecosystem services
LSI	Land-sea interactions	
MAES	Mapping and assessment of ecosystems and their services	Commission working group for implementation of Task 5 of the EU Biodiversity Strategy 2020
MOSAIC	Framework for marine conservation values and ecological coherent networks	Developed by AquaBiota on behalf of the Swedish Agency for Marine and Water Management
MPAs	Marine Protected Areas	Marine conservation area, include national park, Natura2000, reserves etc.
MSFD	Marine Strategy Framework Directive	
MSP	Maritime spatial plan/planning	
OWP	Offshore wind park	

	Specification	Comment
SEA	Strategic Environmental Assessment	A systematic decision support process to ensure that environmental aspects are considered effectively in policy, plan and programme making
UN	United Nations	
UNESCO	United Nations Educational, Scientific and Cultural Organization	
VASAB	Vision & Strategies Around the Baltic Sea	Intergovernmental multilateral cooperation of 11 countries of the Baltic Sea Region on spatial planning and development

EXECUTIVE SUMMARY

Geographical context

The case study concerns the Baltic Sea - one of the largest semi-enclosed water bodies in the world and highly sensitive to human pressures due to its slow water exchange with the North Sea. It is characterised by a comparatively low number of dominating marine species, but a high number of individuals. The main biodiversity assets are represented by habitat types protected under European Union (EU) and national legislation (including reefs, sandbanks, Boreal Baltic islets and small islands, coastal lagoons, large shallow inlets and bays), bird wintering and breeding areas, migratory corridors and few key marine mammal species. The Baltic Sea is considered one of the most polluted seas in the world, with a high intensity of ship traffic and fishing. The most significant pressure is caused by eutrophication, primarily related to land-based run-off of nutrients from agriculture. The fragile ecosystem of the Baltic Sea is also threatened by pollution from hazardous substances, litter, introduction of alien species, physical disturbance of seabed by offshore installations and climate change.

A specific focus of the case study is the southwestern coastal area of Latvia, in the Kurzeme Region, covering both terrestrial and marine parts. The main ecosystem types in the terrestrial part include sandy beaches, wooded and grey dunes, coniferous forests, wetlands, lakes and rivers, grasslands and arable land, including polders. The marine ecosystem includes benthic habitats formed on sandy and mixed substrates, and rocks and boulders (reefs). Coastal waters are important for fish spawning and nursery, as well as birds during migration season and winter. The area is used for coastal tourism, fishing and shipping. The terrestrial part is used for agriculture, forestry and, more recently, wind energy production. There is an emerging interest in the development of offshore wind farms in adjacent territorial waters and the Exclusive Economic Zone (EEZ).

The Baltic Sea countries vary in their development of maritime spatial plans (MSPs). As of early 2021, Germany and Lithuania were developing their second MSPs, having adopted the first one either before the MSP Directive (2014/89/EU)[9] or immediately after (before the transposition deadline). Latvia was the first country in the Baltic Sea Region to adopt a national MSP under the MSP Directive, in May 2019. Finland adopted its MSP (based on three regional MSPs) in December 2020. Poland adopted its MSP on 14 April 2021 (in force from 22 May 2021). Sweden finished the development of its plan in December 2019, which the national government is expected to adopt in early 2021. Lithuania concluded the preparation of its draft plans before the end of 2020, with adoption in mid-2021. Other countries (Estonia, Germany, Denmark) are still consulting and reconciling draft plans, which are likely to be adopted in mid-2021 at the earliest.

Cross-cutting issues addressed in the case study

At Baltic Sea level, the case study addresses *marine green infrastructure* (GI). It considers the use of available datasets for mapping marine GI at regional sea level, including data on the distribution of habitat types and species protected under the Birds and Habitats Directives, together with other marine ecosystem components. It demonstrates how mapping of marine GI can contribute to integrating the

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[9] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0089

ecosystems-based approach (EBA) in MSP by aggregating comprehensive datasets of ecological information, facilitating the development of a holistic method to assess the functioning of ecosystems and deliver this knowledge to planners and decision makers.

At Latvian sub-national level, this case study provides an overview of how land-sea interactions (LSI) are addressed in MSP at local level, including the trade-offs between marine and coastal development interests. Latvia has incorporated coastal zone management into MSP via the assessment of LSI. The analysis for the southwestern coast of Latvia in the Kurzeme region addresses the challenges of setting objectives and balancing interests between MSP and coastal tourism development, from an ecosystem-based approach (EBA) perspective. The case study investigates how the mapping and assessment of coastal ecosystems, landscape and ecosystem services essential for local communities can support EBA, particularly when planning the development of coastal areas. The planning process and Strategic Environmental Assessment (SEA) require the development and assessment of alternatives, and this case study reviews how a trade-off analysis of proposed scenarios (alternatives) can help to balance social, economic and environmental interests and impacts.

Methods and tools addressed

The methods for integrating EBA into MSP focus on mapping ecosystem services and other ecological and landscape features across the different scales for supporting the application of EBA in MSP and coastal zone management. At Baltic Sea scale, ecosystem service and ecological value are mapped for identification of marine GI. This includes a hierarchical aggregation of mapping results to present complex ecological/ecosystem service information in a consolidated user-friendly way for stakeholders and decision makers. At Latvian sub-national level, coastal (land, beach and sea) ecosystem services were mapped, with a hierarchical aggregation of mapping results developed to present complex information simply. Latvian stakeholders were also engaged in a cultural ecosystem service assessment and scenario-building on coastal development at sub-national level.

Key conclusions and recommendations

The approaches to mapping marine GI at Baltic Sea scale and addressing LSIs at sub-national scale in Latvia demonstrate how complex scientific information and knowledge of structure and functioning of marine and coastal ecosystems, service supply and contribution to human well-being can usefully be consolidated for planners and decision makers. Although this approach is still being developed in the Baltic Sea, it provides valuable information to support further integration of EBA in MSP, as well as sustainable governance of marine and coastal areas. It is recommended to apply ecosystem service mapping and assessment for deployment of marine GI and addressing LSIs and to integrate these aspects in MSP processes from the very beginning - during the defining stage and, particularly, in the process of developing and assessing spatial planning solutions.

GI mapping and assessment results allow the identification of ecological hotspots[10] and the application of spatial measures under MSP for preserving essential structures and functions of marine ecosystems, migration corridors and stepping-stones. Marine GI will identify areas that are not currently included in the Natura 2000 network or other protected areas, enhancing the connectivity of the network of protected areas

[10] Areas with high concentration of natural features of high ecological value

and contributing to the goals of the Marine Strategy Framework Directive (2008/56/EC)[11] in respect of achieving good environmental status (GES) and resilience of marine ecosystems.

Similarly, application of the ecosystem service approach in the assessment of LSIs identifies hotspots and trade-offs between ecosystem service supply in off-shore and on-shore areas of the coastal zone, which should be respected in developing solutions for use of the sea and coastal governance.

Common methodologies for mapping marine GI and considering ecological aspects in LSIs are not yet established. This case study should contribute to further cooperation and experience exchange for mainstreaming these concepts in spatial planning, as well as better marine and coastal zone governance.

Links with other projects and processes

The Baltic Sea case study was built on the experience and results of the development and testing of the marine GI concept obtained via the Pan Baltic Scope Project. The case study is also linked to the Helsinki Commission Vision & Strategies Around the Baltic Sea (HELCOM-VASAB) MSP Working Group activities 2020-2021 and VASAB's Capacity4MSP project platform. The Latvian sub-national part of the case study was built on the experience and methods applied in the Interreg Baltic Sea Region Programme project, Land-Sea-Act.

1. INTRODUCTION

The *Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning (MSP)* was contracted by the European Commission (by the Executive Agency for Small and Medium-sized Enterprises with DG Maritime Affairs and Fisheries)[12]. It was awarded to a consortium that brings together Milieu Consulting with ACTeon, the Baltic Environment Forum (BEF), Fresh Thoughts, GRID-Arendal and Wageningen Research (WR). The project contract was signed on 26 November 2019. The project is expected to finish in May 2021.

The main objective of the study is to:

- Propose feasible and practical approaches and guidelines for applying ecosystem-based approaches (EBA) in MSP with the presently available information, and
- Develop a practical method or tool for evaluating, monitoring and review the application of EBA in MSP.

The Terms of Reference (ToR) set out five tasks for the project:

- Task 1: Baseline review/state of play of existing knowledge, research, tools and practices linked to the application of ecosystem-based approaches (EBA) in MSP
- Task 2: Critical analysis of the outcome of Task 1
- Task 3: Development of a set of guidelines and tools for the application of EBA in MSP for EU Member States

[11] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008L0056

[12] Contract no. EASME/EMFF/2018/1.3.11/SI2.814068 (following call for tenders EASME/2019/OP/0002). The project was contracted by the Executive Agency for Small and Medium-sized Enterprises (EASME), which in 2021 became The European Climate, Infrastructure and Environment Executive Agency (CINEA).

- Task 4: Elaboration of MSP cases studies using an EBA, demonstrating the guidelines and tools developed in Task 3
- Task 5: Organisation of a closing workshop

Task 4 saw the preparation of a set of five case studies on the application of EBA in MSP. The results of these case studies were used to support the work under Task 3, the development of a practical approach and guidelines.

This **Baltic Sea cross-border case study** is one of the five case studies. It aims to examine the methods applied in the Baltic Sea region for ecosystem service and marine green infrastructure (GI) mapping to support application of the EBA in MSP. The case study builds on experience gained in the Pan Baltic Scope project, which proposed a marine GI concept and a mapping approach, and it explores opportunities for further methodological development and operationalisation of the concept and approach in MSP. The case study was carried out via desk research, a dedicated online expert workshop, and presentation and discussion of findings to MSP practitioners at the Capacity4MSP Planning Forum #2 on 11 November 2020 and at the International Online Conference on MSP NATURE 2021, on 19-21 January 2021.

The Baltic Sea case study includes sub-national analysis carried out in Latvia, building on the experience of the Interreg Baltic Sea Region Programme project Land-Sea-Act[13], which focuses on how **land-sea interactions (LSIs)** can be addressed in MSP at sub-national level. The case study investigates the trade-offs and potential solutions for balancing national interests in offshore energy development with local interests for preserving the coastal landscape and enhancing sustainable tourism. The case study investigates how the mapping and assessment of coastal ecosystems, landscape and ecosystem services essential for local communities can be applied in trade-off analysis and in assessing different scenarios for the achievement of balanced coastal development.

While the two parts of the report are on different topics and at different scales, each considers the role of **ecosystem services** as a tool for integrating EBA into MSP. Both parts of the case study demonstrate how complex information on ecological qualities and ecosystem service supply can be aggregated in a meaningful and understandable way for stakeholders, planners and decision makers to support consideration of ecological aspects in planning sustainable marine and coastal development.

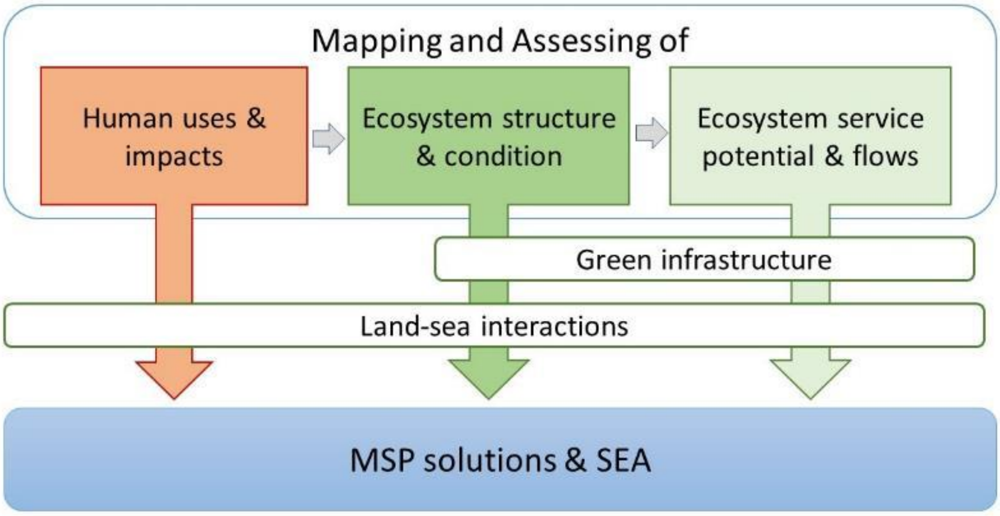
2. BACKGROUND

Marine and costal ecosystems deliver a wide range of ecosystem services and related benefits to humanity, including food, materials, energy, genetic resources, mediation of waste and climate regulation, coastal protection, recreational opportunities, cultural identity, etc. (Beaumont et al., 2007; Liquete et al., 2013; Townsend et al., 2018, Müller et al., 2020). Mapping and assessment of ecosystems and their services (MAES) is widely applied in different policy contexts for describing interactions of socio-ecological systems and is acknowledged as essential key element for implementation of EBA in MSP (HELCOM-VASAB MSP Working Group, 2015). Assessment of marine ecosystem structure, condition and service supply in relation to human uses and impacts are also the bases for two parallel/independent concepts – GI and LSI, both of which account for the complexity of the marine socio-ecological

[13] https://land-sea.eu/

system and can support the relational understanding essential to implementation of EBA in MSP (see Figure 1).

FIGURE 1: APPLYING GI AND LSI CONCEPTS TO SUPPORT EBA IN MSP



In describing GI and LSI, the results from mapping and assessing the ecosystem condition, services provided can contribute to all key steps of MSP (defining, developing, assessing, implementing and follow-up). However, they are most directly linked to the developing and assessing steps. They are also strongly related to the second group of EBA principles 'Giving attention to the human-ecosystem connections and integration', as defined in the Task 2 report of this 'Study on Integrating an EBA into MSP' (the Task 2 report, entitled *What are lessons from current practice in applying Ecosystem-Based Approaches in Maritime Spatial Planning?*, provides an analysis of information from current practices in applying EBA in MSP).

Both GI and LSI can be addressed from content (issues covered) and governance (public participation and cross-border cooperation) perspectives. This case study focuses on the content issues that must be taken into account in implementing EBA in MSP.

2.1 The (marine) GI concept

GI is a relatively new concept in respect of enhancing the EBA in MSP. However, the idea that ecosystem can be seen as a type of infrastructure was proposed as early as the 1980s, with the suggestion that healthy ecosystems are essential not only for maintaining biodiversity but also providing goods and services to people (da Silva & Wheeler, 2017). The concept is well-established in urban and regional planning of terrestrial areas, although its application to the marine context is a novelty.

The GI concept was introduced in EU policy as a tool for implementing the objectives of the EU Biodiversity Strategy 2020 on halting the loss of biodiversity (European Commission, 2011)[14] and addressing other environmental problems, including climate change. The EU GI Strategy[15] defines it as a '*strategically planned network of natural*

[14] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0244

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249

and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas' (European Commission, 2013). This definition indicates the applicability of the concept to marine areas. The Strategy calls for deployment of GI across Europe as a standard element of spatial planning and territorial development.

Several studies on applying the GI concept on land, from local to pan-European level demonstrate its potential for integrating ecological considerations, quantifying ecosystem services and mapping results into spatial planning (e.g. Kopperoinen et al., 2014; Di Marino et al., 2019; Vallecillo et al., 2018). A European Commission report on the progress of the implementation of the EU GI Strategy gives an overview of best practice in GI deployment at different scales and planning contexts, while acknowledging that GI '***is not sufficiently used in maritime spatial plans****, whereas it could contribute to healthy marine ecosystems and deliver substantial benefits in terms of food production, recreation and tourism, climate change mitigation and adaptation, shoreline dynamics control and disaster prevention'* (European Commission 2019a, 2019b, emphasis added). A significant gap in knowledge on the deployment of GI in the marine environment is acknowledged in the Joint Research Centre report, 'Strategic Green Infrastructure and Ecosystem Restoration' (Estreguil et al., 2019). That report highlights the difficulties in establishing links between biophysical features of coastal ecosystems and ecosystem service supply, and notes that the GI concept is poorly developed at the sea-land interface. The main difficulties in applying the GI concept to the marine environment relate to the complexity of marine ecosystems and the scarcity of spatial data suitable for the mapping and assessment of marine ecosystem services (Townsend et al., 2018).

In the marine context, GI can be interpreted as a spatial network of ecologically valuable areas that are significant for the maintenance of ecosystems' health and resilience, biodiversity conservation and multiple delivery of ecosystem services essential for human well-being (Ruskule et al., 2019a; Ruskule et al., 2019b). The definition and delineation of marine GI can therefore encompass various criteria characterising the marine ecosystem, its biological values, functionality and service supply. The marine GI includes Marine Protected Areas (MPAs) as core areas for maintaining biodiversity, but it also goes beyond them to ensure connectivity of the network, and functioning and resilience of marine ecosystem. Application of the GI concept in the marine realm is thus in the line with the Decision of the Conference of the Parties to the Convention on Biological Diversity (CBD) on 'Protected areas and other effective area-based measures' (CBD/COP/DEC/14/8 of 13 November 2018)[16] for conservation of biodiversity, with associated ecosystem functions and services. The decision defines 'other effective area-based conservation measure' as:

> *'a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socioeconomic, and other locally relevant values'.*

It also calls for identification and prioritisation of areas important to the improvement of connectivity and essential ecosystem functions and services. GI mapping and assessment can support implementation of the decision of the Conference of the Parties of CBD, fulfilling the functions of the 'other effective area-based measures'.

[16] https://www.cbd.int/doc/decisions/cop-14/cop-14-dec-08-en.pdf

Mapping of marine GI can be based on the spatial distribution of various marine ecosystem components and assessment of their ecological value, connectivity and contribution to ecosystem service supply. It can help to build a relational understanding of the ecosystem structure and functioning, as well as interaction of the socio-ecological systems. When applied in the MSP process, it can support implementation of EBA by addressing the following aspects:

i. Respecting complex ecological information in developing spatial solutions for allocation of human activities (e.g. wind farms, aquaculture farms) and avoiding harmful development from ecologically valuable/sensitive areas (contributes to precautionary principle);
ii. Applying GI mapping results in the SEA process to assess impacts of MSP solutions on marine ecosystems;
iii. Supporting cross-border coordination of planning solutions in respect of ecological values.

GI mapping can also help to improve the coherence of an existing MPA network by assessing connectivity of that network and identifying areas of high ecological value that are not already included.

2.2 LSIs

Understanding LSIs is critical to the successful delivery of MSP, as marine and coastal activities are often closely interrelated. The LSI concept was initially put forward in Commission Recommendation 2002/413/EC on the implementation of Integrated Coastal Zone Management in Europe[17]. The Recommendation calls on Member States to develop national strategies for Integrated Coastal Zone Management (ICZM) based on defined principles such as integration across sectors and levels of governance, through a participatory and knowledge-based approach.

Under the MSP Directive (2014/89/EU), Member States should address LSIs in MSP as follows:

- Article 4 – 'Each Member State shall establish and implement maritime spatial planning' (Article 4(1)). 'In doing so, Member States shall take into account land-sea interactions' (Article 4(2)).
- Article 6 sets the minimum requirements for MSP: 'Member States shall establish procedural steps to contribute to the objectives listed in Article 5, taking into account relevant activities and uses in marine waters' (Article 6(1). 'In doing so, Member States shall: take into account land-sea interactions...' (Article 6(2)(a)).
- Article 7 is dedicated to LSIs**:**

  'In order to take into account land-sea interactions in accordance with Article 4(2), should this not form part of the maritime spatial planning process as such, Member States may use other formal or informal processes, such as integrated coastal management. The outcome shall be reflected by Member States in their maritime spatial plans' (Article 7(1).

  'Without prejudice to Article 2(3), Member States shall aim through maritime spatial planning to promote coherence of the resulting maritime spatial plan or plans with other relevant processes' (Article 7(2))[18].

[17] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002H0413

[18] Article 2(3) states that: 'This Directive shall not interfere with Member States' competence to design and determine, within their marine waters, the extent and coverage of their maritime spatial plans. It shall not apply to town and country planning.'

Recital 16 of the Directive states that 'MSP should aim to integrate the maritime dimension of some coastal uses or activities and their impacts and ultimately allow an integrated and strategic vision.' The MSP Directive lists possible activities, uses and interests that Member States should consider in their plans (Article 8(2)). These include several areas of activities that could take place in marine or coastal waters and that could affect LSIs, such as aquaculture areas, fishing areas, maritime transport routes and traffic flows, nature and species conservation sites and protected areas, raw material extraction areas, submarine cable and pipeline routes, tourism, and underwater cultural heritage.

In 2017, the European Commission (DG Environment (ENVI)) commissioned a study that led to the production of the brochure, *Land Sea Interactions in Maritime Spatial Planning*. That brochure was designed to give an understanding of how LSI can be addressed when developing MSP (Shipman et al., 2018). It covers eight of the most typical marine development sectors: aquaculture, offshore energy, desalination, fisheries, tourism, marine cables and pipelines, minerals and mining, and ports and shipping. The brochure presents a generic workflow of the main LSI categories (environmental, socioeconomic and technical) in MSP, from scoping to planning, and EBA is one of the aspects to be taken into account when addressing LSI in MSP.

LSI in MSP has been the focus of several recent transboundary projects that support the implementation of MSP in the EU and the EU MSP Platform[19] lists practices that cover the LSI aspect.

2.3 Baltic experience in applying the ecosystem service approach to support EBA in MSP

The Baltic Sea region is advanced in marine protection policy and research, as a result of well-established cooperation under the umbrella of the Helsinki Commission, an intergovernmental organisation for protection of the marine environment in the Baltic Sea (HELCOM). Other positives include a strong scientific foundation, access to long-term data series' (Reusch et al., 2018; Heckwolf et al., 2021) and several transnational cooperation initiatives for enhancing MSP (Hassler et al., 2019). The latter includes a series of projects starting in 2009 (e.g. BaltSeaPlan, PlanBotnia, PartiSEApate, BONUS BATSPACE, BalticLINES, Baltic Scope and Pan Baltic Scope), which established a strong MSP community in the region. Marine biodiversity protection and, later, ecosystem service mapping in the region has been enhanced by projects involving the research community, such as BALANCE, LIFE Marine Protected Areas, MARMONI, BONUS BALTCOAST, BONUS BALTICAPP, BONUS BASMATI, BONUS ROSEMARIE and BONUS MARES.

This transnational cooperation has stimulated the collection of field data, co-generation of knowledge about the marine environment, and the integration of ecologic considerations in MSP. Strong cooperation between planners and environmentalists is evident in the establishment of the Joint HELCOM-VASAB MSP working group in 2010, which developed the Baltic Regional MSP Roadmap 2013-2020, and the *Guidelines for the implementation of ecosystem-based approach in MSP* in 2015. *The Ecosystem Approach in Maritime Spatial Planning: A Checklist Toolbox* was published by the Baltic Scope project in 2017, while *EBA in MSP – a SEA inclusive handbook* was published by the Pan Baltic Scope project in 2019. These guidance

[19] https://www.msp-platform.eu/

documents, together with experience gained from cooperation projects, have facilitated uptake of EBA principles in MSP processes within the Baltic Sea region.

The HELCOM-VASAB guidelines highlighted the identification of ecosystem services as one of the key elements for operationalisation of the EBA, resulting in ecosystem services being addressed in several Baltic MSPs. The Latvian MSP was one of the first in the Baltic Sea region, and it included the characterisation and mapping of several provisioning and regulating services, as well as cultural services related to recreation. This information was also used in the plan's SEA (Veidemane et al., 2017). The Swedish MSP identified ecosystem services as part of sustainability assessment, using a qualitative approach. Estonia's MSP, which is still being finalised, includes quantitative mapping/modelling of ecosystem services, which are then related to socioeconomic benefits[20].

The Swedish National MSP was the first in the Baltic Sea region – and likely in Europe - to apply the concept of GI. The work included the development of the 'Green Map', which aggregates information on the distribution of nature values (birds, mammals, fish and benthic habitats) to be considered in MSP. Since 2012, three versions of the 'Green Map' have been developed, with increasing data accuracy. The first Green Map was based on any data that could indicate a higher nature value, while the final version was built via the weighted aggregation of data from Symphony[21] ecosystem component layers. As result of this mapping, so-called 'n-areas' were identified, where special consideration must be given to high nature values, extending the nature dimension in MSP beyond existing and planned MPAs. The co-existence of nature and other sea uses in the 'n-areas' is possible, yet harm to the listed nature values should be avoided.

The marine GI concept and mapping approach was further developed by the Pan Baltic Scope project by adding the dimension of ecosystem services and testing it at the scale of the Baltic Sea (Ruskule et al., 2019a; Ruskule et al., 2019b). The Pan Baltic Scope approach to mapping marine GI, and the results obtained are presented in Section 3.

The Pan Baltic Scope project explored the practical issues surrounding LSIs in the Baltic Sea area, paying particular attention to:

1) Identifying land-sea issues and linkages in terms of spatial needs and interactions, including across sectors, over time and across borders;
2) Getting the institutional mandates and structures right and promoting institutional capacity for multi-level governance across the land-sea boundary (with local authorities as crucial links);
3) Identifying, informing and mobilising relevant stakeholders and linking them (also across borders);
4) Getting spatial datasets that reach across the land-sea boundary at the right scale to produce planning evidence that can be shared across levels and borders. Lessons learned were published in the project report (Morf et al., 2019).

[20] http://www.sea.ee/planwise4blue/estonia

[21] https://www.havochvatten.se/en/eu-and-international/marine-spatial-planning/symphony---a-tool-for-ecosystem-based-marine-spatial-planning.html

3. MAPPING OF MARINE GI IN THE BALTIC SEA

3.1 Case study area

The case study addresses the Baltic Sea – a marine region with a unique and fragile ecosystem and with significant socioeconomic importance in the northern hemisphere. The Baltic Sea is one of the largest semi-enclosed water bodies in the world, covering 392,978 km^2, with an average depth of 55 m and maximum depth of 459 m. It is surrounded by nine countries - Denmark, Sweden, Finland, Russia, Estonia, Lithuania, Latvia, Germany, and Poland, and its drainage area is inhabited by around 85 million people. The shallow waters of the Baltic Sea and slow water exchange with the North Sea (through the narrow Danish Belts) makes it particularly sensitive to human pressure. It has a low number of dominating species compared to other marine areas, but a high number of individuals. According to HELCOM data, the Baltic Sea hosts 328 biotopes and 2,700 macroscopic species. The most widespread habitat types protected at EU level[22] include reefs (1170), sandbanks (1110), Boreal Baltic islets and small islands (1620), coastal lagoons (1150), large shallow inlets and bays (1160). The Baltic Sea also holds essential bird wintering and breeding areas and migratory corridors. It hosts few marine mammal species - the low numbers of species that have adapted to the specific brackish conditions make the Baltic Sea ecosystem very sensitive to changes, with the result that it has a low adaptation capacity. Climate change-related increases in water temperature and decreases in salinity are expected to affect the distribution of species and their food availability (HELCOM, 2018).

The Baltic Sea is considered one of the most polluted seas in the world. Pressures on the marine environment are caused by intensive shipping, including recreational vessels, and fishing activities. However, one of the most significant environmental problems in the Baltic Sea is eutrophication, which is primarily related to land-based run-off of nutrients from agriculture. According to the second HELCOM holistic Assessment (HOLAS II), 97% of the Baltic Sea area is affected by eutrophication and 12% is assessed as being in the worst status category. Other pressures on the marine environment include pollution by hazardous substances, litter, introduction of alien species (chiefly via ballast waters from ships), physical disturbance of seabeds by offshore installations (e.g. cables, pipelines and wind farms), demersal trawling, shipping and recreational vessels. The fragile ecosystem of the Baltic Sea is also threatened by climate change, which can significantly influence the abundance and distribution of species and habitats.

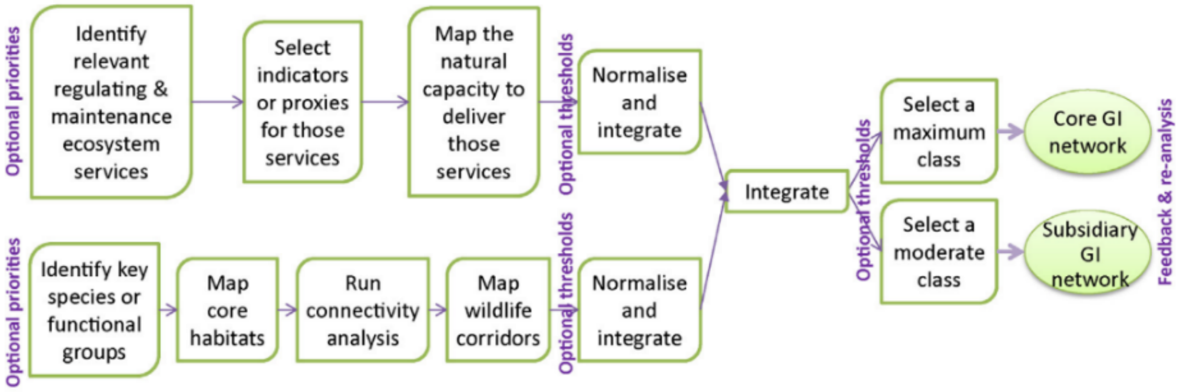
3.2 Methodology for mapping marine GI

GI mapping can involve two complementary approaches – physical mapping of existing GI components (e.g. protected areas, ecological networks and other valuable natural areas); and ecosystem-service based mapping targeting delivery of multiple ecosystem services (Estreguil et al., 2019). A comprehensive methodology for EU-level GI mapping has been proposed by the European Environmental Agency (Liquete et al., 2015). The methodology was tested in a continental case study covering the EU-27 territory, but the authors suggest it is applicable at different spatial scales for planning and policy implementation. It integrates mapping of the natural capacity of ecosystems to deliver services with mapping and connectivity analysis of essential

[22] Under the Habitats Directive. The habitat type numbers are given.

core habitats (Figure 2). The areas assessed as most valuable with regard to one or both aspects are then identified as part of the GI network.

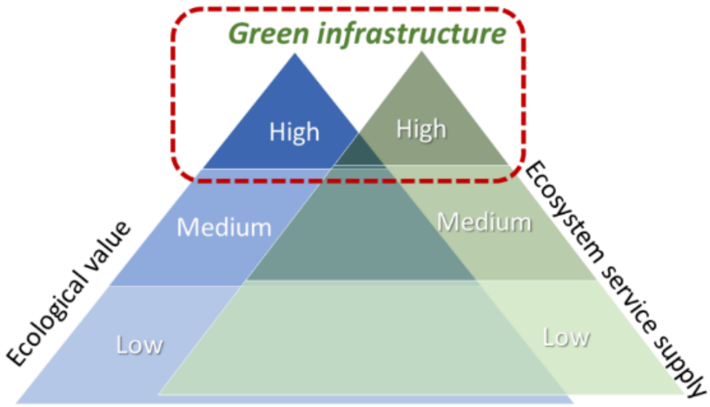
FIGURE 2: METHODOLOGY PROPOSED BY THE EEA FOR MAPPING GI WITHIN A PAN-EUROPEAN CASE STUDY



Source: Liquete et al. (2015).

Mapping of marine GI was tested by the Pan Baltic Scope project at the scale of the Baltic Sea, adopting the methodology proposed by Liquete et al. (2015). The project experts discussed the option of identifying the core areas of marine GI based on the existing network of MPAs or on the ecologically or biologically significant marine areas (EBSAs) proposed within the framework of the UN Convention on Biological Diversity (CBD). However, it was concluded that such an approach would not be sufficient due to data limitations at the time of designating MPAs, and different scale considerations when delineating EBSAs. Instead, the project applied a bottom-up approach by aggregating spatial data on the distribution of benthic habitats and birds, fish and mammals to identify areas of high ecological value and high ecosystem service supply potential. The areas scoring the highest values are considered to be those that form marine GI (Figure 3).

FIGURE 3: CONCEPTUAL APPROACH TO MAPPING OF MARINE GI



Source: Ruskule et al. (2019b).

The Pan Baltic Scope approach to mapping marine GI included the following main steps:

1. **Identification of the ecosystem components forming marine GI and the available datasets for assessment of their distribution**

GI mapping requires consistent and reliable data on the extent and condition of the ecosystem components that form GI and the services they provide. However, only those ecosystem components that are represented in spatial datasets at the selected mapping scale can be included in the analysis. In its GI mapping, the Pan Baltic Scope project used regionally harmonised spatial datasets of the marine ecosystem components covering the whole Baltic Sea (available from the HELCOM Maps and Data service[23], prepared by the HELCOM HOLAS II project). The dataset includes more than 30 layers on spatial patterns of various ecosystem components of the following broader groups: i) habitats, including pelagic habitats, benthic habitats and species (marine landscapes, EU protected (Natura 2000) habitat types; key benthic species), essential fish habitats, bird habitats; ii) mobile species, including presence and abundance of fish species and mammals. However, not all data layers were suitable for GI mapping – data on mobile species (distribution and abundance of fish, birds and mammals) were not included due to insufficient data accuracy, while the data on pelagic habitats (represented by the data layer on productive surface waters) were not included because of an absence of spatial differences. Instead of HELCOM data layers on essential fish habitats, new maps were developed within the Pan Baltic Scope project. During the Pan Baltic Scope expert meetings, the possibility of integrating bird migration routes in GI mapping was discussed but insufficient spatially explicit data meant that this aspect also had to be excluded. Nevertheless, experts acknowledged that migration roots and data on species and habitat connectivity are essential for characterisation and mapping of marine GI.

2. **Development of a GIS tool to aggregate assessment results**

The Pan Baltic Scope project used an existing Geographical Information Systems (GIS) tool developed by HELCOM for the spatial representation of the Baltic Sea Impact Index (BSII), which incorporates the ecosystem components and datasets selected. The GIS tool was extended to perform the necessary data aggregations and produce a GI map of the Baltic Sea area. It combined the assessment results with the maps of ecosystem components to generate maps of high ecological value and service supply areas.

3. **Identification of ecosystem services and ecological value criteria to be used in the assessment**

In assessing ecosystem service supply potential, Pan Baltic Scope experts identified relevant services in the context of marine GI that could be assessed based on the available datasets. The selection was based on the Common International Classification of Ecosystem Services (CICES), Version 5.1[24], and included regulation and maintenance services (filtration of nutrients, storage of nutrients, storage of hazardous substances, erosion control, nursery habitats, pest control, and climate control by biological fixation photosynthesis and by sequestration in sediments), as well as cultural services related to recreation. To assess the ecological value of marine areas, the Pan Baltic Scope expert team applied the same criteria used in the identification of EBSAs: biological diversity; rarity; importance for threatened, endangered or declining species and/or habitats; vulnerability, fragility, sensitivity, or slow recovery; special importance for life-history stages of species; and biological productivity.

4. **Assessment of ecosystem components for their contribution to ecological value and ecosystem service supply**

The Pan Baltic Scope experts assessed the ecosystem service potential and ecological value using a qualitative valuation approach built on an expert-based matrix method, acknowledged as a suitable method for reducing the complexity of human-environmental systems and solving the urgency-uncertainty dilemma (Burkhard et al.,

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[23] https://maps.helcom.fi/website/mapservice/

[24] https://cices.eu/

2009, Burkhard et al., 2012; Jacobs et al., 2015; Campagne and Roche, 2018). Each of the 30 ecosystem components was assessed for its potential contribution to each of the selected ecosystem services and relevance to the six ecological value criteria. Two matrices were developed – one for assessing ecosystem service supply and the other for ecological value – to represent all possible combinations of ecosystem components and criteria. A binary scale was applied for assessment, where 0 represented no or negligible contribution of ecosystem component to the service/ecological value criterion and 1 was assigned if the ecosystem component was expected to contribute significantly to the service or was identified as relevant for that criterion. The assessment scores were obtained through an iterative process. First, the matrices were completed individually by experts from Estonia, Latvia, Sweden, Finland, Germany and HELCOM (representing the Pan Baltic Scope project expert group and some external experts), then the individual assessment results were compiled into a single matrix. Joint online meetings allowed discussion of inconsistencies and differences until a consensus in assessment was achieved (see Annexes 1a and 1b for examples of the matrices).

5. **Mapping of ecologically valuable areas and ecosystem services supply potential**

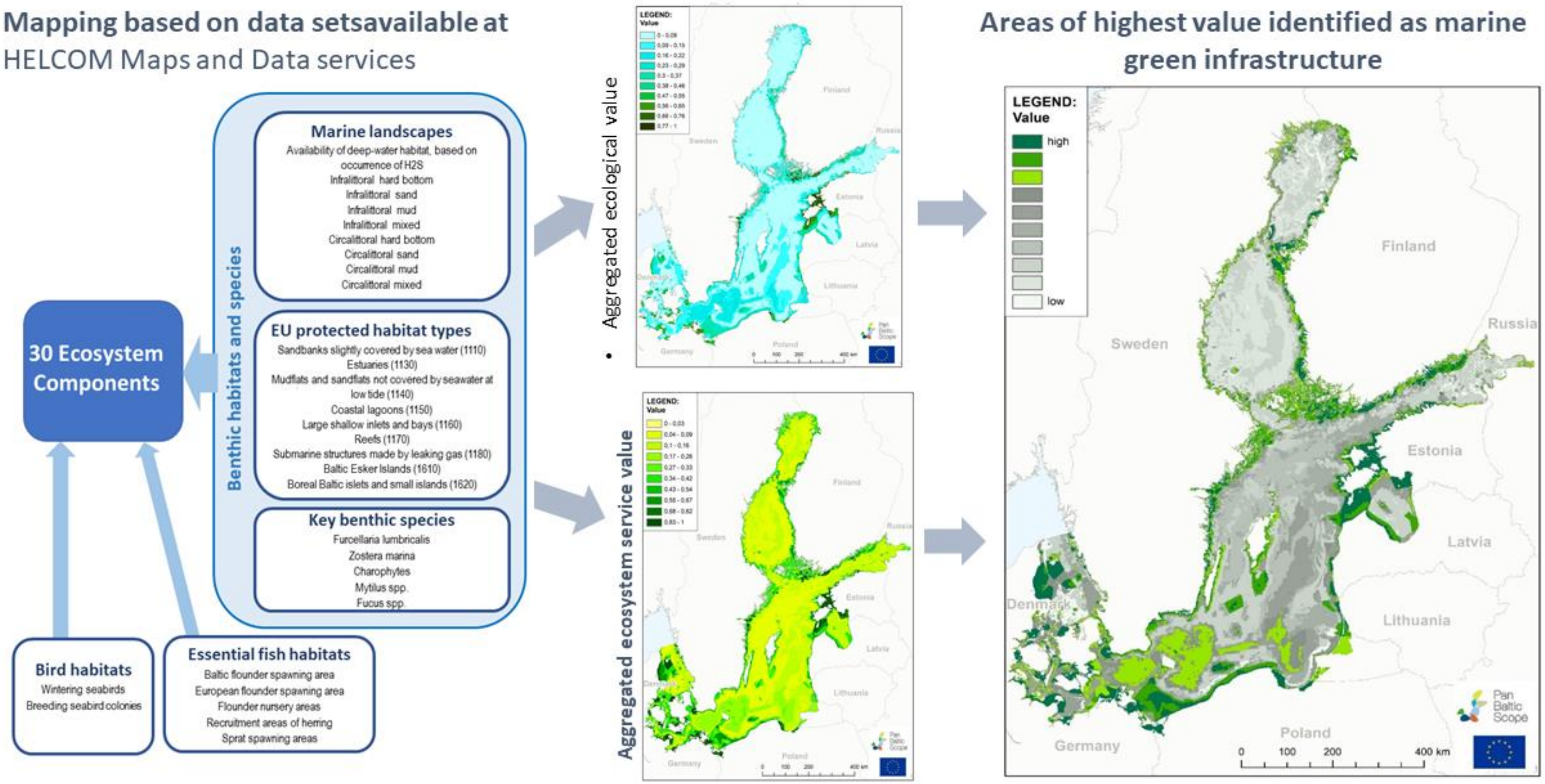
The assessment results of ecosystem service supply potential and ecological value were entered into the GIS tool. A hierarchical data aggregation approach was applied to producing aggregated maps of ecological value and ecosystem services. This included the production of separate maps for each ecological value criterion in relation to each ecosystem component group (benthic habitats, birds, fish and mammals), which were then aggregated at the level of ecosystem component groups and, finally, in a composite aggregated ecological value map. At each step, the values were normalised to a 0-1 range in order to avoid over-representation of ecosystem groups represented in a higher number of ecosystem data layers. A similar approach was applied to ecosystem service mapping. However, a slightly different hierarchical data aggregation was applied in order to avoid domination of those ecosystem features that were represented in many data layers (e.g. benthic habitats) and any resulting double counting of their ecosystem service supply value. The aggregation method is described in detail in the Pan Baltic Scope report on GI concept for MSP (Ruskule at al., 2019a)[25].

6. **Producing the aggregated GI map**

The results of the ecological value and ecosystem services mapping were integrated into a single marine GI map (Figure 4). The map indicates the continuous range of the aggregated values of each grid cell. However, according to the concept described above, marine GI is formed by the areas with the highest ecological value and/or highest value for ecosystem service supply. That interpretation is in line with the European Commission definition of GI, which should encompass a network of areas managed for protection of biodiversity and delivery of a wide range of ecosystem services. However, unlike terrestrial areas, where patches of green or blue space have a distinct border, such borders cannot be distinguished in marine environment. An arbitrary threshold had to be defined for the areas with the highest value and thus considered marine GI. Pan Baltic Scope experts proposed that the 30% of the Baltic Sea area with the highest scores for aggregated ecological and ecosystem service supply value should be recognised as marine GI.

[25] See http://www.panbalticscope.eu/wp-content/uploads/2019/12/PBS_project_green-infrastructure_report_FINAL.pdf. A scientific paper is being prepared.

FIGURE 4: PAN BALTIC SCOPE METHODOLOGICAL APPROACH TO MAPPING OF MARINE GI



Note: In the final GI map on the right, the green colour indicates the 30% of the Baltic Sea area that represents the highest ecological and ecosystem service supply value (the most valuable areas in dark green, other highly valuable areas in light green).

Source: based on Ruskule et al. (2019b).

The Pan Baltic Scope approach to marine GI mapping described here can be considered a relatively simple method to aggregate complex information on various ecological aspects where harmonised datasets on the relevant ecosystem components are available for the particular mapping area. However, the reliability of the GI mapping results depends on accuracy of the input data, which is still insufficient for several components of the marine ecosystem, at least in the Baltic Sea. Other limitations acknowledged by the project experts include a lack of connectivity analysis of marine ecosystem components and the need for more comprehensive ecosystem service assessment, including considerations of spatial variations in biota, ecosystem condition and vulnerability of ecosystem services to cumulative pressures, quantification of service supply and assessing GI functionality by assessing ecosystem service supply and demand relations. The expert knowledge-based matrix approach could be replaced by a quantitative method for mapping ecosystem service supply, applying ecological modelling techniques (e.g. phenomenological, process-based, macro-ecological and/or connectivity models).

3.3 Stakeholder and expert engagement in developing the marine GI concept

3.3.1 Outcomes of the online expert workshop 'Methodology for Marine Green Infrastructure Mapping', *26 October 2020*

A small online expert workshop was organised on 26 October 2020 to discuss the methodology for marine GI mapping and its applicability in MSP. The meeting was attended by marine ecologists and MSP practitioners from the Baltic Sea region, as well as consortium members of the study on integrating EBA into MSP:

- Tony Zamparutti, Milieu Consulting, Belgium
- Kristina Veidemane, Baltic Environmental Forum-Latvia
- Anda Ruskule, Baltic Environmental Forum-Latvia
- Jan Schmidtbauer Crona, Swedish Agency for Marine and Water Management
- Philipp Arndt, Federal Maritime and Hydrographic Agency, Germany
- Solvita Strāķe, Latvian Institute for Aquatic Ecology
- Kerstin Schiele, Leibniz Institute for Baltic Sea Research Warnemünde, Germany
- Susanna Jernberg, Finnish Environment Institute

During the workshop, the following issues were presented and discussed:

- **Existing experiences in marine GI mapping:**
  - Pan Baltic Scope project experience in the development of the marine GI concept and the testing of GI mapping at the Baltic Sea scale; and
  - Swedish experience in mapping marine GI, including development of the Green Map, aggregating various nature values for the Swedish MSP, assessing potential impacts of climate change on marine GI, identifying climate refugia areas, and application of the ecosystem service concept by using the MOSAIC[26] tool at local scale.

[26] Framework for marine conservation values and ecological coherent networks, developed by AquaBiota on behalf of the Swedish Agency for Marine and Water Management.

Participants noted the valuable experience gained from the Pan Baltic Scope project, which showed that it is possible to apply the GI concept in the marine environment, considering the functionality of each ecosystem component.

- **Potential and limitation for further development of marine GI mapping methodology**: The accuracy of the input data was highlighted as one of the most important aspects in marine GI mapping. This was one of the limitations in the Pan Baltic Scope project, where only the datasets on ecosystem components harmonised at the Baltic Sea scale were applied. Advantages of local/national scale assessments were highlighted, as these can make use of more accurate data (e.g. application of MOSAIC tool at coastal municipality level; national scale ecosystem service mapping in Latvia within BONUS BASMATI project, which assessed relative the contribution of each ecosystem component to each ecosystem service).
  Nonetheless, the regional sea scale is essential for mapping the marine GI to address the connectivity of marine ecosystems in a transnational perspective. Connectivity analysis was highlighted as a major issue for the further development of marine GI mapping methodology. In the Pan Baltic Scope project, connectivity analysis was not carried out due to limited human and time resources, but it was recognised as a crucial aspect in assessing marine GI. In addition, the Pan Baltic Scope approach to setting an arbitrary threshold (i.e. 30% of the most valuable areas) for delineation of the marine GI was questioned. Rather, a continuous gradient of the value could be applied in GI mapping to exclude areas with lower cumulative values, which nevertheless might be essential for functioning of the ecosystem.

- **Applicability of the GI concept and mapping results at different steps of the MSP cycle**: Findings of the Pan Baltic Scope project and recommendations from the marine GI session organised in the framework of the 3rd Baltic MSP Forum (19-21 November 2019, Riga) were presented, highlighting the potential for the GI concept to support implementation of the EBA in MSP and improve coherence of the MPA network. Participants discussed the applicability of the GI concept across the different steps of MSP (defining, developing, assessing, implementing and follow-up). Results of the discussion are presented in Table 1 below.

TABLE 1: OPPORTUNITIES AND LIMITATIONS FOR OPERATIONALISING THE GI CONCEPT IN MSP, IDENTIFIED BY PARTICIPANTS AT THE EXPERT MEETING

MSP steps	Opportunities	Limitations
Defining	• Identification of ecosystem components essential for maintaining marine ecosystem and human well-being; • Setting objectives and targets	• Looking at single species/habitats only? • Ecosystem functionality must come from other parts
Developing	• Mapping of marine GI, including areas of high ecological and ecosystem services value • Development of spatial solutions/zoning to move potentially harmful development away from ecologically valuable or sensitive areas or to improve ecosystem condition, including designated 'high nature value'	• Reliability • Less data/certainty in Exclusive Economic Zone (EEZ), especially on ecosystem services • Non-binding status

MSP steps	Opportunities	Limitations
	areas in the plans • Using GI mapping as a basis for developing a sustainable Blue Economy	
Assessing	• Applying GI mapping results in assessment of impacts of alternative scenarios/ SEA procedure • Including GI mapping results in economic and social analysis, using ecosystem services • Identifying mitigation measures to minimise negative impacts on GI	• Reliability • Assessments depend on assumptions about effects of pressures and ecosystem component sensitivities that naturally include uncertainties • Challenges in communicating impacts on GI at an aggregated level, as well as a more specific ecosystem component level
Implementing	• Applying GI mapping results in Environmental Impact Assessment (EIA) • Supporting cross-border coordination of the planning solutions in respect of ecological values	• Reliability
Follow-up	• Applying GI mapping results in monitoring: assessment of ecosystem condition in areas forming marine GI and impacts of applied MSP solutions • Assessment of GI condition can be linked to Marine Strategy Framework Directive monitoring frameworks	• Reliability

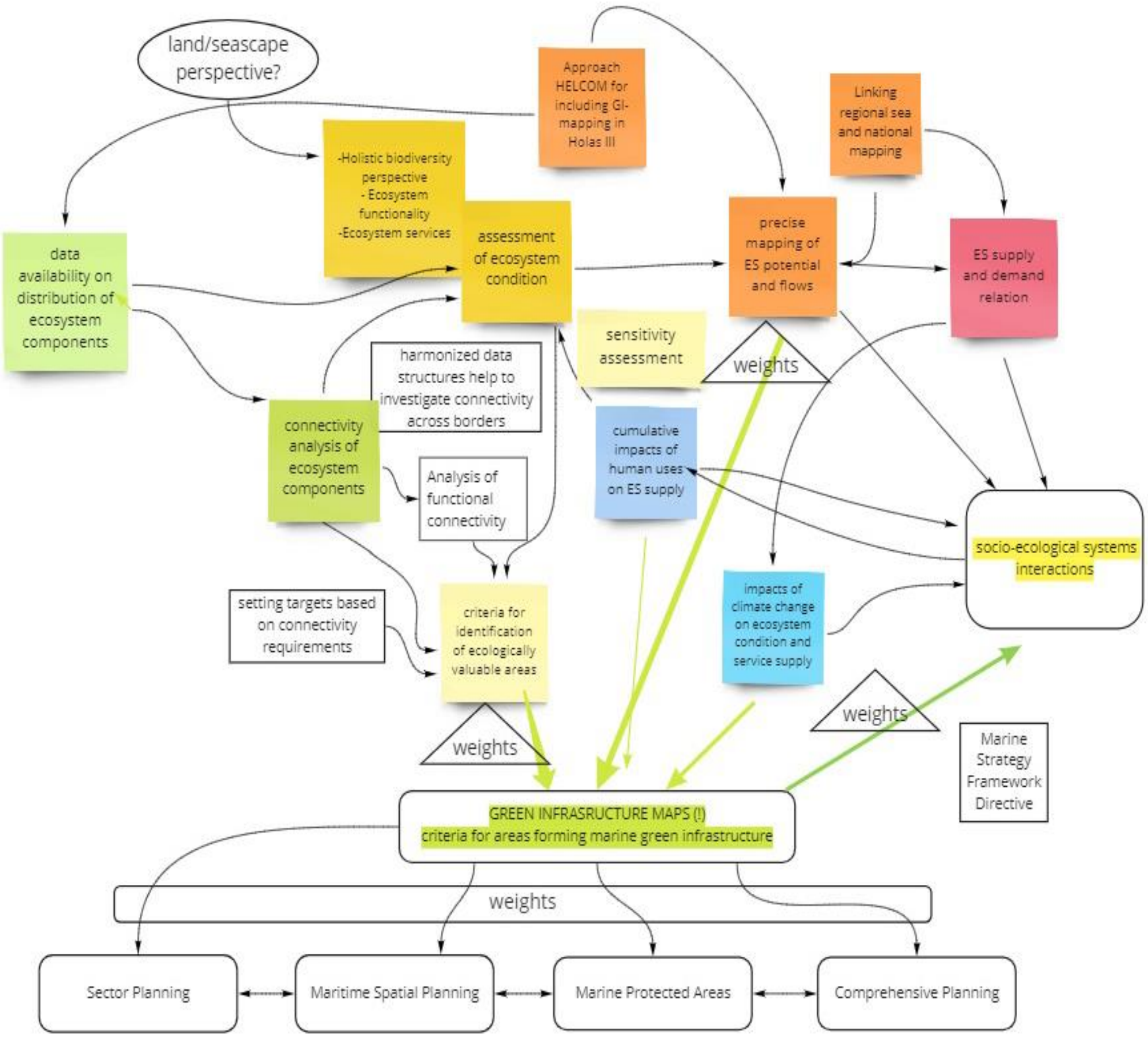
Further development of marine GI concept and mapping methodology

Participants of the expert workshop created a mind map, illustrating the different aspects to be considered in the marine GI mapping and its application in different planning/marine governance contexts (Figure 5).

- GI mapping should be based on a holistic biodiversity perspective, integrating ecosystem functionality and ecosystem service supply.
- Major elements of marine GI mapping include:
  - Assessment of ecosystem condition;
  - Connectivity of its components and identification of ecologically valuable areas;
  - Precise mapping of ecosystem service potential, flows and relation to ecosystem service demand;
  - Sensitivity assessment of ecosystem components (including recoverability/resilience to human pressures) and assessment of cumulative impact on ecosystem condition and service supply;
  - Assessment of climate change impact on ecosystem condition and service supply.
- Data availability on the distribution of ecosystem components is an essential precondition for GI mapping. HELCOM should be approached with respect to the need to develop new datasets and to integrate GI mapping in Holistic Assessment III.

- Connectivity assessment should be the major focus of any further development of marine GI mapping methodology. This includes the functional connectivity of ecosystem components, how different areas are reachable for species, and how activities regulated by MSP can hinder connectivity.
- Stakeholder/expert-derived weights can be applied to the criteria for areas forming marine GI, as well as for integration of the GI mapping results into different planning contexts and analysis of socio-ecological system interactions.

FIGURE 5: MIND MAP OF ASPECTS TO BE CONSIDERED IN MARINE GI MAPPING



Source: Baltic Environmental Forum-Latvia (2020).

3.3.2 Outcomes of the Capacity4MSP Planning Forum #2, *11 November 2020*

The GI concept was presented and discussed during the November 2020 Planning Forum organised by the Baltic Sea Interreg programme's platform project, Capacity4MSP[27]. Planning forums are organised regularly to support informal

[27] https://vasab.org/project/capacity4msp/

collaboration among MSP practitioners. They act as a practical dissemination and collaboration platform, supporting ongoing national and regional MSP processes and implementation of MSP policy. The GI concept was presented at the 2nd Planning Forum on 11 November 2020. The event was held online and was attended by 30 participants, representing planners from governmental bodies and researchers from the Baltic Sea countries.

Anda Ruskule presented the draft results of this Baltic case study on GI mapping, including an overview of the GI concept and the experience of its application in the Baltic Sea Region (e.g. testing the marine GI concept in Pan Baltic Scope project, as well as its application in Swedish MSP and the development of regional 'Green Infrastructure Action Plans' by using the MOSAIC tool to facilitate EBA for spatial management of marine nature values). She shared feedback on the Pan Baltic Scope approach to GI mapping and recommendations for its further development that had emerged from the Session on Marine GI and its role in MSP, held at the 3rd Baltic MSP Forum (19-21 November 2019, Riga) and from the online expert workshop on 'Methodology for Marine Green Infrastructure Mapping', organised in the framework of this case study (26 October 2020).

Participants of the Capacity4MSP Planning Forum embraced the concept of marine GI and acknowledged its potential for supporting EBA in MSP. Jaczek Zaucha (University of Gdansk) noted that the GI concept encompasses aspects of marine ecosystems that are already (partly) addressed in ongoing and finalised MSP processes. The added value from the application of the GI concept would be in revealing how to strengthen the resilience of a marine ecosystem, supporting its long-term functionality as well as contributing to the achievement of GES under the Marine Strategy Framework Directive. It was also suggested that GI mapping should include cultural heritage.

Discussions at the Planners' Forum highlighted a problem: in countries with legally binding MSPs (e.g. Germany, Poland), respecting ecologically valuable/GI hotspot areas that do not have statutory protection would be more problematic when defining sea-use conditions, compared to countries with non-binding, strategic MSPs (e.g. Sweden). In the case of Germany, the MSP sets strict conditions for the use of the sea, with stricter data requirements for determining sea use limitations and solutions and for the stakeholder consultation process. By contrast, in Sweden, where MSP is strategic or recommendation-based in nature, the consideration of ecological values can be more easily integrated into proposals on use of the sea – the MSP zoning map includes 'n-areas' in addition to the existing and planned MPAs, as areas requiring particular consideration of nature values.

Participants in the Planners' Forum acknowledged that connectivity is an important aspect and there is a need to secure migration corridors in national MSP processes. One suggestion was to consider the results of the Interreg project North SEE, a study on the connectivity of MPAs and particularly valuable and vulnerable areas in the North Sea[28].

4. LSIs AT LOCAL/SUB-NATIONAL SCALE

Although the national MSP of Latvia addresses LSIs, the issue is considered from the perspective of national maritime development policies and the MSP does not focus on local or sub-national (regional) development needs in the LSI. Latvia's separation of

[28] https://northsearegion.eu/media/7068/final-version_connectivity_in_the_north_sea_final.pdf

responsibilities between maritime and terrestrial planning domains and between administrative levels is one of the challenges when addressing multiple uses and interests, holistically and spatially. Strengthening the coherence of the resulting MSP with other relevant planning processes is critical in ensuring sustainable development in the coastal zone in Latvia.

EBA was applied in the development of the Latvian MSP. It included MAES, which is seen as one of tools for operationalising EBA in MSP (Veidemane et al., 2017). Ecologically valuable or sensitive areas were identified, with the goal of avoiding sea uses that could endanger these areas or destroy their ecosystem structures and functions (e.g. benthic habitats) and the services they provide. Due to limited time and resources in drafting the MSP, the MAES approach was tested and applied only for marine ecosystems, without linking these to coastal (shoreline and inland) ecosystems.

This section presents the application of the MAES approach to support the balancing of national MSP interests for developing offshore wind energy with local and regional coastal tourism development goals. A combination of different methods – biophysical and social – was used to deliver an integrated assessment of ecosystems and the services they deliver in marine and coastal areas. The assessment results were used for stocktaking, scenario-building, and evaluation and trade-off analysis in the LSI domain. This part of the case study is based on the experience and methods applied in the Interreg Baltic Sea Region Programme project, Land-Sea-Act[29].

4.1 Case study area

The case study area is located in the Kurzeme Region on the southwestern coast of Latvia and the eastern Baltic Sea (Figure 6). To demonstrate LSI, the case study area includes a terrestrial part (up to 10 km inland from the shoreline) and a marine part (comprising the adjacent territorial waters and EEZ from Latvian-Lithuanian border to the northern border of the Pāvilosta municipality. The terrestrial part contains five local municipalities (Rucava, Nīca, Liepāja, Grobiņa and Pavilosta), including the city of Liepāja (68,500 inhabitants), a small town, Pāvilosta, 10 coastal and seven inland villages, and several smaller settlements.

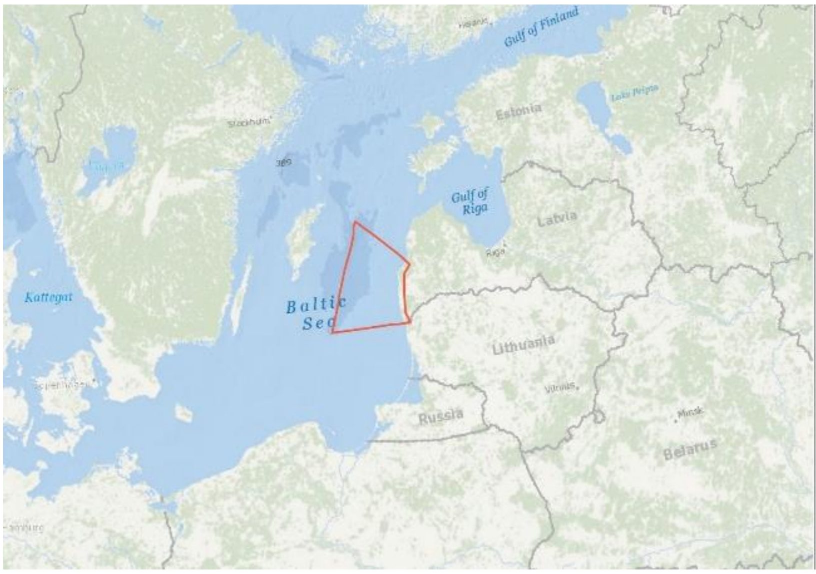
The main ecosystem types in the case study area are sandy (as well as stony and pebble) beaches, wooded and grey dunes, coniferous forests, wetlands, lakes and rivers, grasslands and arable land, including polders. The marine ecosystems include benthic habitats formed on sandy and mixed substrates, as well as rocks and boulders (reefs). Coastal waters are important areas for fish spawning and nursery, and for birds during migration season and in winter.

The area is used for coastal tourism, fishing and shipping (it includes one large port, Liepāja, and a small recreational and fishing port in Pāvilosta). The terrestrial part is also used for agriculture, forestry and, more recently, renewable energy production, with wind turbines installed in the terrestrial part of the case study area and an emerging interest from developers to construct off-shore wind farms in the adjacent territorial waters and EEZ. The anticipated offshore wind energy development is raising concerns among local stakeholders in respect of the potential negative impact on landscape and coastal tourism. Stakeholders are also worried about expansive,

29 https://land-sea.eu/

uncontrolled tourism development and insufficient tourism infrastructure that could damage fragile coastal habitats and landscape.

FIGURE 6: LOCATION OF THE CASE STUDY AREA



Source: Baltic Environmental Forum-Latvia (2021).

The Latvian national MSP was adopted in May 2019 and spatially defines the areas with priority use for shipping, military interests, investigation of nature values, research areas for offshore wind park (OWP) development and corridors of perspective electricity cables. Sustainable tourism and recreation is identified as one of the strategic objectives of the MSP. However, the plan does not spatially prioritise areas for these human activities but, instead, states that tourism and recreation can be carried out in areas of general use. The MSP also foresees the assessment of impacts of OWPs on landscape and nature assets when issuing licences for wind park developments. Negotiation on balancing the interests of OWPs and landscape protection is therefore unresolved and left to the implementation stage.

Tourism development in the coastal zone was strategically planned in the National Long-term Thematic Plan for Development of Coastal Public Infrastructure[30], adopted in 2016 during the development of the MSP. This plan is focused on terrestrial coastal areas, with activities considered from the perspective of recreation at the beach (bathing, walking, leisure, bird-watching, etc.).

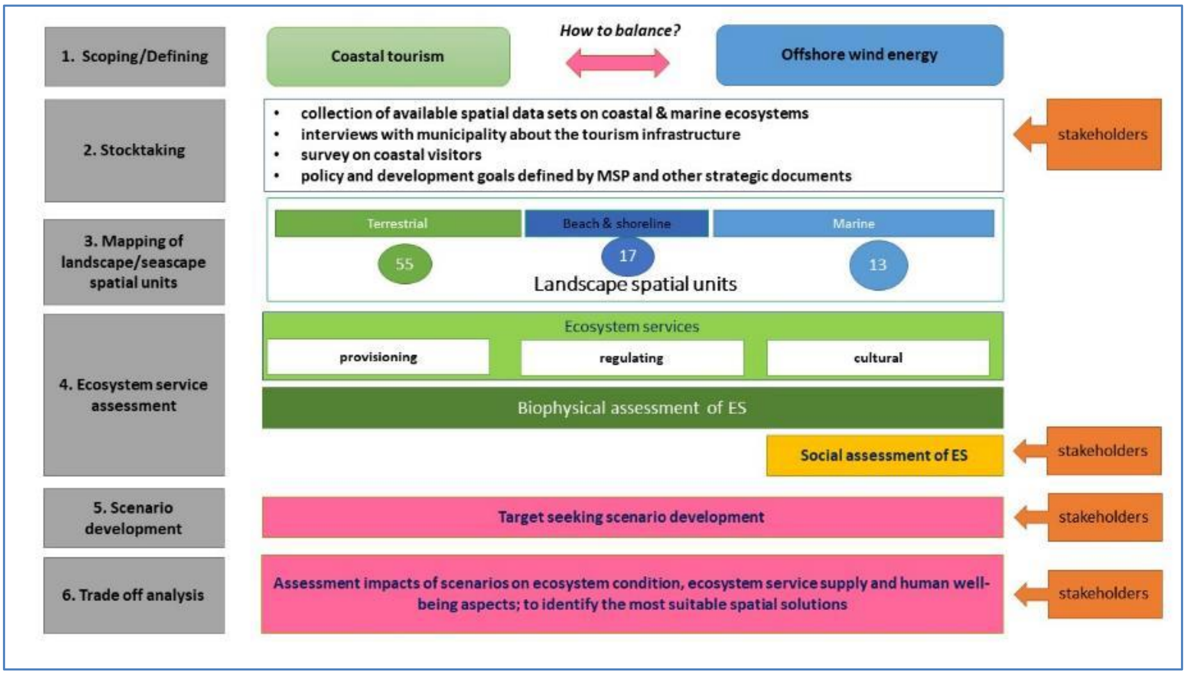
Each municipality also sets tourism and recreation goals and tasks in its local development and spatial planning documents. Since 2016, Latvian coastal municipalities have a right to plan the use of the sea up to 2km from the coastline, although they are generally slow to avail of this opportunity. A true LSI between maritime and terrestrial planning that covers important aspects of lifestyle of coastal communities, including tourism and recreation, has yet to be established.

[30] http://polsis.mk.gov.lv/documents/5763

4.2 Method for addressing LSIs through applying ecosystem service approach

The case study focused on addressing LSI in MSP by operationalising the MAES and using MAES results in trade-off analysis and determining MSP solutions. The workflow in Figure 7 combines the steps and elements of the MSP planning cycle (from scoping/defining, stocktaking to developing the plan), accommodating the MAES process and using MAES results in decision-making. It foresees strong stakeholder engagement throughout the process, engaging them not only in providing information, data, feedback or comments, but also in scenario-building, assessment and in MAES itself (social assessment).

FIGURE 7: WORKFLOW TO APPLY MAES APPROACH TO ADDRESSING LSI IN MSP



Source: Baltic Environmental Forum-Latvia (2021).

Like many studies, implementation was launched with a scoping/defining task and via stocktaking activities. The case study focuses on finding a balance between offshore wind energy development and coastal tourism, taking into account nature and landscape values. The stocktaking covered the following tasks:

- Collection of available spatial datasets on coastal and marine ecosystems and tourism infrastructure (topographic maps, land cover maps, municipality development and spatial plans, tourism information, database of cultural heritage monuments, forestry data, semi-natural habitat survey results, schematic data on coastline character/typology, bathymetry data, benthic habitat maps, bird distribution data in marine areas, etc.);
- Interviews with municipalities on the latest developments and future plans for tourism infrastructure (car parks, trails, access to beach roads, etc);
- A survey of coastal visitors (including monitoring visitor flow and counting), their impact on the environment (e.g. littering, habitat trampling) and on coastal public capacity;
- Collection of available information on potential interest areas for offshore wind energy development and other sea use interests/conditions (available from the

MSP of Latvia, sectoral policy documents and other relevant information sources).

The third step was to create a base-map for MAES, with particular focus on assessing multiple values of coastal land and seascapes. The MAES was designed based on a widely applied cascade model (Potschin et al., 2016) and CICES (Czúcz et al., 2018), which has been acknowledged by EU MAES reports[31]. Particular attention was paid to mapping and assessing cultural ecosystem services and landscape qualities, with landscape and seascape units identified based on relatively homogenous biophysical (relief, geology, land cover or habitat type) and use characteristics as service providing units. The creation of a base-map resulted in the delineation of 55 terrestrial, 17 shoreline landscapes and 13 seascape units. Drawing borders for these landscape and seascape units required recognition of place identity and cultural heritage and can be applied when communicating the mapping results with stakeholders, highlighting LSIs and discussing the most appropriate management solutions.

The fourth step was dedicated to the assessment of ecosystem services. The case study applied two categories of methods – biophysical and social assessment methods. Economic valuations were not feasible, due to financial constraints. The case study covered relevant ecosystem services from all three categories: provisioning, regulating and cultural services. However, the greatest emphasis was on cultural ecosystem services, as they play an important role in tourism and recreation. Biophysical mapping and assessment required empirical data from public data sources, fieldwork and expert assessments of landscape qualities. It was based on a set of criteria and indicators linked to physical attributes (e.g. land cover features and distance to roads). Social methods involved stakeholder engagement activities (see 4.3.1).

The fifth step was to develop new scenarios with stakeholder involvement. A target-seeking scenario (normative) method (IPBES, 2016) was selected to explore possible pathways to meet offshore wind energy production targets and define tourism potential in the area. This method was employed because the long-term goals have been established for national maritime and renewable energy policies by 2030. The optimal solution has not been determined, however, and various alternative options can be created and evaluated. New, ambitious national renewable energy policy goals for 2050 are being negotiated following the adoption of the EU Green Deal. The target-seeking scenario method supports the capture of multiple and contrasting views on how to reach the goals, as stakeholders are involved in co-designing the future process.

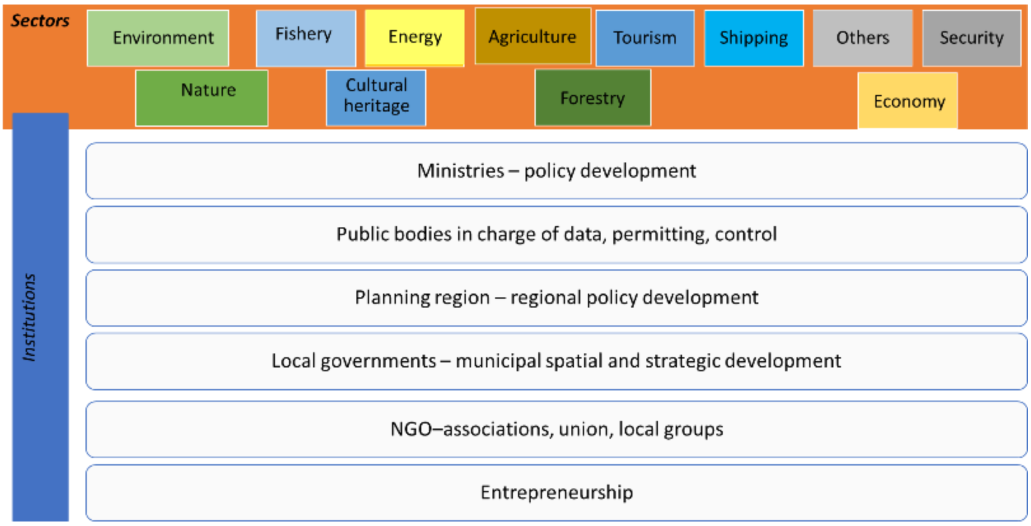
The sixth step is to deliver a final optimal solution that includes trade-off analysis and outlines a spatial solution to balance the goals of offshore wind energy production and local and regional tourism development. The trade-off analysis focused on gains and losses in the ecosystem services supply in the proposed alternatives. The optimal solution considered the results of the trade-off analysis, as well as the existing zoning of the national MSP.

[31] https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm

4.3 Stakeholder engagement in assessing LSIs and scenario development in the Land-Sea-Act project

Stakeholder involvement is an important element when addressing complex challenges in the analysis of trade-offs and the search for optimal solutions for MSP. The sub-national case study was designed with strong stakeholder involvement in different phases and tasks in the planning process (Figure 7). In addition to stakeholders, the wider public was invited to take part in the mapping and assessment of recreational services in the area.

FIGURE 8: STAKEHOLDER MAPPING SCHEME FOR LSI CASE STUDY



Source: Baltic Environmental Forum-Latvia (2021).

At the beginning of the case study implementation process, the relevant stakeholders were identified (Figure 8) and their interests analysed in the context of sea and land use and in relation to MSP and other planning processes. As Latvia has recently finished its MSP (which also had a strong stakeholder involvement process), the same stakeholder involvement methodology was followed here (Veidemane et al., 2017). The main emphasis in the case study was on engaging local and sub-national (regional) stakeholders from all relevant sectors and institutions. The LSI requires the involvement of both marine and terrestrial stakeholders (e.g. forestry, agriculture). Tourism and recreation activities in coastal marine and terrestrial areas are interlinked (these activities are at and on the water) and these sectors were already involved in MSP to some extent.

4.3.1 Participatory methods for mapping and assessing coastal landscape and ecosystem service value and recreational potential

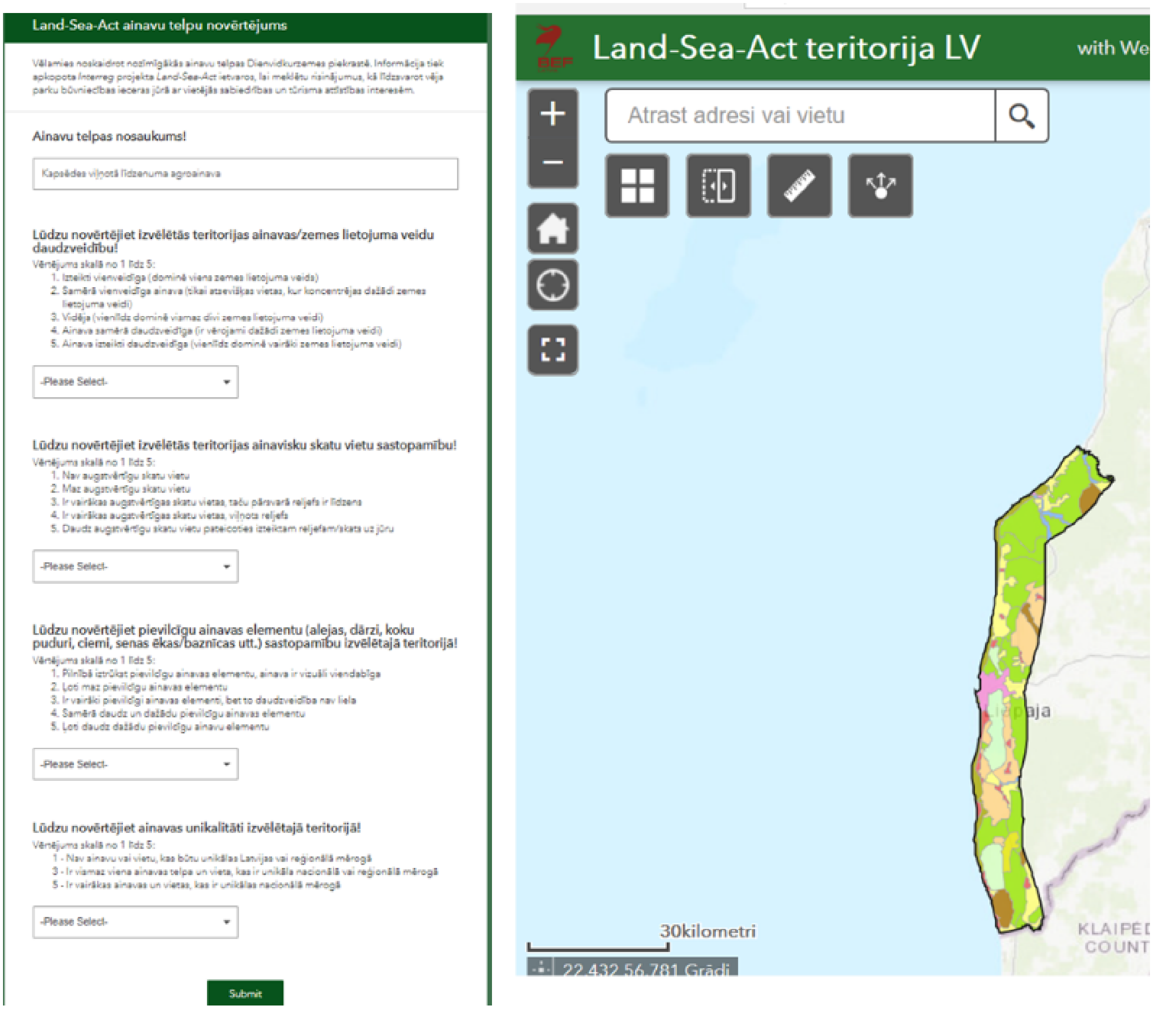
The application of social methods is widely recognised for operationalising MAES in decision-making, as they measure individual and collective preferences (Santos-Martin et al., 2018; Vihervaara et al., 2019). Different societal groups view landscapes and ecosystems (including marine and coastal systems) in terms of their own economic, cultural and society needs. Their needs are based on geographical conditions and societal characteristics that are place-specific.

The case study applied a participatory GIS method to map and assess multiple values of coastal land and seascapes. Two interventions were implemented, using ArcGIS web online survey tools:

1) **Stakeholder engagement in assessing the landscape qualities based on selected indicators** (diversity of land use/land cover types; presence of scenic views; presence of small-scale landscape elements; uniqueness of landscape).

The method was used in a stakeholder workshop. Experience suggested that a written or online survey approach would have been difficult to implement, as participants needed to interact with the expert team to clarify various aspects and to receive technical support in using the ArcGIS platform (see Figure 9 below).

FIGURE 9: VIEW OF THE SURVEY FORM IN THE ARCGIS WEB TOOL FOR ASSESSING LANDSCAPE QUALITIES PER LANDSCAPE UNIT



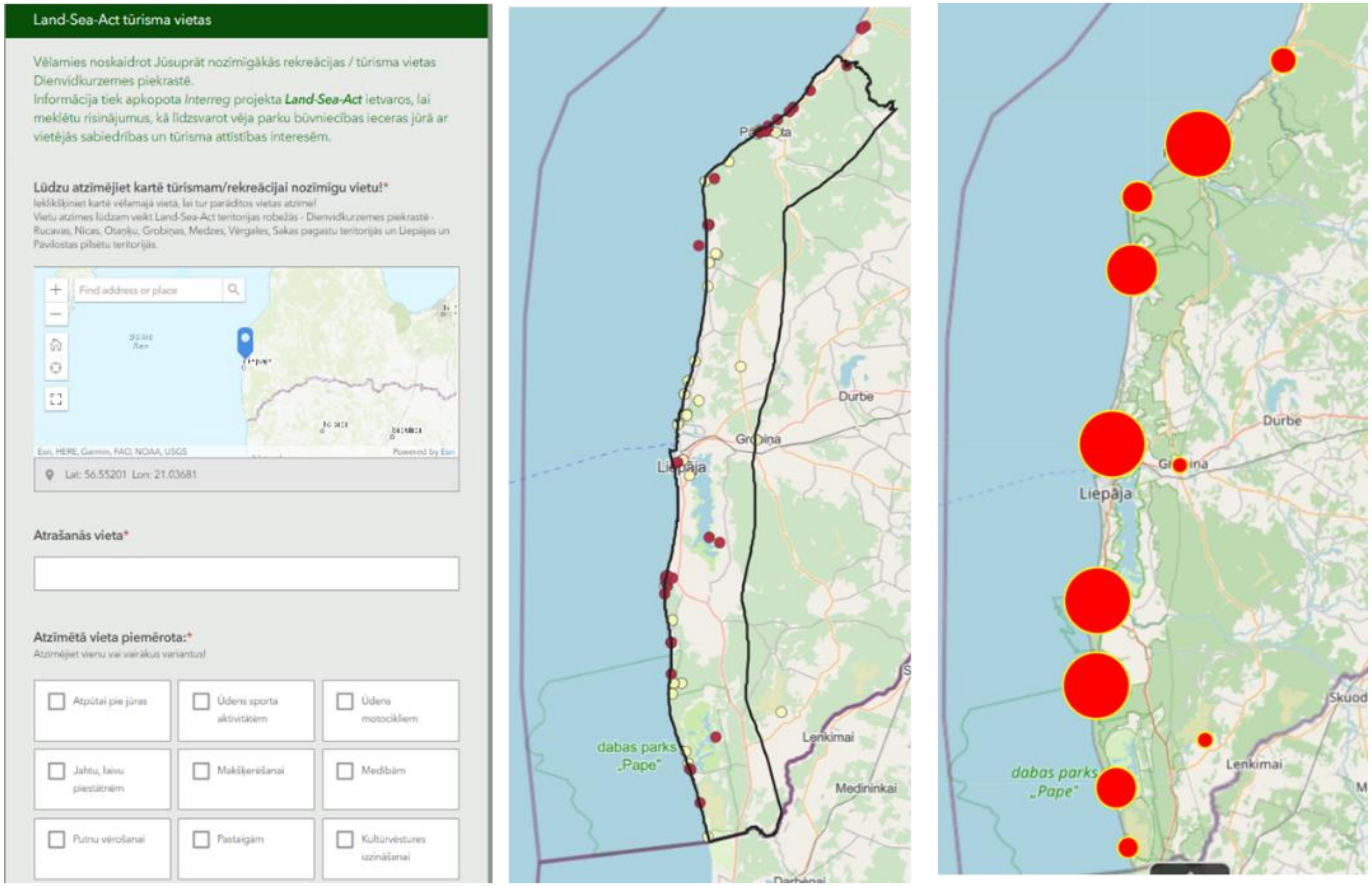
Source: Baltic Environmental Forum-Latvia (2021).

Local knowledge collected from stakeholders was used to supplement and verify the expert assessment. That information confirmed that values of the cultural ecosystem services are not only linked to the outstanding natural beauty of the landscapes and seascapes (e.g. vista and panoramic qualities), but also the opportunity to have physical interaction and experiences, including traditional bathing, water sports, and niche activities. The latter gained further recognition during the COVID-19 pandemic in 2020 and 2021, when indoor social and physical activities were restricted.

2) Collect local knowledge on spatial distribution and significance of cultural ecosystem services

The online survey was launched in autumn 2020. It identified 80 sites and assessed the qualities of ecosystem services they provided. Respondents were asked to identify locations and complete a short questionnaire characterising the functionality of each site identified. This method is easy to implement, with members of the public increasingly skilled at using various GIS-based online applications.

FIGURE 10: VIEW OF SURVEY FORM AND RESULTS FROM ARCGIS WEB TOOL FOR MAPPING OF SIGNIFICANT SITES FOR RECREATION AND TOURISM



Source: Baltic Environmental Forum-Latvia (2021).

Sociocultural valuation uses multiple methods to observe, consult and engage with stakeholders to assess their preferences and values. The preference assessment method was applied to determine the marine and coastal landscapes, ecosystems and ecosystem services that make the greatest contribution to well-being at local and regional level in the case study area. By implementing the collective preference technique, local and regional stakeholders debated and assigned values to the land and seascapes and the ecosystem services in the area.

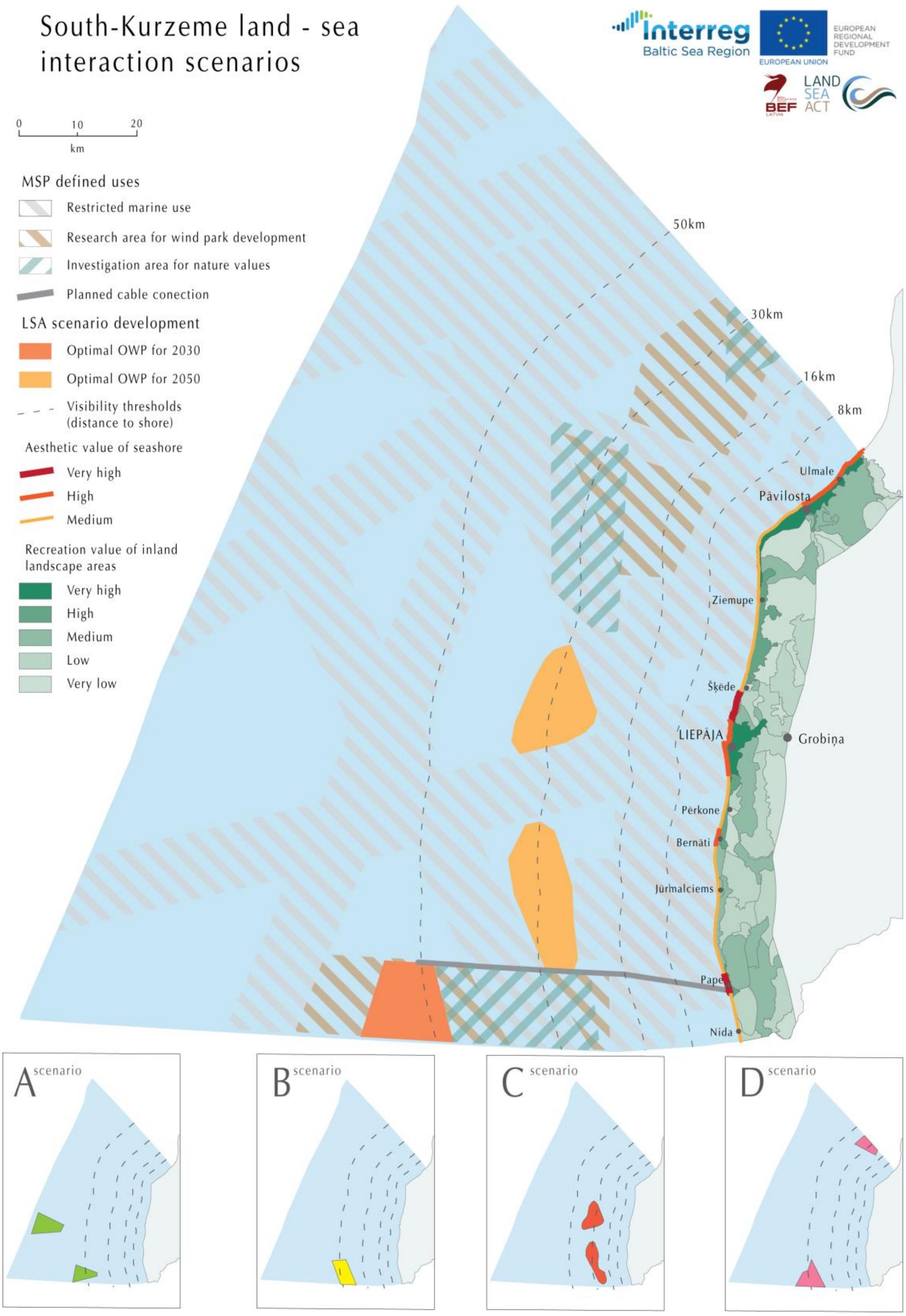
4.3.2 Stakeholder engagement in scenario-building for balancing coastal development interests

A face-to-face scenario-building workshop was organised with some 40 participants, including national and local officials, spatial planners, nature conservation experts, representatives of the tourism sector, and wind energy developers. Participants were divided into four mixed groups to discuss possible options for offshore wind energy and tourism development in Southwestern Kurzeme. During the group discussions, participants explored the spatial limitations and opportunities for construction of OWPs, identified spatial solutions for OWP locations that would ensure achievement of Latvia's 2030 and 2050 targets for offshore wind energy production, and defined priority areas and targets for sustainable tourism development in the area. Participants also had to consider MAES results and visibility thresholds (distance from shoreline) in order to respect local interest and preserve landscapes.

Each group proposed an alternative scenario (pathway) – A, B, C, D (Figure 11), resulting in partly similar spatial solutions (i.e. overlapping areas). This eased the determination of the optimal solution for an OWP location for 2030 and the identification of new spatial locations for 2050.

The results of the scenario-building workshop were used to develop an optimal solution for balancing offshore wind energy production with local interest in preserving the coastal landscape and developing tourism (Figure 11). The proposed optimal solution for 2030 is in line with designated research areas for OWP development, corridors for perspective electricity cables, and investigation areas of nature values, as defined in the Latvian MSP. The optimal solution for 2050 includes additional areas for production of offshore wind energy, which would allow Latvia to achieve its ambitious target to establish OWPs with capacity of 2.9 GW. The case study results can support the national planning authority (Ministry of the Environmental Protection and Regional Development) to implement the MSP, with OWP impacts on landscape and nature assets due to be assessed when issuing licences for wind park developments.

FIGURE 11: VISUALISATIONS OF SPATIAL SCENARIOS AND PROPOSED OPTIMAL SOLUTION



Source: Baltic Environmental Forum-Latvia (2021).

DISCUSSION

This Baltic cross-border case study analyses opportunities for (a) operationalising the GI concept and (b) addressing LSIs to support integration of EBA in MSP. The case study looked at two different scales – regional sea scale for mapping of GI, and local/(sub-national) for addressing LSI. Both aspects of the case study are strongly linked to MAES, which is an essential component in applying EBA to MSP.

The ecosystem service concept demonstrates how ecosystem structures and functions contribute to human well-being, thus supporting understandings of the interrelations between ecological, social and economic systems (Burkhard et al., 2012). Assessing the multifunctionality of ecosystems and identifying geographical areas with a high potential for delivering a wide range of ecosystem services is a crucial component of the GI concept. GI mapping helps to integrate ecological aspects and information on ecosystem service supply in land use planning at various scales (from local to pan-European), as demonstrated in several terrestrial case studies (e.g. Kopperoinen et al., 2014; Di Marino et al., 2019; Mander et al., 2018; Vallecillo et al., 2018), in MSP at sea-basin scale, as shown in a Pan Baltic Scope case study (Ruskule et al., 2019a; Ruskule et al., 2019b), and - to some extent - at national scale (Swedish MSP).

The Latvian case study, undertaken within the Land-Sea-Act Project at sub-national scale, demonstrates that ecosystem service mapping has substantial potential for addressing LSI issues by identifying trade-offs between off-shore and coastal (on-shore) development interests and assessing the impacts of development scenarios on coastal ecosystems and the well-being of coastal communities.

Although applied at different scales and contexts, the two approaches presented here involve the aggregation of large amounts of data and assessments. Both methods allow the identification and respect of ecological hotspots in spatial planning and in the sea/land use governance process. They therefore help to present complex ecological and ecosystem service information in a consolidated user-friendly way for stakeholders and decision makers, giving holistic overviews of marine and coastal ecosystems and their contribution to human well-being, in line with EBA principles.

The analysis of the literature review for the overall study (Task 2 of the *Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning*) suggests structuring the EBA principles into four groups of activities for the integration of EBA in MSP. The relation of the GI and LSI concepts to these four groups is indicated in Table 2 below.

The GI and LSI concepts are both related to all key steps of MSP (i.e. defining, developing, assessing, implementing and follow-up). Marine GI mapping results can be applied in the development and assessment stage of the MSP (e.g. assessing the status of marine ecosystem, identification of ecosystem services delivered, cumulative impact analysis, SEA). They can also contribute to defining objectives and targets, as well as impact assessment at implementation and follow-up steps. LSI should be considered throughout the whole MSP process, whereas the specific approach developed under the Land-Sea-Act project best fits into the developing and assessing steps.

Integration of the GI mapping and assessment results in MSP would support the objectives of the EU Biodiversity Strategy 2030 and the implementation of the EU Birds and Habitats Directives, as well as the Marine Strategy Framework Directive, by identifying measures outside of the Natura 2000 network, such as measures to improve the connectivity of the MPA network and that of functionally related parts of the ecosystems and to avoid sea uses that increase fragmentation of habitats or create obstacles for species migration. GI mapping can also help to identify areas of high ecological value, which could potentially be considered for extending the MPA network.

TABLE 2: RELEVANT AND CONTRIBUTION OF GI AND LSI TO THE FOUR GROUPS IDENTIFIED FOR EBA IN MSP

Groups of activities for EBA in MSP	Relevance/contribution of GI assessment	Relevance/contribution of LSI assessment
Capturing the complexity of ecosystems: ecological integrity and biodiversity, ecosystem connections, the dynamic nature of ecosystems, appropriate spatial and temporal scales	**Highly relevant**; GI mapping helps to identify biodiversity hotspots, assess ecological integrity and connectivity between ecosystem components/GI core areas. GI mapping at sea-basin scale also helps to identify the appropriate spatial scale for defining sea use solutions with respect to ecological considerations and ecosystem connectivity	**Partly relevant** Applying MAES for assessment of LSI can help to characterise the interconnections between marine and terrestrial ecosystems, as well as synergies and trade-offs in ecosystem service supply
Giving attention to the human-ecosystem connections and integration: consider cumulative impacts, identify ecosystem services and beneficiaries, account for global socioeconomic changes, account for social, economic and environmental aspects in assessments to define the sharing space and management rules, ensure interdisciplinarity in science that translates biophysical and human/decision-making processes, includes spatial and temporal scale issues	**Highly relevant** The marine GI concept helps to illustrate interrelations between ecological and human systems. GI mapping results can be linked to assessments of cumulative impacts, affecting ecosystem conditions and, consequently, ecosystem service supply and human well-being. Results from GI assessments can be applied to decision- on allocation of space for different sea uses	**Highly relevant** Application of the MAES approach in assessment of LSI helps to illustrate interrelations between ecological and human systems. This approach can be applied in assessing impacts of different sea/land use scenarios to ecosystem structure and condition, which consequently have an impact on ecosystem service supply and human well-being. The results can support decisions on allocation of space for different land and sea uses
Accounting for uncertainty to support adaptive management: how uncertainty is analysed and captured, how it is accounted for in the definition of MSP and management rules, any specific methods and processes in place for delivering adaptive management, how monitoring captures changes and helps adaptation decisions	**Relevant** Uncertainty in GI mapping and assessment is related to the availability and accuracy of input data, expert knowledge, and robustness of the applied methods. The level of uncertainty should be acknowledged to increase the credibility of assessment results used in decision-making	**Relevant** Uncertainty in assessment of LSI is related to the availability and accuracy of input data, expert knowledge, and robustness of the applied methods. The level of uncertainty should be acknowledged to increase the credibility of assessment results used in decision-making
Organising the MSP process: stakeholder mobilisation, science-policy	**Relevant** The GI concept has strong potential for contributing to the	**Relevant** LSI assessment can contribute to the science-

Groups of activities for EBA in MSP	Relevance/contribution of GI assessment	Relevance/contribution of LSI assessment
interface, build connection to other (sector/environmental) policies to deliver 'integrated management' of space. The challenge is to assess coherence between established governance and the functioning and dynamics of the human-ecological systems captured in the previous three thematic areas, including in spatial and temporal scale	science-policy interface by developing methodologies/tools for consolidating complex scientific information and knowledge on functioning and dynamics of the human-ecological systems in a meaningful way for policy/decision makers	policy interface by offering tools for consolidating complex ecological and socioeconomic information on marine and terrestrial part of the coastal zone. The LSI concept is particularly suitable for supporting stakeholder engagement in the MSP process, as demonstrated by the Land-Sea-Act project

Marine GI mapping can be performed at different spatial scales. The most meaningful, however, is regional sea level, as demonstrated by the Pan Baltic Scope study. This level facilitates assessment of the entire marine ecosystem and supports cross-border coordination of MSP solutions in respect of ecological values. In turn, the most suitable scale for addressing LSIs is sub-national (local or regional), as these interactions usually concern place specific land/sea use issues and involve interactions with local stakeholders.

Further transboundary cooperation is needed at sea-basin scale, such as collaboration projects between researchers and MSP practitioners. This is particularly true for promoting deployment of the marine GI concept, including the establishment of a common methodology that involves connectivity analysis and extends the mapping to coastal areas. This, in turn, would support integration of the ecological/ecosystem service component in LSI.

RECOMMENDATIONS

Several recommendations can be proposed, based on the work for this Baltic Sea cross-border case study and discussions at the 3rd Baltic MSP Forum (Riga, November 2019), the online expert workshop on Marine GI (October, 2020) and the Capacity4MSP Planning Forum #2", (November 2020).

Recommendations for promoting the marine GI concept:

- The marine GI concept should be used in the application of EBA to MSP. It should be used in MSP (as well as other EU legislation) to improve nature protection outside MPAs. Where possible, Member States should seek to integrate this throughout their MSP cycles. For example, marine GI can support national MSP processes from the beginning, during the stocktaking stage, through to the process of developing spatial planning solutions (e.g. avoiding harmful sea use within areas of high ecological/ecosystem service supply value and enhancing connectivity between protected or ecologically interrelated areas). This concept should also be considered in the SEA of MSP.

- Marine GI mapping should be based on the best available knowledge and most recent data on the distribution of various marine ecosystem components, where possible taking into account expected impacts of climate change.
- The interconnectivity of marine GI needs to be considered from a cross-border perspective: marine GI should therefore be mapped at sea-basin level. Countries conducting MSP should devote sufficient resources to mapping or modelling of GI and its connectivity analysis, as well as collaboration with neighbouring counties, preferably using common datasets.
- The concept of marine GI and mapping approaches need to be further developed. Doing so will improve both input data and assessment methods (e.g. connectivity analysis, a more comprehensive approach to ecosystem service mapping).
- The integration of the GI concept into ecosystem-based management of marine areas could be encouraged by international organisations, such as UNESCO.
- In the Baltic Sea Region, HELCOM should continue the development of the concept, supporting its application by generating new datasets, integrating GI mapping results in its Holistic Assessment III, promoting the exchange of information on national approaches, and promoting the application of GI mapping in MSP.

The following recommendations on LSI can be proposed, based on the work for the sub-national case study and interim outcomes from the Interreg Land-Sea-Act project work in Latvia.

Recommendations to MSP authorities for advancing LSI assessment:

- LSI demands particular attention in MSP and other spheres of planning as it forms a distinctive space that links different ecosystems – marine, coastal and terrestrial. However, it often crosses administrative planning boundaries, from local to regional to sub-national. Setting a framework – both content and process – is essential to structure the work. In the MSP context, a framework for the land-sea interface and LSI could usefully be set up in the scoping/defining step of the planning process.
- The MAES process provides a suitable method to integrate multiple economic, social and ecological values that need to be taken into account in complex decision-making situations, such as planning coastal areas. Although distinctive ecosystems (marine, terrestrial) are addressed individually in the land-sea interface, the holistic approach and availability of ready-made methods for ecosystem service assessment suggests their wider application in MSP.
- Stakeholder engagement is a key tool that can be further supported via digital means, such as online GIS platforms that provide interactive collaboration between planners and stakeholders. Some national MSPs have been created using online and digital products. Digitalisation and online tools are very welcome, particularly in data collection. However, there is also a need for face-to face meetings where solutions and compromises can be agreed.

REFERENCES

- Altvater S., Lukic I. and Eilers S. (2019). *EBA in MSP - a SEA inclusive handbook*. Pan Baltic Scope Project. Rostock: Federal Maritime and Hydrographic Agency (BSH), pp. 1-65.
- Beaumont, N.J., Austen, M.C., Atkins, J.P., Burdon, D., Degraer, S., Dentinho, T.P., Derous, S., Holm, P., Horton, T., van Ierland, E., Marboe, A.H, Starkey, D.J., Townsend, M. and Zarzycki T. (2007). 'Identification, Definition and Quantification of Goods and Services Provided by Marine Biodiversity: Implications for the Ecosystem Approach'. *Marine Pollution Bulletin*, 54(3), 253–65, https://doi:10.1016/j.marpolbul.2006.12.003.

- Burkhard, B., Kroll, F., Müller, F. and Windhorst, W. (2009). 'Landscapes' capacities to provide ecosystem services–a concept for land-cover based assessments'. *Landscape Online,* 15, 22, doi: 10.3097/LO.200915.
- Burkhard, B., de Groot, R., Costanza, R. and Seppelt, R. (2012). 'Solutions for sustaining natural capital and ecosystem services'. *Ecological Indicators*, 21, 1-6.
- Campagne, C.S. and Roche, P.K. (2018). 'May the matrix be with you! Guidelines for the application of expert-based matrix approach for ecosystem services assessment and mapping'. *One Ecosystem,* 3, https://doi.org/10.3897/oneeco.3.e24134.
- Czúcz, B., Arany, I., Potschin-Young, M., Bereczki, K., Kertész, M., Kiss, M. and Haines-Young, R. (2018). 'Where concepts meet the real world: A systematic review of ecosystem service indicators and their classification using CICES'. *Ecosystem Services*, 29, 145-157.
- Di Marino, M., Tiitu, M., Lapintie, K., Viinikka, A. and Kopperoinen, L. (2019). 'Integrating green infrastructure and ecosystem services in land use planning. Results from two Finnish case studies'. *Land Use Policy*, 82, 643-656, doi:10.1016/j.landusepol.2019.01.007.
- Estreguil, C., Dige, G., Kleeschulte, S., Carrao, H., Raynal, J. and Teller, A. (2019). *Strategic Green Infrastructure and Ecosystem Restoration: geospatial methods, data and tools*. Luxembourg: Publications Office of the European Union, https://ec.europa.eu/jrc/en/publication/strategic-green-infrastructure-and-ecosystem-restoration
- European Commission (2011). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Our life insurance, our natural capital: an EU biodiversity strategy to 2020. COM(2011) 244 final In. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0244&from=EN
- European Commission (2013). Green infrastructure (GI) – Enhancing Europe's natural capital. COM(2013)249, http://eur-lex.europa.eu/resource.html?uri=cellar:d41348f2-01d5-4abe-b817-4c73e6f1b2df.0014.03/DOC_1&format=PDF
- European Commission (2019a). *Review of progress on implementation of the EU green infrastructure strategy*. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2019) 236 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0236&qid=1562053537296

  European Commission (2019b). *Additional information on the review of implementation of the green infrastructure strategy*. Commission Staff Working Document. COM (2019) 236 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019SC0184&qid=1562054969676&from=EN
- Hassler, B., Blažauskas, N., Gee, K., Luttmann, A., Morf, A., Piwowarczyk, J., Saunders, F., Stalmokaitė, I., Strand, H. and Zaucha, J. (2019). 'New generation EU directives, sustainability, and the role of transnational coordination in Baltic Sea maritime spatial planning'. *Ocean and Coastal Management,* 169, 254–263, doi: 10.1016/j.ocecoaman.2018.12.025.
- Heckwolf, M.J., Peterson, A., Jänes, H., Horne, P., Künne, J., Liversage, K., Sajeva, M., Reusch, T.B.H. and Kotta, J. (2021). 'From ecosystems to socio-economic benefits: a systematic review of coastal ecosystem services in the Baltic Sea'. *Science of the Total Environment*, 755, 142565.
- HELCOM (2018). 'State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016'. *Baltic Sea Environment Proceedings,* 155, https://helcom.fi/wp-content/uploads/2019/06/BSEP155.pdf
- Joint HELCOM-VASAB Maritime Spatial Planning Working Group (2015). Guidelines for the implementation of ecosystem-based approach in MSP, p. 18, http://www.vasab.org/index. php/maritime-spatial-planning/msp-wg.
- IPBES (2016). The methodological assessment report on scenarios and models of biodiversity and ecosystem services. In S. Ferrier, K.N. Ninan, P. Leadley, R. Alkemade, L. A. Acosta, H. R. Akçakaya, L. Brotons, W. W. L. Cheung, V. Christensen, K. A. Harhash, J. Kabubo-Mariara, C. Lundquist, M. Obersteiner, H. M. Pereira, G. Peterson, R. Pichs-Madruga, N. Ravindranath, C. Rondinini and B. A. Wintle (Eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.
- Jacobs, S., Burkhard, B., Van Daele, T., Staes, J., and Schneiders, A. (2015). 'The Matrix Reloaded: a review of expert knowledge use for mapping ecosystem services'. *Ecol. Modell*, 295, 21–30, doi: 10.1016/j.ecolmodel.2014.08.024.
- Kopperoinen, L., Itkonen, P. and Niemela, J. (2014). 'Using expert knowledge in combining green infrastructure and ecosystem services in land use planning: an insight

into a new place-based methodology'. *Landscape Ecology*, 29, 1361–1375, doi: 10.1007/s10980-014-0014-2.

- Liquete, C., Piroddi, C., Drakou, E.G., Gurney, L., Katsanevakis, S., Charef, A. and Egoh, B. (2013). 'Current status and future prospects for the assessment of marine and coastal ecosystem services: a systematic review'. *PLoS ONE,* 8, e67737.
- Liquete, C., Kleeschulte, S., Dige, G., Maes, J., Grizzetti, B., Olah, B. and Zulian, G. (2015). 'Mapping green infrastructure based on ecosystem services and ecological networks: A Pan-European case study'. *Environmental Science and Policy*, 54, 268–280, https://doi.org/10.1016/j.envsci.2015.07.009
- Morf, A. (Ed.), Cedergren, E., Gee, K., Kull, M. and Eliasen, S. (2019). *Lessons, stories and ideas on how to integrate Land-Sea Interactions into MSP*. Stockholm: Nordregio.
- Müller, F., Bicking, S., Ahrendt, K., Dang, K.B., Blindow, I., Fürst, C., Haase, P., Kruse, M., Kruse, T., Ma, L.& Perennes, M., Ruljevic, I. , Schernewski, G., Schimming, C.-G., Schneiders, A., Schubert, H., Schumacher, J., Tappeiner, U., Wangai, P. and Zelený, J. (2020). 'Assessing ecosystem service potentials to evaluate terrestrial, coastal and marine ecosystem types in Northern Germany – An expert-based matrix approach'. *Ecological Indicators*, 112, 106116, doi: 10.1016/j.ecolind.2020.106116.
- Potschin, M. and Haines-Young, R. (2016). 'Defining and measuring ecosystem services'. In M. Potschin, R. Haines-Young, R. Fish and R.K. Turner (Eds.), *Routledge Handbook of Ecosystem Services*, London, Routledge, pp. 25-44.
- Reusch, T.B.H., Dierking, J., Andersson, H.C., Bonsdorff, E., Carstensen, J., Casini, M., Czajkowski, M., Hasler, B., Hinsby, K., Hyytiäinen, K., Johannesson, K., Jomaa, S., Jormalainen, V., Kuosa, H., Kurland, S., Laikre, L., MacKenzie, B.R., Margonski, P., Melzner, F., Oesterwind, D., Ojaveer, H., Refsgaard, J.C., Sandström, A., Schwarz, G., Tonderski, K., Winder, M. and Zandersen, M. (2018). 'The Baltic Sea as a time machine for the future coastal ocean'. *Science Advances*, 4, eaar8195.
- Ruskule, A., Bergström, L., Schmidtbauer Crona, J., Kotta, J., Arndt, P., Strāķe, S. and Urtāne, I. (2019a). *Green Infrastructure Concept for MSP and Its Application Within Pan Baltic Scope Project*. Final Report. Pan Baltic Scope, http://www.panbalticscope.eu/wp-content/uploads/2019/12/PBS_project_green-infrastructure_report_FINAL.pdf
- Ruskule, A., Bergström, L., Schmidtbauer Crona, J., Kotta, J., Arndt, P., Strāķe, S. and Urtāne I. (2019b). *Mapping of Marine Green Infrastructure: Pan Baltic Scope Approach*. Ministry of Environmental Protection and Regional Development of the Republic of Latvia, http://www.panbalticscope.eu/wp-content/uploads/2019/12/Green-Infrastructure-brochure-print-FINAL.pdf
- Santos-Martin, F., Viinikka, A., Mononen, L., Brander, L., Vihervaara, P., Liekens, I. and Potschin-Young, M. (2018). 'Creating an operational database for ecosystems services mapping and assessment methods'. *One Ecosystem*, 3, e26719.
- da Silva J.M.C. and Wheeler E. (2017). ‚Ecosystems as infrastructure'. *Perspectives in Ecology and Conservation*, 15, 32-35.
- Schmidtbauer Crona J., Ruskule, A., Kopti, M., Käppeler, B., Dael, S. and Wesołowska, M., (2017). The Ecosystem Approach in Maritime Spatial Planning: A Checklist Toolbox. Baltic Scope project.
- Shipman, B., Roberts, H., Dworak, T., Zamparutti, T., Krüger, I., Veidemane, K., Mashkina, O., Parrod, C., Ceresil, E., Moarcas, A. and Oules, L. (2018). *Land Sea Interactions in Maritime Spatial Planning*, http://ec.europa.eu/environment/iczm/pdf/LSI_FINAL20180417_digital.pdf
- Swedish Agency for Marine and Water Management (2019). Swedish National Marine Plan.
- Townsend, M., Davies, K., Hanley, N., Hewitt, J.E., Lundquist C.J. and Lohrer A.M. (2018). 'The Challenge of Implementing the Marine Ecosystem Service Concept'. *Frontiers in Marine Science*, 5 (359).
- Vallecillo, S., Polce, C., Barbosa, A., Castillo, C.P., Vandecasteele, I., Rusch, G.M. and Maes, J. (2018). 'Spatial alternatives for Green Infrastructure planning across the EU: An ecosystem service perspective'. *Landscape and Urban Planning*, 174, 41-54.
- Vihervaara, P., Viinikka, A., Brander, L., Santos-Martín, F., Poikolainen, L. and Nedkov, S. (2019). ‚Methodological interlinkages for mapping ecosystem services–from data to analysis and decision-support'. *One Ecosystem*, 4, e26368.
- Veidemane, K., Ruskule, A. and Sprukta, S. (2017). *Development of a maritime spatial plan: the Latvian recipe*, http://www.balticscope.eu/events/final-reports/
- Veidemane, K., Ruskule, A., Strake, S., Purina, I., Aigars, J., Sprukta, S., Ustups, D., Putnis, I. and Klepers, A. (2017). 'Application of the marine ecosystem services approach in the development of the maritime spatial plan of Latvia'. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 13(1), 398-411.

ANNEX 1A: MATRIX FOR ASSESSMENT OF ECOLOGICAL VALUE OF MARINE ECOSYSTEM COMPONENTS

HELCOM BSII Ecological Diversity Components	Biodiversity	Rarity	Importance for threatened, endangered or declining species and/or habitats	Vulnerability, fragility, sensitivity or slow recovery	Special importance for life-history stages of species	Biological productivity
Availability of deep water habitat, based on occurrence of H2S	0	1	0	0	0	0
Infralittoral hard bottom	0	1	0	0	0	0
Infralittoral sand	0	1	0	0	0	0
Infralittoral mud	0	1	0	0	0	0
Infralittoral mixed	0	1	0	0	0	0
Circalittoral hard bottom	1	1	1	1	1	1
Circalittoral sand	0	1	1	1	1	1
Circalittoral mud	0	1	1	1	1	1
Circalittoral mixed	1	1	1	1	1	1
Sandbanks which are slightly covered by sea water at all time (1110)	1	1	1	1	1	1
Estuaries (1130)	1	1	1	0	1	1
Mudflats and sandflats not covered by seawater at low tide (1140)	0	1	0	0	0	0
Coastal lagoons (1150)	1	1	1	0	1	1
Large shallow inlets and bays (1160)	1	1	1	1	1	1
Reefs (1170)	1	1	1	1	1	1
Submarine structures made by leaking gas (1180)	1	1	1	1	1	1
Baltic Esker Islands (UW parts, 1610)	1	1	1	1	1	1
Boreal Baltic islets and small islands (UW parts, 1620)	1	1	1	1	1	1

HELCOM BSII Ecological Diversity Components	Biodiversity	Rarity	Importance for threatened, endangered or declining species and/or habitats	Vulnerability, fragility, sensitivity or slow recovery	Special importance for life-history stages of species	Biological productivity
Furcellaria lumbricalis	1	1	1	1	1	1
Zostera marina	1	1	1	1	1	1
Charophytes	1	1	1	1	1	1
Mytilus sp.	1	1	1	1	1	1
Fucus sp.	1	1	1	1	1	1
Productive surface waters	1	1	1	0	1	1
Cod abundance	0	0	1	0	0	1
Cod spawning area	1	1	1	1	1	1
Herring abundance	0	0	0	0	0	1
Sprat abundance	0	0	0	0	0	1
Recruitment areas of perch	1	1	1	1	1	1
Recruitment areas of pikeperch	0	1	1	1	1	1
Wintering seabirds	1	1	1	1	1	0
Breeding seabird colonies	1	1	1	1	1	0
Grey seal distribution	0	0	0	0	0	0
Harbour seal distribution	0	0	0	0	0	0
Ringed seal distribution	1	1	1	1	0	0
Distribution of harbour porpoise	1	1	1	1	0	0

ANNEX 1B: MATRIX FOR ASSESSMENT OF MARINE GI RELATED ECOSYSTEM SERVICES

HELCOM BSII Ecological Diversity Components	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals			Control of erosion rates	Maintaining nursery populations and habitats	Pest control (including invasive species)	Regulation of chemical composition of atmosphere and oceans (atmospheric CO^2 and other greenhouse gases):		Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment	
	filtration of nutrients	storage of nutrients	storage of hazardous substances				by biological fixation in process of photosynthesis	by sequestration in sediments	through active or immersive interactions	through passive or observational interactions
Availability of deep water habitat, based on occurrence of H2S	0	1	1	0	0	0	0	1	0	0
Infralittoral hard bottom	1	1	1	1	1	0	1	0	1	1
Infralittoral sand	0	1	1	0	1	0	1	0	1	1
Infralittoral mud	0	1	1	0	1	0	1	1	0	0
Infralittoral mixed	1	1	1	1	1	0	1	0	0	0
Circalittoral hard bottom	1	1	1	0	0	0	0	0	0	0
Circalittoral sand	0	1	1	0	0	0	0	0	0	0
Circalittoral mud	0	1	1	0	0	0	0	1	0	0
Circalittoral mixed	0	1	1	0	0	0	0	0	0	0
Sandbanks which are slightly covered by sea water at all time (1110)	0	1	1	0	1	0	1	0	1	1
Estuaries (1130)	1	1	1	0	1	0	1	1	1	1

HELCOM BSII Ecological Diversity Components	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals			Control of erosion rates	Maintaining nursery populations and habitats	Pest control (including invasive species)	Regulation of chemical composition of atmosphere and oceans (atmospheric CO^2 and other greenhouse gases):		Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment	
Mudflats and sandflats not covered by seawater at low tide (1140)	0	1	1	0	1	0	1	1	1	1
Coastal lagoons (1150)	1	1	1	0	1	0	1	1	1	1
Large shallow inlets and bays (1160)	1	1	1	0	1	0	1	1	1	1
Reefs (1170)	1	1	1	1	1	0	1	0	1	1
Submarine structures made by leaking gas (1180)	0	1	1	0	0	0	0	0	0	0
Baltic Esker Islands (UW parts, 1610)	1	1	1	1	1	0	1	1	1	1
Boreal Baltic islets and small islands (UW parts, 1620)	1	1	1	1	1	0	1	1	1	1
Furcellaria lumbricalis	0	1	1	0	1	0	1	0	1	1
Zostera marina	0	1	1	1	1	0	1	1	1	1
Charophytes	0	1	1	0	1	0	1	1	1	1
Mytilus sp.	1	1	1	0	1	0	0	0	1	1
Fucus sp.	0	1	1	0	1	0	1	0	1	1
Productive surface waters	1	0	0	0	1	0	1	0	1	1
Cod abundance	0	1	1	0	0	1	0	0	1	0
Cod spawning area	0	1	1	0	1	1	0	0	0	0
Herring abundance	0	1	1	0	0	0	0	0	1	0
Sprat abundance	0	1	1	0	0	0	0	0	1	0
Recruitment areas of perch	0	1	1	0	1	1	0	0	0	0
Recruitment areas of pikeperch	0	1	1	0	1	1	0	0	0	0
Wintering seabirds	0	1	1	0	0	1	0	0	1	1
Breeding seabird colonies	0	1	1	0	0	1	0	0	1	1
Grey seal distribution	0	1	0	0	0	0	0	0	1	1
Harbour seal distribution	0	1	0	0	0	0	0	0	1	1
Ringed seal distribution	0	1	0	0	0	0	0	0	1	1

HELCOM BSII Ecological Diversity Components	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals			Control of erosion rates	Maintaining nursery populations and habitats	Pest control (including invasive species)	Regulation of chemical composition of atmosphere and oceans (atmospheric CO^2 and other greenhouse gases):		Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment	
Distribution of harbour porpoise	0	0	0	0	0	0	0	0	1	1

Scores: 0 – ecosystem component has no or negligible contribution to particular service; 1 – ecosystem component can provide the service

Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

III

Black Sea case study:

The role of existing EU legislation in integrating EBA into MSP in Bulgaria and Romania

Revised Case Study Report

Written by Tanya Milkova, Fresh Thoughts Consulting

July – 2021

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LIST OF ABBREVIATIONS

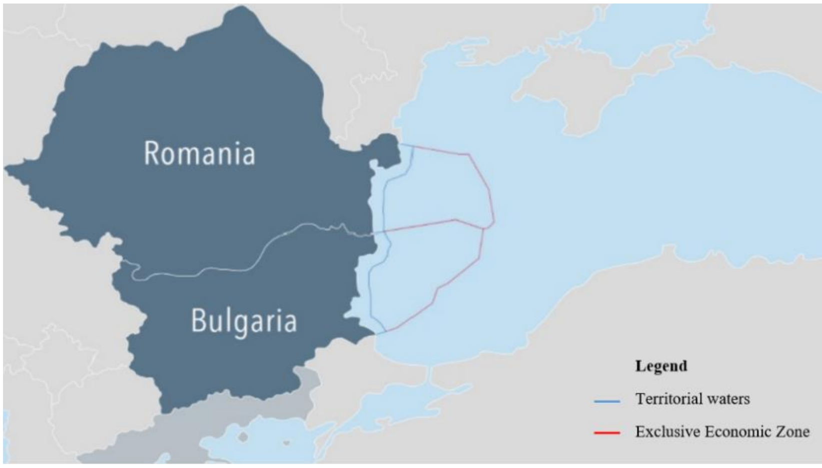
BQE	Biological quality element
CFP	Common Fisheries Policy
EASME	Executive Agency for Small and Medium-sized Enterprises
EBA	Ecosystem-based approach
HPI	Human pressure and impact
ICM	Integrated coastal management
ICPDR	International Commission for the Protection of the Danube River
ISMEIMP	Investigations on the State of the Marine Environment and Improving Monitoring Programmes developed under MSFD (Black Sea project)
LSI	Land-sea interactions
MSFD	Marine Strategy Framework Directive (2008/56/EC)
MSP	Maritime Spatial Planning
nm	nautical miles
RBD	River Basin District
RBMP	River Basin Management Plan
SCI	Site of Community Importance
SPA	Special Protection Area
WD	Directive 2008/98/EC on waste and repealing certain Directives
WFD	Water Framework Directive (2000/60/EC)

1. SUMMARY

1.1 Location

This case study addresses the Western part of the Black Sea, in particular the maritime spatial planning (MSP) areas of both Black Sea Member States, Bulgaria, and Romania (Figure 1). The planning areas defined by both countries' national legislation cover the *internal sea waters*[32], *coastal waters* (to 1 nautical mile (nm)), *territorial waters* (to 12 nm), the *contiguous zone* (to 24 nm) from the territorial sea baseline, and the *Exclusive Economic Zone* (EEZ), up to 200 nm.

FIGURE 1: MSP AREA OF BULGARIA AND ROMANIA (MSP PLATFORM[33])



1.2 Overview

The MSP process in Bulgaria and Romania began in 2015 with the MARSPLAN-BS project[34], supported by the European Maritime and Fisheries Fund (EMFF) of the

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[32] The internal sea waters of the Republic of Bulgaria are defined by Article 6 of the Act on Maritime Spaces, Inland Waterways, and Ports of the Republic of Bulgaria (State Gazette No 28/29.03.2018) and include:

- the waters between the coastline and the exit lines, from which the width of the territorial sea is measured;
- the waters of the ports, bounded on the sea side by the line connecting the most distant points in the sea of the anchorages, hydraulic and other permanent port facilities;
- the waters of: a) Varna Bay between the coastline and the straight line connecting Cape St. Constantine with Cape Ilandzhik; b) Burgas Bay between the coastline and the straight line connecting Cape Emine with Cape Maslen nose;
- the waters between the shoreline and the straight exit lines connecting Cape Kaliakra with Cape Tuzla, Cape Tuzla with Cape Ekrene and Cape Maslen nose with Cape Rohi.

In Romania, Law 17/1990 on the regime of internal waters, territorial sea, the contiguous zone and exclusive economic zone of Romania sets the legal status of internal sea waters. These are the waters between the shoreline and baselines. The baselines are the straight lines joining the furthermost points of the shoreline, including the islands, mooring places, hydraulic constructions or port facilities.

[33] https://www.msp-platform.eu/sea-basins/black-sea-0

[34] http://www.marsplan.ro/en/

European Union (EU). The process continues through MARSPLAN-BS II[35], whose main objective is to support the development of national maritime spatial plans in Bulgaria and Romania based on the results of the first project. It also aims to develop the MSP common strategy for the cross-border area and provide effective stakeholder participation during this process.

This case study investigates how the requirements and instruments of the existing EU legal framework can support and facilitate the application of an ecosystem-based approach (EBA) in MSP, including in a transboundary context. It looks particularly at the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD), the Common Fisheries Policy (CFP), and biodiversity legislation (Birds and Habitats Directives, collectively, the Nature Directives).

The study is based on an analysis of the situation and progress of the two Black Sea Member States in the process of implementing MSP. Using desktop research and interviews, the study analyses the tools, results and progress in implementing related policies, paying particular attention to the extent to which EBA elements are integrated into the development of the maritime spatial plans of both countries.

As of January 2021, Romania was still in the early stages of developing its national MSP (data gathering and processing), while Bulgaria's procedure for the strategic environmental assessment (SEA) of the draft MSP was underway. The study focuses on the documents available, namely the common methodologies and analyses prepared by the two countries, and Bulgaria's draft national MSP (fourth version since November 2020). Additional information was gathered during the interviews.

As part of the case study, an online workshop[36] was held with key stakeholders relevant to the implementation of EBA. It aimed to facilitate discussions on i) how obligations and opportunities offered by existing EU legal frameworks could best be taken up by the two countries, and at regional scale to facilitate the implementation of EBA in MSP, and ii) what is needed to make better use of the EBA approach, particularly in a transboundary context.

1.3 Cross-cutting issues and processes

The study examines the functional coherence between the key pieces of EU legislation and policy (WFD, MSFD, CFP, Nature Directives), current progress and challenges in their implementation. It analyses the possibilities and mechanisms for optimal integration that would ensure implementation of EBA in MSP.

The elements of integration achieved when implementing the abovementioned related policies are considered, including elements and methods of analysis, monitoring programmes and programmes of measures (PoM). Special attention is paid to cross-border coordination between Bulgaria and Romania in the implementation of related policies.

Mechanisms for integrating governance and knowledge and for involving stakeholders are considered and discussed, along with their potential to support EBA in MSP.

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[35] Ibid.

[36] https://msp-eba-black-sea.fresh-thoughts.eu/events/msp-eba-black-sea/

The analysis reflects the grouping of the basic EBA principles: 1) Capturing the complexity of ecosystems, 2) Giving attention to the human-ecosystem connections and integration, and 3) Organising the MSP process. The benefits and potential for improving operational implementation of the EBA through the integration of related policies are discussed, along with good practice examples and key challenges experienced.

The study examines the overall conceptual framework, as well as individual elements of each of the related policies in terms of EBA, including how their interaction ensures its practical application.

1.4 Concluding notes

The study confirms the need to operationalise the links between related policies if EBA is to be integrated into MSP.

Key general recommendations are presented to improve the efficiency of the MSP process, as well as country-specific recommendations.

Ensuring expert capacity and operational involvement of stakeholders is crucial for the effectiveness of the planning and follow-up process.

Each of the related policies supports the implementation of the EBA. MSP should find the best way to capture the achievements of the related policies and reconcile existing and potential uses of the marine environment.

The development of MSP across the Black Sea would benefit from a stronger role for the Black Sea Commission as a body for communication and coordination between countries: the Commission could act as a platform for exchanges on policies and actions for the use and protection of marine resources. Cooperation on MSP in the Mediterranean Sea may provide an inspiration for work in the Black Sea.

2. INTRODUCTION

2.1 About this report

This report is a deliverable written for the EU project EASME/2019/OP/0002: *Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning, in particular in the Context of the Implementation of the Maritime Spatial Planning Directive 2014/89/EU* (EASME/EMFF/2018/1.3.1.1)[37].

The main objective of the project is to propose feasible and practical approaches and guidelines for applying an ecosystem-based approach (EBA) in maritime spatial planning (MSP) with the currently available information, and a practical method or tool for evaluating, monitoring and reviewing the application of EBA in MSP. The study is

[37] The project was contracted by the Executive Agency for Small and Medium-sized Enterprises (EASME), which in 2021 became The European Climate, Infrastructure and Environment Executive Agency (CINEA)

coordinated by Milieu Consulting SRL with the following partners and subcontractors: ACTeon, Baltijas Vides Forums (Baltic Environmental Forum), Stichting Wageningen Research and Fresh-Thoughts Consulting GmbH.

As part of the project, five case studies address the application of EBA in MSP, focusing on different European regional seas and seas outside the European Union (EU). These will be used to support the development of the practical approach and guidelines.

This **Black Sea case study examines how the requirements and instruments of the existing legal frameworks,** in particular the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD), the Common Fisheries Policy (CFP), Natura 2000 and biodiversity legislation (the Birds and Habitats Directives – the Nature Directives), **can support and facilitate the application of EBA in MSP, including in a transboundary context**.

The study is based on an analysis of the situation and progress of the two Black Sea Member States, Bulgaria and Romania, in implementing MSP. It analyses the tools, results, and progress in implementing related policies, paying particular attention to the integration of EBA elements into the development of the maritime spatial plans of both countries.

The analysis reflects the grouping of the basic EBA principles: 1) Capturing the complexity of ecosystems, 2) Giving attention to the human-ecosystem connections and integration, and 3) Organising the MSP process. It discusses the benefits and potential for improving the operational implementation of the EBA through the integration of related policies and presents good practice examples.

Given that information supply is of key importance in the MSP process, this study pays special attention to the management and availability of data within the related policies.

2.2 Methods

2.2.1 Evidence gathering

The case study has two main steps:

Step 1: Detailed assessment of the current situation:

- An assessment of the work achieved under MARSPLAN - BS II and its predecessor, MARSPLAN - BS[38];
- A review of how Bulgaria and Romania are implementing specific components of existing directives (MSFD, WFD, Nature Directives, CFP) in relation to key EBA principles;
- An overview of how the implementation of these directives is supported in a cross-border context (for both Black Sea Member States);
- An analysis of the integration of relevant policy elements into the MSP process implemented by Bulgaria and Romania.

[38] http://www.marsplan.ro/en/about-marsplan-%E2%80%93-bs-project.html

The analysis reflects the grouping of the basic EBA principles for the draft Practical approach (Task 3 of the overall project), namely: 1) Capturing the complexity of ecosystems, 2) Giving attention to the human-ecosystem connections and integration, and 3) Organising the MSP process.

The study is based on a literature review (regulations, implementation reports, strategic documents, outputs and lessons learned within related projects, etc.), and targeted interviews with key stakeholders[39]. Initial contact was made with the MARSPLAN - BS II project team and other experts involved in the MSFD, Habitats Directive and CFP implementation during the period August - December 2020. Interviews were conducted in January 2021.

The interviews with both Bulgarian and Romanian officials and experts reflected a range of roles in the MSP process or in policy implementation. Eight semi-structured interviews were carried out, and two written responses were received. The list of interviewees and the authorities' written responses are presented in Annex 1.

Step 2. Online workshop

The workshop brought together key stakeholders relevant to EBA implementation, aiming to facilitate discussions on 1) how obligations and opportunities offered by existing directives (WFD, Nature Directives, CFP, MSFD, etc.) could best be taken up by countries and, at regional scale, facilitate the implementation of EBA in MSP, and 2) what is needed to make better use of the EBA approach, particularly in a transboundary context.

Originally planned at the Black Sea regional scale to facilitate dialogue between the stakeholders, the forum of the meeting was subsequently expanded to provide a wider platform for sharing experiences and views. Representatives from the other European sea regions, European-wide organisations and initiatives, as well as those outside the EU, also joined the workshop.

A summary of the meeting was sent to the participants, including key findings of the discussions, a list of participants and a link to the presentations (see Annex 2).

2.2.2 Analysis and structure of this report

The report is structured as follows:

Section 3 presents an overview of the case study, including a list of the main actors and legislative framework of the policies analysed.

Section 4 provides an overview of the overall conceptual framework, elements, methods, approaches and results related to the EBA, in the context of ongoing progress in the implementation of the related policies by the two Black Sea Member States. It highlights the main challenges in policy implementation and integration into MSP the process.

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[39] In addition, the case study draws on the personal experience of the author who, until the end of 2018 worked on the practical implementation of the WFD and MSFD in Bulgaria, in particular with the development and implementation of the River Basin Management Plan (RBMP) for the Black Sea River Basin District and the Marine Strategy of Bulgaria.

Section 5 presents some findings and conclusions on the benefits and potential of EBA implementation in MSP through the integration of related policies:

- How has work under other EU legislation supported the integration of the EBA into MSP?
- Has this work supported cross-border work on EBA and MSP?
- What are the main lessons learned?
- What steps could strengthen the use of other EU legislation as a tool for EBA in the MSP process?

Section 5 also presents key recommendations, focusing on how implementation of EBA can be organised to make best use of the tools and results of specialised policies.

3. CASE STUDY OUTLINE

3.1 Context

At a general conceptual level, MSP faces the challenge of reconciling and ensuring links between economic elements (e.g. prosperity in coastal areas, development of offshore and port infrastructure) and balanced use of natural resources in compliance with the priorities and requirements of environmental policy. This requires in-depth knowledge and consideration of the specifics, current developments and trends in the development of all elements subject to MSP.

Of the six countries sharing the Black Sea coast, only two - Bulgaria and Romania - are EU members. They share a common border, both terrestrial and downstream of the Danube, as well as marine borders. Although they do not have a delimited marine boundary[40], the MSP planning area has been identified.

Both Bulgaria and Romania have limited experience in applying MSP. Prior to the adoption of the MSP Directive, there were only project-based efforts and results, with a series of EU-funded and other projects related to MSP in the Black Sea implemented since 2007 (e.g. PlanCoast[41], PEGASO[42], COCONET[43], PERSEUS[44]. MISIS[45], SymNet[46],

[40] The maritime boundary between Bulgaria and Romania is not yet delimited. (The Agreement between the Republic of Bulgaria and the Republic of Turkey for delimitation of maritime spaces between the two countries was signed in 1999, and the maritime boundary between Romania and Ukraine was agreed in 2009).

[41] http://www.plancoast.eu/

[42] http://www.vliz.be/projects/pegaso/

[43] https://cordis.europa.eu/project/id/287844

[44] http://www.perseus.tufts.edu/hopper/

[45] https://www.msp-platform.eu/projects/msfd-guiding-improvements-black-sea-integrated-monitoring-system

[46] https://www.msp-platform.eu/key-words/symnet-project

MESMA[47], ECOAST[48]). This case study focuses on the latest developments in the implementation of MARSPLAN BS and MARSPLAN-BS II projects.

MARSPLAN-BS was the first pilot project to directly support competent authorities in Bulgaria and Romania to implement the MSP Directive and to help capacity building. It prepared a draft MSP for the cross-border area of Mangalia-Shabla as a pilot exercise to test the capacity of Romania and Bulgaria to develop a concrete instrument for management of the marine area.

Bilateral coordination activities for implementing the MSP Directive continued through MARSPLAN-BS II. Its main objectives relate to: development of the national maritime spatial plans in Bulgaria and Romania, with an updated Geographic Information System (GIS) model and database, based on the results of MARSPLAN-BS; developing the MSP common strategy for the cross-border area of Bulgaria and Romania, including Land-Sea Interactions (LSI) and Multi-Use (MU) concepts, and providing effective stakeholder participation in the design of national and cross-border MSP process.

As of January 2021, Romania was still in the early stages of developing its national MSP (data gathering and processing), while the strategic environmental assessment (SEA) procedure for Bulgaria's draft MSP was underway[49]. The study focuses on the documents available, namely the common methodologies and analyses prepared in coordination by the two countries, as well as Bulgaria's developed draft national MSP (fourth version since November 2020). Additional information was gathered during the interviews. As the draft plan for the Mangalia-Shabla area was conceived as a pilot exercise, it was considered a starting point for the MSP process.

3.2 Key Legislation

Directive 2014/89/EU establishing a framework for maritime spatial planning was transposed into Bulgarian national legislation by an amendment of the Maritime Spaces, Inland Waterways, and Ports of the Republic of Bulgaria Act (State Gazette No 28/29.03.2018).

The law sets out the framework and procedure for the development, consultation and adoption of the national MSP. Requirements for establishing cross-border coordination with the countries of the Black Sea region are also defined, namely:

> *'Art. 51d: (2) Bulgaria shall cooperate with the countries of the Black Sea region, including within the Organisation of the Black Sea Economic Cooperation and the Commission for the Protection of the Black Sea against pollution. Cooperation with Romania is aimed at achieving coherence and coordination of national maritime spatial plans on transnational issues.*

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[47] https://mesma.org/

[48] http://www.ismar.cnr.it/projects/international-projects/copy5_of_project-001/ecoast-project?set_language=en&cl=en

[49] The procedure follows the requirements of the Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32001L0042

> *(3) The Maritime Spatial Plan of the Republic of Bulgaria may also be developed as a part of the Black Sea Transboundary Maritime Spatial Plan.'*

Romania transposed the MSP Directive into national law through Government Ordinance 18/2016, adopted by Law No. 88/2017. In addition, Decision No. 406/2017 lays down the regulation and the composition of the Maritime Spatial Planning Committee, the competent authority of Romania. Decision No. 436/2018 (State Gazette No 530/27.06.2018) regulates the methodology for developing the Maritime Spatial Plan.

Government Ordinance 18 sets out requirements for cross-border cooperation in the MSP process as follows:

> *'Art. 6(2) In the elaboration and implementation of the maritime spatial plan, the following shall be taken into account:*
>
> *...*
>
> *f) ensuring cross-border cooperation between the neighbouring Member States with the same marine waters in order to ensure that maritime spatial plans are coherent and coordinated throughout the marine region concerned, in accordance with the provisions of this ordinance;*
>
> *g) endeavour to cooperate, as far as possible, with the competent authorities of third countries on their actions relating to maritime spatial planning in the relevant marine regions, in accordance with the international law and conventions to which they are party;'*

Despite the recommendation for its implementation, there is no definition of EBA in the national legislation of either country regulating the implementation of MSP, nor in the national legislation transposing the MSFD, WFD or Nature Directives, nor national legislation related to the CFP. (Key national legislation transposing or implementing these pieces of EU legislation is provided in the table in Annex 3.)

3.3 Key actors

Bulgaria

The designated national competent authority on MSP implementation is the Ministry of Regional Development and Public Works. An Advisory Council on MSP has been established as a subsidiary body to the Minister of Regional Development, to support the cooperation and coordination between relevant stakeholders during the MSP process (State Gazette No 79/25.09.2018)[50]. The functions, tasks, and composition of the Advisory Council are determined by rules issued by the Minister of Regional Development and Public Works.

The final version of the national MSP shall be adopted by the National Expert Council on Territorial Development and Regional Policy, and then approved by the Council of Ministers.

The national competent authority for the implementation of the environmental protection legislation (including WFD, MSFD, Nature Directives, and SEA) is the

[50] https://www.lex.bg/bg/laws/ldoc/2137187171

Ministry of Environment and Water, with the following subdivisions operating at national and sub-national level:

- The ***Executive Environment Agency (EEA)*** is responsible for the national coordination of environmental monitoring and manages the national biodiversity monitoring system. The EEA issues IPPS permits on the state territory in coordination with the other Ministry subdivisions.
- Four ***Basin Directorates*** at the Ministry are the competent water management authorities at basin level. The ***Black Sea Basin Directorate*** (BSBD) is the competent authority for the development of the Black Sea River Basin District Management Plan, the Marine Strategy of Bulgaria, and their implementation and update. BSBD issues and controls the implementation of most of the permits for water abstraction and use of water bodies (including aquaculture).
- The ***Regional Inspectorates of Environment and Water*** are the competent authorities at regional level for the implementation of the requirements of the Nature Directives, SEA, Waste Directive, etc., control of permits for wastewater discharge, and integrated pollution prevention and control (IPPC) permits. There are 15 regional inspectorates on the state territory, three of which are within the Black Sea River Basin District.

An ***Advisory and Coordination Council for Protection of the Black Sea Environment*** was established under the Regulation on the protection of the marine environment (State Gazette No 94/30.11.2010)[51]. Chaired by the Minister of Environment and Water, its role is to coordinate the activities of the responsible authorities and other relevant stakeholders involved in the process of development, adoption and implementation of the Marine Strategy and the Programme of Measures (PoM).

The ***Institute of Oceanology to the Bulgarian Academy of Sciences (IO-BAS)*** is responsible for monitoring the marine waters, according to the monitoring programmes at the Black Sea District RBMP and the Marine Strategy of Bulgaria. The monitoring is performed annually, based on contracts between the Ministry of Environment and Water and the IO-BAS.

The ***Minister of Agriculture, Food and Forestry,*** together with the ***Minister of Transport*** and the ***Minister of Environment and Water***, manage and control the implementation of the National Programme for Fisheries and Aquaculture. The ***Scientific and Technical Council for Fisheries and Aquaculture*** has been established under the Minister of Agriculture, Food and Forestry as a consultative body. It includes representatives of the related ministries and their units, scientific organisations in the field of fisheries and aquaculture, fisheries enterprises, and the National Fisheries Association.

The ***Executive Agency of Fisheries and Aquaculture*** (NAFA) under the Minister of Agriculture, Food and Forestry shall manage, monitor, and control fisheries, aquaculture, and trade in fish and other aquatic organisms. It implements the CFP.

Romania

In Romania, the ***Ministry of Regional Development and Public Administration*** is the coordinating central authority responsible for preparing national legislation on MSP, nominating MSP authorities and implementing the MSP Directive.

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[51] http://saveti.government.bg/web/cc_501/1

The ***MSP Committee*** is the national competent authority established to develop and monitor the implementation of the MSP. Coordinated by the prime minister, it is an inter-ministerial body, without legal personality.

The **Ministry of Environment, Water and Forests** is the national competent authority for the implementation of environmental policy, including the MSFD, Nature Directives and the SEA Directive.

The ***National Administration Romanian Waters,*** under the coordination of the Ministry of Environment, Waters and Forests, is responsible for the implementation of EU water directives throughout the 11 Water Directorates, all of which are within the national part of the Danube International River Basin District. One of these Directorates, Dobrogea Litoral, is responsible for developing and implementing a sub-basin management plan that covers Romania's coastal waters. The monitoring of marine waters is subject to assignment through public procurement.

The ***National Agency for Fisheries and Aquaculture,*** under the Ministry of Agriculture and Rural Development, is the authority designated for the overall implementation of the CFP. The Operational Programme for Fisheries Management is carried out by the Ministry of Agriculture and Rural Development.

4. ELEMENTS OF EBA PROVIDED VIA THE IMPLEMENTATION OF EU LEGISLATION

The following sections provide an overview of the overall conceptual framework, elements, methods, approaches and results related to EBA in the implementation of related policies by the two Black Sea Member States. These sections consider three of the four groups of EBA principles that were identified in the literature analysis for the overall study. These three groups are:

- Capturing the complexity of ecosystems;
- Giving attention to human-ecosystem connections and integration;
- Organising the MSP process.

The fourth group - accounting for uncertainty and adaptive management - is not addressed here, given the as-yet limited experience and progress of the MSP process in the Black Sea Member States.

4.1 Capturing the complexity of ecosystems

Ecosystem-Based Management acknowledges the complexity of ecosystems and the uncertainty related to management, recognising that all factors and their interactions that affect ecosystems are not fully understood and may never be. The evolution of scientific knowledge is perceived as an iterative, upgrading process that incorporates the results of previous actions and allows management to adapt to uncertainty.

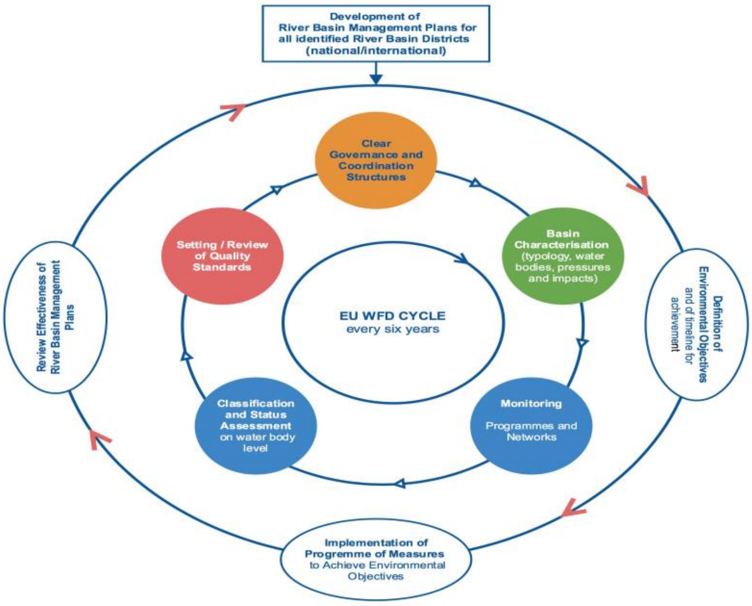
4.1.1 EBA elements in the context of the Water Framework Directive

The WFD sets out a common conceptual framework for characterising and assessing the state of waters and impacts from natural processes or human activities. It sets out the basic requirements and methodological framework for each of the implementation stages, expressed as separate successive elements in RBMPs:

1. Characterisation of surface and groundwater;
2. Analysis of the pressure and impact of anthropogenic activities on the waters;
3. Identification of protected areas (designated under other EU legislation);
4. Assessment of the status of surface and groundwater bodies;
5. Establishment of programmes for monitoring the status and assessment of trends in its changes;
6. Setting environmental objectives and exemptions where the objectives cannot be achieved for certain water bodies, or achievement may be delayed;
7. Defining a PoM to achieve environmental objectives.

All of these elements determine the management cycle of WFD implementation.

FIGURE 2: WFD PLANNING CYCLE (KURA II, 2018*)*



At the time of development of the first MSPs (and the current study), implementation of the second updated RBMPs for the period 2016-2021 was underway.

Water characterisation is the first step in water management, which identifies the general physical-geographical and hydromorphological conditions determining the general environmental conditions of individual types of ecosystems. In their second RBMPs, Bulgaria and Romania apply a WFD System B typology (Annex II). According to System B, optional typology factors used to determine the coastal water types are mean substratum composition and wave exposure.

Within the intercalibration process, a common coastal water type was specified between Bulgaria and Romania[52]. Despite the existence of a common WFD type of marine water, a transboundary water body has not been identified due to the different types of pressures and impacts on coastal waters in the two countries, and their respective statuses on both sides of the border area.

For the defined surface water body types, including coastal waters, type-specific reference conditions and classification systems are developed to assess ecological status.

In cases where a water body (or part thereof) has been severely altered due to economically or socially significant activities (e.g. flood protection, navigation), and where restoration is unjustified for reasons of technical feasibility or disproportionate costs, the body can be designated a 'heavily modified water body' (Article 4(3) WFD)[53]. Given that ecological status is an expression of the quality and structure of the functioning of aquatic ecosystems, the ecological status for these water bodies is expressed as ecological potential.

Two of the four water bodies in the coastal waters of Romania are identified as 'heavily modified'. Bulgaria has not identified heavily modified water bodies in its coastal waters.

Following the first stage of characterization, the pressures and impacts on aquatic ecosystems caused by human activities are analysed, with Member States identifying the significant anthropogenic pressures to which the surface water bodies are liable to be subject (e.g. significant point sources of pollution, diffuse sources of pollution, water abstraction, flow regulation, morphological alterations to water bodies and other relevant pressures, and their impacts on the status of surface waters). The human pressure and impact (HPI) analyses use any other relevant information, including monitoring data, data related to permits issued, etc. The HPI analysis considers all types of pressures affecting the state of the water ecosystems. Although criteria of significance are adopted for each type of pressure, in the case of a deterioration of a water body, all sources exerting pressure on the quality element which do not meet the environmental objectives, can be defined as significant.

In essence, the HPI analysis reflects actual cumulative impacts on water bodies. It looks not only at human-ecosystem interrelations but also gives a clear picture of the interactions between the individual components of aquatic ecosystems, as well as between ecosystems. For coastal water bodies, the HPI analysis takes into account the impact of pollutants introduced by inflowing rivers and reflects the impact from sources, sometimes located at a considerable distance from the shore. The prevailing and local currents in the marine environment, as well as those that occur under certain meteorological conditions, determine the distribution of pollutants (i.e. whether locally or over considerable distances).

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[52] CW-BL1, described as mesohaline (5 - 6 to 18 - 20 ‰), microtidal (< 1 m), shallow (< 30 m), highly to moderately exposed, mixed substratum (rock, send). Although there are differences in the definition of wave exposure in the common coastal water types between the two countries (for Bulgaria the common type is defined as very exposed, and for Romania, moderately exposed), the wave exposure is similar due to their similar locations in front of open, straight shores, east-northeast-southeast exposure, and facing the direction of the prevailing winds from the northeast.

[53] Artificial water bodies can also be designated but these are generally irrelevant in the marine context.

Based on the typology and analysis of anthropogenic pressure and impacts, water bodies are defined as the main unit for water management.

Risk assessment of water bodies not achieving good ecological status or good ecological potential is the final element of the HPI analysis. It is based on the identified quality elements not achieving good status, as well as trends in factors determining the negative impacts, including:

- Conditions and terms for permits, including those under the Industrial Emissions Directive[54];
- Approved programmes for the implementation of directives on environmental protection where actions related to the reducing of pressures on the water bodies are envisaged;
- Regional development plans when actions related to reducing pressures on the water bodies are envisaged;
- Assessment of uncertainties related to unspecified negative impacts or the likelihood of continued assimilation or transport of existing pollutants into the environment, for example from old contaminants deposited in sediment.

A water body with good status can be assessed as 'at risk' of identified or expected pressures, which could lead to the status diminishing.

The analysis determines the quality elements impacting on risk, driving forces, and aspects for which action must be taken to ensure the achievement or maintenance of good status. These elements must be taken into account when planning and authorising activities in the marine environment.

The risk identified for Bulgarian coastal water bodies in the second RBMP stems chiefly from complex pollution from settlements and resorts, with or without treatment, and diffuse pollution. For Romania, diffuse pressures from discharge not connected to a sewerage network is considered the most significant pressure on coastal waters (all four water bodies). The most significant in both the first and second cycle is nutrient pollution, affecting 100% of coastal water bodies.

The HPI analyses approach is described in detail in the RBMP, together with the criteria for significant pressure agreed for the four river basin districts[55]. Detailed justifications are being prepared as a working document supporting the RBMP. That document contains a summary of the data underpinning the analysis, relevant conclusions and proposals for measures or for the revision of issued permits.

The **monitoring and assessment of the ecological status** of surface waters, including marine waters, is carried out on the basis of the applicable biological quality elements (BQE) for the respective category and type of waters, the supporting hydromorphological and physico-chemical quality elements, and on the data for the specific pollutants contained in the waters (WFD, Annex V). For coastal waters, the relevant BQEs are phytoplankton, macroalgae and angiosperms, and benthic invertebrate fauna. Due to their high mobility, fish species are not a relevant BQE for assessing the coastal waters' ecological status.

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[54] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32010L0075

[55] https://tinyurl.com/dub6rvar

The BQE assessment methods should be intercalibrated for each ecoregion defined in Annex XI of the WFD. For the Black Sea ecoregion, the BQE analysis methods are intercalibrated between Bulgaria and Romania and included in the intercalibration decision[56].

The **chemical status assessment** in the second RBMPs is performed for priority substances, according to Directive 2013/39/EU amending Directives 2000/60/EC and 2008/105/EC, with regard to priority substances in the field of water policy. The content of the priority substances, where applicable, is determined in the water, sediment and/or biota.

Virtually all aspects of impacts on ecosystems and their components are covered by the quality elements and relevant assessment methods.

Monitoring programmes are planned to provide comprehensive and objective information on water bodies' status and to supplement and validate the assessment of anthropogenic impact, planning of measures to achieve environmental objectives and assessment of efficiency of the measures applied in the RBMP implementation.

The number of monitoring sites for surveillance and operational monitoring in the coastal waters of Bulgaria has increased significantly since the first RBMP[57]. In Romania, based on the monitoring results since the first RBMP cycle, a more focused coastal monitoring programme targeted a reduced number of operational coastal monitoring sites in the second RBMP. Surveillance monitoring is not undertaken during the second RBMP, given that coastal water bodies have been assessed as not in good status[58]. Romania clarified that the operational monitoring programme is carried out each year during a management plan cycle and will be replaced by surveillance monitoring if the water bodies reach good status.

The Romanian National RBMP was developed in agreement with the international Danube RBMP, coordinated by the International Commission for the Protection of the **Danube** River (ICPDR). The methodological framework established with other countries in the Danube River Basin was used as the basis for the national and sub-basin management plans.

Detailed information, including a description or references to the applied methodologies on characteristics, pressures and impacts, status, monitoring programmes, environmental objectives and exemptions, is available in the RBMPs for the Black Sea River Basin District (Bulgaria)[59] and the Dobrogea Litoral sub-basin

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[56] Commission Decision (EU) 2018/229 of 12 February 2018 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018D0229&from=EN

[57] https://ec.europa.eu/environment/water/participation/map_mc/countries/bulgaria_en.htm

,[58] https://ec.europa.eu/environment/water/participation/map_mc/countries/romania_en.htm

[59] https://bsbd.org/bg/index_bg_5493788.html

(Romania)[60], including in the electronic reports of both countries in the EU's Water Information System for Europe (WISE)[61].

In practice, each stage of the WFD implementation reflects individual successive elements of EBA.

Ongoing challenges related to WFD implementation

There are several ongoing challenges at the time of development of the third RBMP (2022-2027) for Bulgarian Black Sea River Basin District (RBD) regarding coastal waters:

- Further development of the classification systems and establishment of type-specific reference conditions for the assessment of coastal waters' ecological status, according to the revised coastal water typology in the second RBMP;
- Determination of national Environmental Quality Standards/threshold values for priority substances in sediments, applicable to both WFD and MSFD.

For Romania, ongoing challenges in the second RBMP (2015-2021) to be addressed in the third plan include:

- Further improvement of the methodology for defining ecological potential for all water categories at water body level, including coastal waters;
- Establishment of type-specific conditions for the hydromorphological and physico-chemical quality elements.

A common challenge faced by both countries is ensuring the minimum frequencies required under the WFD for monitoring coastal waters to ensure sufficient temporal resolution and necessary confidence of the status assessment, both ecological and chemical. These challenges concern the complexity and confidence of the coastal waters' status assessment, specifically properly designed management measures and relevant uses of the marine environment.

Integration of RBMP in the MSP

Bulgaria's MSP uses some data for status assessments under the RBMP. However, no clear link or methodology is provided on how the coastal waterbody status, risk assessment and associated pressures are addressed in MSP (concerning LSI, setting objectives, indicators to evaluate, monitoring MSP implementation, etc.). At the same time, a clear link is made with the working scenario of climate change adopted in the RBMP, the impact of climate change on the development of the coastal territory and maritime areas, and the activities carried out in terms of MSP.

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[60] https://rowater.ro/dadobrogea/Planul%20de%20Management%20Bazinal/Forms/AllItems.aspx

[61] https://cdr.eionet.europa.eu/bg/eu/wfd2016/documents/bg2000/;

https://cdr.eionet.europa.eu/ro/eu/wfdart13

4.1.2 The Marine Strategy Framework Directive

The box below provides an overview of key requirements of the MSFD related to EBA and ecosystem monitoring.

Article 1(3) of the MSFD stipulates that marine strategies shall apply an EBA to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status (GES) and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations.

The MSFD sets an overall conceptual framework for assessing the state of the marine environment and related impacts, through 11 qualitative descriptors (MSFD, Annex I). This Directive complements the WFD in coastal waters, considering not only the composition and structure of biological communities but also habitats' characteristics. At the same time, the scope of the pressure types observed has been expanded, compared to the WFD, through descriptor 10 - Marine Litter, and Descriptor 11 - Underwater Noise and Energy.

Based on the initial assessment of the state of the marine environment (Article 8 MSFD), Member States shall establish a comprehensive set of environmental targets and associated indicators for their marine waters to guide progress towards achieving GES in the marine environment. Analyses of pressures and impacts as part of the initial assessment complement those under the WFD (namely LSI assessment).

Key requirements for assessment of the state of the marine environment under the MSFD are set by Commission Decision (EU) 2017/848 (GES Decision)[62]. The revised decision was adopted after almost two years of discussions, based on experience gained in the first cycle of the implementation of the Directive. During the annual meetings of the GES Working Group, Member States report on how the GES decision has been implemented at regional and subregional levels, on their plans to develop aspects of the revised GES Decision where regional or subregional cooperation is required, and on progress made.

At EU level, through the established technical groups, expert networks, and series of meetings, work continues to develop those aspects of the GES Decision where cooperation or guidance is needed. To support the achievement of the necessary level of confidence and accuracy in the state of marine environment assessment, a draft Article 8 MSFD Assessment Guidance is being developed and is expected to be proposed for endorsement in autumn 2021. In support of the Guidance, a workshop on horizontal issues was held on 30 September 2020 to share and discuss methods for setting baselines and threshold values within and between descriptors and to identify where coherence needs to be improved[63].

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[62] Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32017D0848

[63] https://circabc.europa.eu/sd/a/3a4db13f-5566-4526-84a5-de9fd3b99d74/GES_23-2020-Minutes%20-%20final.pdf

The initial assessment of the status of the marine environment (2012) was developed despite serious gaps in the available data and the knowledge for defining GES. These gaps applied to all Member States, albeit to different extents. It posed challenges in planning monitoring programmes for a credible ongoing assessment of the state of the marine environment, the pressures and impacts, and progress made towards achieving GES.

Since 2014, Bulgaria and Romania have worked together to create coordinated monitoring programmes. This cooperation follows the MSFD's requirements for regional cooperation (Article 6), and it supported by the EU-funded project, *Technical and administrative support for the joint implementation of the Marine Strategy Framework Directive (MSFD) in Bulgaria and Romania – Phase I*[64]. However, the first monitoring programmes of both countries were developed with limited administrative and expert capacity.

Bulgaria

The project, *Investigations on the State of the Marine Environment and Improving Monitoring Programmes developed under MSFD*[65] (ISMEIMP, 2015-2017) sought to put the MSFD implementation in Bulgaria on a solid scientific basis and fill gaps in the available information by conducting additional studies. The project was funded by the EEA Financial Mechanism. The project presents a good example of adaptive management in several aspects.

The implementation period of the project coincided with the EU-level revision of GES understanding and relevant key documents:

- Commission Decision 2010/477/EU on criteria and methodological standards on good environmental status of marine waters (GES Decision);
- Annex III of the Marine Strategy Framework Directive 2008/56/EU.

Given the significant changes underway, the project, applied a flexible approach based on drafts of these two documents. As a consequence, the monitoring programmes were updated following the revised GES Decision - the indicators and environmental targets for all descriptors were revised or validated, threshold values for some indicators were revised or derived, and the GES definitions were revised or developed. The updated monitoring programmes were included in the Marine Strategy of Bulgaria at the end of 2016[66]. Implementation of the updated monitoring programmes began in 2017, with the intention of using the results in the update of the initial assessment in 2018.

Although Bulgaria has not yet updated the initial assessment, the monitoring programmes, updated within the ISMEIMP project are designed to provide the necessary information to evaluate GES and develop indicators and threshold values. They provide the necessary monitoring networks with sufficient spatial resolution.

[64] https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/bucharest/pdf/Final_Report_020415.pdf

[65] https://www.bsbd.org/UserFiles/File/projects/ISMEIMP/ISMEIMP%20Project%20Final%20Report.pdf

[66] https://bsbd.org/bg/m_env_and_action.html

Each of the monitoring programmes contains recommendations for filling in information and knowledge gaps.

The monitoring programmes are designed to be focused and cost-effective so that they can benefit all three EU policy areas – MSFD, Nature Directives and the WFD. Thus, the programmes on D1,6 (benthic habitats) and on D1,4 (pelagic habitats) are interlinked with the WFD programmes in coastal waters; pressure-related monitoring programmes on D5 (eutrophication) and D8 (contaminants) provide traceability of the gradient in the spread of pollutants in the marine environment from coastal waters to open sea. The methodological framework of the MSFD monitoring programmes is consistent with that applicable to the WFD, insofar as possible.

MSFD monitoring programmes on D1,6 (benthic habitats) and D1 (fish) take into account the requirements of the Habitats Directive by considering and providing information for the assessment of special habitat types or species. **As a result of the coordination activities, the** project 'Natura 2000 in the Black Sea'[67] has been planned, aiming for synchronisation and optimisation of data collection processes and their reporting under the Habitats Directive, WFD and MSFD. Despite its importance in implementing the Habitats Directive, MSFD and WFD, the project is stalled, due to a suspended administrative procedure for assigning studies.

D1 (fish) and D3 (commercially exploited species) monitoring programmes are integrated with existing monitoring under the national programme for collection, management and data use in the fisheries sector, according to Regulation (EU) 2017/1004 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy.

Romania

After reporting on its MSFD monitoring programmes at the end of 2014, Romania did not carry out follow-up activities until the deadline for revision in 2020. Nevertheless, in 2015-2016 Romanian experts actively participated in the bilateral meetings held within the project 'Technical and administrative support for the joint implementation of the Marine Strategy Framework Directive (MSFD) by the EU Black Sea Member States - Phase III'[68], The main aim of these meetings was to facilitate the exchange of knowledge and experience and harmonisation of indicators and threshold values on individual MSFD descriptors. Within the meetings, Bulgaria shared the results of the national ISMEIMP project with Romania.

Based on the accumulated data during the first implementation cycle, Romania's new monitoring programmes, updated in line with the revised GES decision, were reported to the European Commission in December 2020[69].

Ongoing challenges related to MSFD implementation

One of the main priorities for the national Marine Strategy implementation **in Bulgaria** is the continuous upgrading and updating of marine environmental data and

[67] https://www.moew.government.bg/bg/priroda/proekti/novini/

[68] https://slideplayer.com/slide/16268293/

[69] https://cdr.eionet.europa.eu/Converters/run_conversion?file=ro/eu/msfd_art17/2020reporting/xmldata/envx9idmq/ART11_RO_MONprog_v10.12.2020.xml&conv=628&source=remote

improving or further developing the definitions, targets, and assessment indicators of GES under MSFD descriptors.

At present, however, the monitoring data remain fragmented, due to insufficient national funding and the timeframe for conducting surveys. The lack of data means that some indicators or threshold values have yet to be developed under the criteria set by the GES Decision.

According to the Bulgarian Water Act, the Institute of Oceanology is the designated organisation for marine monitoring. However, the monitoring (jointly for WFD and MSFD) is carried out on the basis of an annual assignment by the Bulgarian Ministry of Environment and Water. The administrative procedure for specifying the scope of the annual contracts starts after the approval of the target budget for that year and takes time. This creates regular delays of the start of monitoring campaigns, which in many cases makes it impossible to conduct seasonal observations or apply the minimum frequency of observations. The administrative mechanism under which the annual monitoring of marine waters is carried out must be improved, and a targeted strategy applied for the consistent implementation of the monitoring programmes, observing the allowable minimum frequency of monitoring for each of the quality elements, in accordance with WFD and MSFD requirements. To that end, a three-year distributed budget was forecast for 2019-2021. Unfortunately, it was only partially implemented due to insufficient funding, and the conclusion of annual agreements was subsequently delayed.

Bulgaria has not yet updated the assessment of the state of the marine environment at the time of preparation of the MSP, although the deadline set by MSFD was October 2018. In recent years, Bulgaria has encountered serious difficulties in maintaining expert capacity within government administrations, both at national and regional level, which seriously hinders the timely and effective implementation of commitments under the various sectoral policies, particularly MSFD, WFD, the Nature Directives, etc.

Romania faces an issue with fragmented marine water monitoring data due to insufficient funding. Monitoring is carried out on an annual basis by assignment. Romania's national legislation does not designate a competent authority for the implementation of marine monitoring. Rather, different scientific organisations have undertaken the task over the years, creating an additional challenge in managing non-uniform monitoring data. There is no established national water information system, nor is there a common database.

As a result, Romania also faces the challenge of addressing existing data gaps and developing or validating some indicators and threshold values under the criteria set by the GES Decision. This is currently being done through two ongoing projects (ANEMONE and CeNoBs) (see section 5.2).

Following the deadlines for the MSFD implementation, Romania submitted its update on the initial assessment of the state of the marine environment and the related targets and indicators, (Articles 8, 9, 10) on 15 December 2018 and updated it again in December 2019.

Integration of the MSFD in MSP

The Marine Strategy is recognised as a key document in the development of ***Bulgaria's*** National MSP. However, no clear methodology or explanation is provided in Bulgaria's draft MSP to explain how exactly the Marine Strategy elements are addressed in MSP (e.g. LSI, setting objectives, indicators or monitoring MSP implementation). The extent to which current developments and forecasts on the assessment of GES have been taken into account is unclear. Similarly unclear is the use – if any – of the analyses of existing conditions in the maritime space of Bulgaria and Romania, prepared in coordination by the two countries[70] under the MARSPLAN II project.

Bulgaria's draft MSP defines more integrated indicators for monitoring, evaluation, and management of the implementation process (e.g. 'Reduced anthropogenic pressure and improved status of the marine environment', 'Preserved/increased populations of target species'). This determines a high degree of conditionality and, consequently, ambiguity in reporting. The indicators should be specific and measurable. GES indicators are used to a very limited extent. The application of assessment indicators under descriptor 3 is only envisaged in relation to the defined synthesis indicator 'Reduced pressure from commercial fishing, scientifically justified quotas for exploited species and control of unregulated fishing in protected areas'. Even that is not direct, but through the envisaged general 'State of populations of the commercial fish species' indicator.

As of January 2021, ***Romania*** was still in the early stages of developing its national MSP (data gathering and processing). The study thus focuses on the documents available, namely the common methodologies and analyses prepared in coordination by the two countries, as well as Bulgaria's developed draft National MSP (fourth version since November 2020). As the draft plan for the Mangalia-Shabla transboundary area (developed within the first MARSPLAN project) was conceived as a pilot exercise, it was considered a starting point for the MSP process.

4.1.3 The Nature Directives

Currently, the Natura 2000 protected areas network in ***Bulgaria***[71] includes:

- 120 Special Protection Areas (SPAs) for wild birds, covering 23.1% of the territory of Bulgaria;
- 234 Sites of Community Importance (SCIs) for protection of natural habitats, covering 30.3% of the territory of Bulgaria.

The total number of Natura 2000 sites is 341, with 13 sites having a common border under the two Directives. Three of the areas under the Habitats Directive are entirely marine aquatic, and 14 include marine waters.

The total number of Natura 2000 sites for protection of habitats of ***Romania***[72] is 465, of which 171 are SPAs for wild birds. The national network of Marine Protected Areas (MPAs) comprises two Marine Reserves, nine sites for protection of habitats and one SPA.

For the Natura 2000 habitats and species, Member States should identify and report assessments under the categories of conservation status and conservation status trend (unfavourable status only) by habitat/species taxonomic group. For habitats, the distribution and the area within the boundaries of the protected areas are determined,

[70] https://drive.google.com/file/d/1cJ4rWOksltMXeOBvxFwnJrRcEN7CkojO/view

[71] https://www.natura2000.moew.government.bg

[72] http://www.mmediu.ro/articol/natura-2000/435

while, for species, the areas of distribution are determined. The assessment of conservation status should be accompanied by an evaluation of the pressures and threats on habitats and species.

As the implementation of the Nature Directives (with respect to establishing the Natura 2000 network) is quite advanced across the EU (with further work in the marine environment), efforts are focused on the coherent assessment of the conservation status of species and habitats across the EU and on setting appropriate conservation measures. For MPAs, this process is closely related to the development of the understanding and assessment of GES, according to the MSFD.

Although Natura 2000 sites are designated to protect only habitats and species of European importance, they also play a role in the conservation of other habitats and species, with impacts beyond their boundaries. For example, MPAs are important breeding areas for fish and other species, and thus help to maintain stocks of the commercially exploited species. They also facilitate the development of biodiversity and the overall provision of ecosystem services.

Ongoing challenges related to implementation of the Nature Directives

Current challenges for the Black Sea region (for both ***Bulgaria*** and ***Romania***) include:

Insufficient monitoring data. While monitoring programmes have been developed and regular monitoring is carried out under the WFD and the MSFD, biodiversity monitoring is carried out primarily under projects. Only a few of the species included in the National System for Monitoring the Status of Biological Diversity in Bulgaria are subject to systematic monitoring by the relevant competent authorities.

Insufficient data on the distribution and status of bottom habitats.

Lack of methodologies for monitoring and assessment of status for a number of species and natural habitats. To overcome the data shortage in respect of distribution boundaries and status of marine habitats, the 'Natura 2000 in the Black Sea' project was launched in 2018, funded by Bulgaria's Operational Programme 'Environment 2014-2020'[73] under the European Structural and Investment (ESI) Funds. The project aims to complete the development of the Natura 2000 network in the marine environment and provides for research and mapping of the distribution of natural habitat types, habitats of species, and their populations, and for determining their conservation status in the sea areas of Bulgaria. One challenge addressed by the project is the need to integrate the requirements and principles of the MSFD, particularly the GES Decision, which regulates the criteria and requirements for determining and assessing GES.

Lack of MPA management plans and enforcement of their conservation measures.

Need for coordination on monitoring, evaluation, and reporting for the Nature Directives, MSFD and WFD[74]. This is an EU-wide issue, with discussions launched at a joint meeting of Maritime and Water Directors and Nature Directors in Luxembourg in

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[73] https://www.eufunds.bg/archive2018/index.php/en/programming-period-2014-2020/operational-programmes-2014-2020/operational-programme-environment-2014-2020

[74] https://op.europa.eu/webpub/eca/special-reports/marine-environment-26-2020/en/

2015[75]. The dialogue was continued at expert level during the Joint meeting on biodiversity assessment and reporting under the MSFD and Nature Directives in March 2018 in Brussels[76]. Among the main priorities identified were the need to synchronise the deadlines for evaluation and reporting under individual directives, the terminology used, avoiding double evaluation, and for common evaluation systems to be developed rather than linking individual systems.

Integration of Nature Directives in MSP

The elements and requirements of the Nature Directives are addressed in Bulgaria's draft MSP, based on the information available and the current protection regimes. Both SCIs and SPAs are included in the analysis of the status of the components of the marine environment and interactions with the adjacent coastal zone. Special attention is paid to two species of birds that are monitored under the MSFD - European shag (*Phalacrocorax aristotelis*) and Mediterranean shearwater (*Puffinus yelkouan*).

4.1.4 The Common Fisheries Policy

The Common Fisheries Policy provides a clear definition of EBA according to its objectives, and clear provisions allowing for coordinated implementation by the Member States. It is currently based on Regulation (EU) 1380/2013, which provides the framework for the overall CFP initiatives.

The CFP's main objectives are to ensure sustainable exploitation of water resources and aquaculture from an ecological, economic and social point of view, and to minimise the negative impacts of fishing activities on the marine ecosystem, ensuring that aquaculture and fisheries activities avoid the degradation of the marine environment. The box below provides further details on the CFP's approaches and measures.

To achieve its objectives, the two main approaches that are enshrined in the CFP are:

- **'Precautionary approach to fisheries management'**, according to which 'the absence of adequate scientific information should not justify postponing or failing to take management measures to conserve target species, associated or dependent species and non-target species and their environment'.
- **'Ecosystem-based approach to fisheries management'** for 'managing fisheries within ecologically meaningful boundaries which seeks to manage the use of natural resources, taking account of fishing and other human activities, while preserving both the biological wealth and the biological processes necessary to safeguard the composition, structure and functioning of the habitats of the ecosystem affected, by taking into account the knowledge and uncertainties regarding biotic, abiotic and human components of ecosystems'.

[75] https://circabc.europa.eu/sd/a/05d5af21-6b75-48c1-857c-5737eeaf5764/Joint%20EU%20Water%252c%20Nature%20and%20Marine%20Directors%27%20Workshop%20Synthesis_Luxembourg%202015.pdf

[76] https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp?FormPrincipal:_idcl=navigationLibrary&FormPrincipal_SUBMIT=1&org.apache.myfaces.trinidad.faces.STATE=DUMMY&id=fb68e18d-0b1a-46fb-bd11-b1aec6fe0978

The CFP framework sets out the following tools for meeting the objectives set in respect of the conservation and sustainable exploitation of marine biological resources:

- **Ongoing monitoring - study and assessment of the state of the populations of exploited fish species.** For species for which there is a negative trend in population development, an EU regulation sets annual catch limits for each country in a given marine region. For the Black Sea, the quota species are turbot (*Scophthalmus maximus*) and sprat (*Sprattus sprattus*). Annual stock assessment surveys are conducted for these species. The fishing opportunities applicable in the Mediterranean and Black Seas for certain fish stocks and groups of fish stocks in 2021 are fixed by *Council Regulation (EU) 2021/90 of 28 January 2021 fixing for 2021 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in the Mediterranean and Black Seas*[77]

  If necessary, the competent fisheries and aquaculture authorities may initiate a study to assess the stocks of the species concerned. In Bulgaria, increased extraction of the 'White mussel' of the species *Donax Trunculus* and *Chamelea Gallina* led to a a study being initiated in 2020 to assess the stocks of these species.

- **Measures to adapt the fishing capacity of fishing vessels to available fishing opportunities.**
- **Measures on the fixing and allocation of fishing opportunities.**
- **Minimum conservation reference sizes for exploited species.**
- **Technical measures,** which may include the following**:**
  - characteristics of fishing gear and rules concerning their use;
  - limitations or prohibitions on the use of certain fishing gear and on fishing activities in certain areas or periods.

A detailed assessment of the state of fish populations, in particular commercial fish species and other aquatic organisms, is carried out as an element of the MSFD assessment of the state of the marine environment. The information collected as part of the *Programme for collection, management, and use of data in the fisheries sector* complements MSFD monitoring data. Therefore, during the development of the Maritime Strategy of Bulgaria, the monitoring programmes on D1 (Fish) and D3 (Commercially exploited species) monitoring programmes have been integrated with the existing monitoring under the National Programme for collection, management, and use of data in the "Fisheries" sector. Accordingly, the MSFD GES assessment identifies the necessary follow-up actions for the protection or restoration of the populations of the exploited species and their habitats.

The exploitation of fisheries resources in the Black Sea is limited by its natural characteristics. i.e. its poor water exchange with other sea basins, and the presence of an anoxic zone (with an average depth of below 150 m), rich in hydrogen sulfide, which determines the limit of distribution of the inhabiting biological species. The draft MSP for Mangalia-Shabla calls for a large part of the marine continental shelf to be formally protected to preserve the biodiversity of flora and fauna and the conditions that support its specific processes.

[77] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2021.031.01.0001.01.ENG&toc=OJ%3AL%3A2021%3A031%3ATOC

Data processing and management in the framework of CFP is covered by Regulation (EU) 2017/1004 of 17 May 2017 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing Council Regulation (EC) No 199/2008. Both Bulgaria and Romania have a unified information system, managing data on:

- catch and unwanted catch by species and by fishing zones;
- fishing gear used;
- fishing vessel registers and characteristics.

In addition, the vessel monitoring system (VMS)[78] has been introduced in Bulgaria and Romania under the CFP to help monitor and enforce fisheries requirements.

Ongoing challenges related to implementation of the CFP

Challenges include:

- Insufficient MSFD monitoring data in both Bulgaria and Romania for descriptors D1 (Fish) and D3 (Commercially exploited species) do not provide a reliable assessment of the population structure or functioning of fish species, making it impossible to determine protection or restoration measures;
- Insufficient monitoring data to determine 'white mussel' stocks, which inhibits the planning of adequate catch limits in Bulgaria;
- Lack of orders issued for the establishment of MPAs in Bulgaria (these orders are the first legal mechanism for the application of restrictions), together with the lack of MPA management plans, means that protection regimes cannot be applied to fishing activities.

Integration of CFP in MSP

CFP elements are broadly addressed in ***Bulgaria's*** draft National MSP, including economic indicators. A detailed analysis of synergies and conflicts related to fisheries activities was taken into account in the zoning of the marine areas as part of the draft Plan. Relevant recommendations (measures) are also provided in the MSP.

CFP elements (including economic indicators) have been addressed for ***Romania*** in the analyses of existing conditions in the maritime space of Bulgaria and Romania prepared under MARSPLAN II.

Both Bulgaria and Romania face gaps in the implementation of the CFP that affect their MSP processes:

- Bulgaria has no spatial database for fishing areas and catchment, only for aquaculture activities;
- Romania lacks a legislative framework related to:
    - marine water concessions for aquaculture projects financed via European funding schemes or private capital;
    - implementation of a national programme for the classification of harvesting and cultivation zones for molluscs, according to European Regulation No 854/2004.

[78] A satellite-based monitoring system (appled to vessels above 12 metres in length) providing data on the location, course and speed of vessels.

This hinders the development of aquaculture activities.

4.1.5 Strategic Environmental Assessment

The national legislation of both Bulgaria and Romania sets out the same SEA procedure - the assessment is performed when a draft planning document is available.

As of January 2021, a procedure for SEA of Bulgaria's draft MSP is underway.

Given that the MSP affects protected areas, during the first consultation the competent authority (Ministry of Environment and Water) decided[79] that the SEA report must include, as a separate annex, a report assessing the extent to which the draft MSP impacts the objectives of the protected areas (November 2020). According to national legislation, consultations on the SEA report will only start after the competent authority has given a positive assessment of the extent to which the draft MSP impacts the protected areas.

According to national legislation, reports on the implementation of the MSP are to be prepared every two years by the Minister of Regional Development and Public Works with the assistance of all stakeholders and the National MSP Advisory Council. These reports should reflect progress in achieving the goals set, including implementation of the measures provided by the SEA, linkages with the Marine Strategy and its PoM, links to the RBMP, as well as with all other national strategic documents in the sectors related to the maritime areas of the Republic of Bulgaria.

4.2 Human-ecosystem connections and integration

An essential element of the ecosystem approach is, based on the understanding of the structure and functioning of ecosystems and their interactions, to objectively assess and distinguish the natural and anthropogenic factors affecting themincluding their intensity and scope. This will allow the planning of effective actions for maintaining a healthy environment, along with sustainable use of natural resources.

4.2.1 The Water Framework Directive

The analysis of anthropogenic pressures and impacts under the WFD provides detailed information with good spatial resolution, imposed by the specific requirements of the Directive. This information is essentially an assessment of LSI, based on real data.

When setting environmental objectives for water bodies, the deadlines may be extended for the purposes of phased achievement of the objectives, provided that no further deterioration occurs in the status of the affected body (Article 4(4) WFD). In some cases, less stringent environmental objectives may be set for specific water bodies when they are so affected by human activity, or their natural condition is such that the achievement of these objectives would be unfeasible or disproportionately expensive (Article 4(5) WFD). Extensions of the deadline and the establishment of less

[79] https://www.moew.government.bg/static/media/ups/articles/attachments/%D0%95%D0%9E-6%20%D0%BE%D1%82%2005.11.20204b36c2ef5cfdf7c87f9d853c0dc8a85f.pdf

stringent environmental objectives are exemptions that are admissible only under the specific circumstances specified in the Directive. The justifications should be specifically set out and explained in the RBMPs, with , and those objectives are reviewed every six years.

In the second RBMP, ***Bulgaria*** presented exemptions for 12 of its 17 coastal water bodies. ***Romania*** presents exemptions for all four of its coastal water bodies.

The objective setting and exemptions are being used to prioritise necessary actions and to plan appropriate measures. The WFD provides for environmental objectives that should be achieved by the most cost-effective combination of measures. Cost-effectiveness assessment and public participation in the proposed measures are key instruments in this process. If there is sufficient evidence that costs seem to be disproportionate, careful assessment and balanced decision-making on benefits and costs is an integral part of the planning process. This measure must therefore be taken into account when planning activities in the maritime space.

The PoM in the second RBMPs (for both Bulgaria and Romania) were based on the Human Pressures and Impact analyses, status assessment, and assessment of the effectiveness of the first PoM. The main measures related to the main pressures, such as measures to reduce urban pollution, measures to reduce pressure from agriculture, etc.

The PoM for the second RBMP of the Black Sea RBD of Bulgaria is coordinated with the Marine Strategy. Planned measures relate to reducing waste pollution from land and reducing pollution from shipping activities. Mitigation measures, possible adverse effects on use, key BQE indicators, additional indicators and expected ecological effects are specified for each surface water category (river, lake, coastal waters) and each type of pressure.

The draft MSP for the Mangalia-Shabla cross-border area makes a clear link to the RBMP, stating that 'In order to achieve a healthy ecosystem status in the territorial waters, nutrient loading and pollution from urban areas and economic activities must be cut. The implementation of river basin management plans will play a key role in cuts to nutrient loading and pollution from on-land sources.'

The Action plan for the cross-border draft MSP addresses the WFD Key Types of Measures (KTMs). In some cases, the planned measures address activities subject to WFD/RBMP, namely '*Construction or upgrades of wastewater treatment plants', 'Improvements in flow regime and/or establishment of ecological flows', etc.* The point is how related policy elements can be integrated without duplication, or the conditions in which duplication is acceptable.

In the section 'Relationship with other policies and documents', Bulgaria's draft MSP lists a number of strategies at national level related to the water sector but does not reflect on the relationship with the RBMP. The objectives of the MSP refer to compliance with the MSFD's PoM but not the RBMP, whose measures include actions to reduce the pressure from land-based sources on the marine environment, as well as activities for the construction of facilities in the coastal zone. Similarly, the recommendations in the Bulgaria draft MSP do not refer to the RBMP PoM.

4.2.2 The Marine Strategy Framework Directive

The MSFD requires PoMs and subsequent action by Member States to be based on an EBA to the management of human activities, in particular the precautionary principle.

The MSFD PoMs of Bulgaria and Romania have been developed in a coordinated manner through two projects, one supported by the German government[80] and the other by the European Commission[81].

Bulgaria's MSFD PoM contains 23 measures, while that of Romania has 29. Of these, 17 are cross-border common or coordinated measures. MSFD PoMs combine measures addressed the following themes, all of which are potentially relevant for MSP: eutrophication, reduction of contaminants, conservation of biodiversity, prevention of the spread of invasive non-indigenous species, sustainable use of marine living resources, reduction of marine litter, and limitation of underwater noise.

Bulgaria's MSFD PoM is integrated with the revision of the WFD PoMs and is based on an analysis of the effect of the implementation of the measures in the first RBMP. Given that the measures related to the import of nutrients from land-based sources (related to D5, Eutrophication) are addressed in the RBMP, such measures are not planned in the PoM for the Maritime Strategy of Bulgaria.

Development of the Marine Strategy considered optimal synchronisation with related policies, in respect of monitoring, GES assessment, and the necessary measures, including legislative amendments. Some of the measures, in particular those related to fisheries, were developed in close collaboration with technical experts and representatives of the authorities responsible at both national and regional level. This helped to ensure that the measures were appropriate and well defined, and increased commitment to their practical implementation.

The existing MPAs are defined under the Nature Directives. However, some of the measures under the Marine Strategy call for the integration of the Marine Strategy and Nature Directives in the MPA management plans.

MSFD measures were developed from the initial assessment of the status of the marine environment and gap analysis in order to ensure the necessary scope and adequacy for environmental needs. However, the initial assessment implies various gaps and uncertainties.

At the time of developing the PoM, GES definitions, environmental targets and indicators for all descriptors were not established or were still being tested. A quantitative assessment of the effects of planned measures on achieving GES was

[80] Implementation of the Marine Strategy Framework Directive (MSFD) in Bulgaria – Development of Programmes of Measures under Article 13, funded by the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia (AAP) and coordinated by the German Federal Environment Agency (UBA) to the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety, https://www.umweltbundesamt.de/en/topics/sustainability-strategies-international/cooperation-eeca-centraleastern-european-states/project-database-advisory-assistance-programme/development-of-a-programme-of-measures-for

https://www.bsbd.org/v2/bg/page_3686260.html

[81] Technical and administrative support for the joint implementation of the Marine Strategy Framework Directive (MSFD) in Bulgaria and Romania – Phase 2, funded by DG Environment, https://www.bsbd.org/v2/bg/page_3058355.html

therefore not applicable. Accordingly, the implementation of the present PoM was not expected to achieve GES by 2020. Moreover, the first PoM contains some measures aimed at creating a legal or institutional environment or conducting research, which will facilitate planning of specific technical or institutional measures at a later stage.

Some of the measures in the Marine Strategy are included as recommendations in Bulgaria's draft MSP. However, the considerations and priorities underpinning these measures are not clarified.

The Action Plan in the draft MSP for the Mangalia-Shabla cross-border area addresses MSFD-related KTMs, supplementing the WFD's KTMs. An indicative relationship between the WFD KTMs and the MSFD descriptors is presented. In some cases, the measures planned address activities subject to MSFD, namely *'Study, develop and introduce common methodologies to assess the condition of marine ecosystems status by coordinated scientific research', or 'Set appropriate management targets and monitoring indicators in order to achieve good environmental status', etc.* Possible adaptation could be *'Initiation and adoption of mitigation measures for the regulation of relevant uses of the marine environment in cases of ascertained non-achievement of GES/environmental targets'*.

One shortcoming affecting the MSP process in Bulgaria is the delay in the updated assessment of the status of the marine environment, meaning there will be no updated analysis of the anthropogenic impact under the MSFD.

4.2.3 The Nature Directives

The Nature Directives require Member States to report, every six years, on the conservation status of the natural habitat types and species of Community importance, the impacts of the conservation measures taken, and to report, every two years, on the derogations adopted concerning specific species, the causes, and circumstances related to the derogations, the control measures applied and the results achieved. The formulation, monitoring of achievement, and revision of conservation objectives are crucial components of the Natura 2000 site management. Conservation objectives underpin the adoption of those conservation measures that correspond to the ecological requirements of habitats and species, and should make the largest contribution to the achievement of their favourable conservation status.

At the time of the preparation of this case study, in Bulgaria, only 49 (two MPAs) of the sites for the protection of habitats have been issued with government orders for announcement under the procedure of Article 12 of the Biodiversity Act, which makes them SACs (these orders are the first legal mechanism for the application of the protection regime). Management plans are not yet in place. Accordingly, measures to maintain and improve the conservation status planned for each protected area and included in the standard Natura 2000 forms are not yet operational.

Announcement orders have been issued for all SPAs. Action plans have been adopted for some species and draft action plans have been prepared for others.

There are management plans for MPAs designated under the Protected Areas Act in Bulgaria, which often overlaps with Natura 2000 sites (none of the current management plans are related to marine waters). Necessary measures are currently being implemented through projects.

Six of the Romanian MPAs (five SCIs and the SPA) have adopted management plans but these were developed before Romania's transposition of the Nature Directives.

Consequently, the conservation measures are not considered adequate for those Directives' requirements. However, conservation measures can also be integrated into other development plans: statutory, administrative or contractual measures to protect natural habitat types and species of European importance present at the site could be part of plans such as the MSP or regional development plans. In the RBMP, for example, when setting the objectives for water bodies within the boundaries of protected areas, the measures, subject and objectives of the protected areas are taken into account. Similarly, transboundary MSFD measures No. 13 and No. 14 between Bulgaria and Romania relate to the protection of seabird species and to the integration of GES requirements in MPA management plans.

The draft National MSP of Bulgaria takes into account the location, subject and objectives of the protected areas related to the marine environment and the coastal zone in the zoning of marine areas. The relevant recommendations (measures) are also provided in the plan.

Detailed information and public access to the data on the protected areas, conformity assessment procedures and related documents are available on the website of the Information System for the protected areas of the Natura 2000 ecological network[82].

4.2.4 The Common Fisheries Policy

The CFP measures for the conservation and sustainable exploitation of marine biological resources include development and implementation of multiannual plans for restoration and management of a single species or in the case of mixed fisheries or where the dynamics of stocks relate to one another (fisheries exploiting several stocks in a relevant geographical area), taking into account knowledge about the interactions between fish stocks. The management plans should be based on scientific data and, where targets relating to the maximum sustainable yield (MSY) cannot be determined due to insufficient data, plans should be based on the precautionary approach, ensuring at least a comparable degree of conservation of the relevant stocks. Both Bulgaria and Romania use multiannual plans for the quota fish stocks of turbot and sprat.

In line with precautionary approach, incentives are applied through the national fisheries operational programmes (including economic) to fishing with a lower impact on the marine ecosystems and fisheries resources.

Given the wide range of pressures caused by fishing activities on the marine environment, the MSFD PoMs of Bulgaria and Romania include several cross-border measures to mitigate and prevent harmful effects and restore fish stocks. They seek to stimulate environmentally friendly techniques for fishing and shellfish harvesting, apply time-space prohibitions and restrictions, and reduce waste from fishing activities, among others.

There are 1,857 fishing vessels in the Bulgarian fishing fleet, 95% of which are smaller than 12m (small-scale fishing). The Romanian fleet is significantly smaller, with 123 fishing vessels, seven of which exceed 12m in length.

An important element of the EBA applied by the CFP is the control of fishing activities, specifically:

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[82] http://natura2000.moew.government.bg

- periods of the ban on fishing;
- minimum conservation reference sizes by species;
- fishing effort and allocations of fishing opportunities for quota fish stocks;
- compliance with fishing gear requirements, in terms of selectivity and the possibility of damage to the marine environment;
- areas with restrictions on catching or applying certain fishing techniques.

The regulation of the various restrictions, as well as the control activities, have a high degree of bilateral coherence between Bulgaria and Romania. In both countries, orders introducing restrictions are issued jointly by the line ministries responsible for the implementation of fisheries policy and environmental protection. The precepts are issued based on bilateral coordination between the States[83].

Joint control missions are carried out on an exchange basis between Bulgaria and Romania, approximately monthly. At the end of each year, an annual plan for joint inspections is created with the European Fisheries and Control Agency, and is strictly followed. Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy[84] applies. Since the regulation amendments in 2019, border control services participate in joint inspections. This control system has received positive feedback, with enforcement authorities stating that it facilitates communication and controls effectiveness.

The spatio-temporal constraints applied by the CFP, as well as the related measures of the Maritime Strategy, are the basis for zoning in MSP, as well as the coordination of the activities in the marine environment, including the application of the multi-use concept.

In practice, each of the related directives requires the implementation of the EBA in an appropriate scope, according to the objectives and priorities, at each stage of its implementation.

4.3 Organising the MSP process

The case study examines the way in which the MSP process provides for strong exchange of information and views with stakeholders, the public and government authorities on ecosystem aspects of MSP.

An Advisory Council on Maritime Spatial Planning was established as a subsidiary body to the Bulgarian Ministry of Regional Development to support cooperation and coordination between relevant stakeholders during the MSP process. The functions, tasks, and composition of the Advisory Council are determined by rules issued by the Minister of Regional Development and Public Works. The Advisory Council is assigned coordination, advisory, coordinating and control functions for the development and implementation of the National MSP to facilitate effective communication between the relevant government agencies involved, including:

- Coordination and decisions on the vision, framework, textual and graphic content of the MSP, taking into account the application of EBA;

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[83] http://iara.government.bg/?page_id=15460 http://www.anpa.ro/?cat=4

[84] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009R1224

- Assistance in determining the spatial and temporal distribution of realised and future activities in maritime areas, in accordance with the Marine Strategy of the Republic of Bulgaria, except activities aimed at the defence or national security of the Republic of Bulgaria;
- Support use of the best available data, including spatial data, for the development of MSP.

An additional element providing adaptive management is included in the regulations for the MSP Advisory Council and is defined by its Article 12:

> *'Art. 12(1) Upon the proposal by the chairman, the Council may make decisions for the establishment of working groups for solving separate issues from the competence of the Council.*
>
> *(2) The nominal composition of the working groups shall be approved by the Chair of the Council and may include experts from the local government and representatives of the interested parties, who may contribute to the solution of the issues under para. 1.'*

The approach is very similar to that established in the Marine Strategy of Bulgaria.

Among the principles enshrined in the national MSP of Bulgaria, is: '***Adaptiveness of the planning process and consistency in monitoring*** - ensuring such a process and format of maritime spatial planning, which allows to take into account the dynamics of the marine environment and changes in it and to have clear mechanisms in place to monitor, evaluate and revise the plan.'

Despite the established coordination mechanism and extensive stakeholder consultation during the MSP development process, one of the main challenges identified is the need for better operational integration of the competent authorities of the various sectors of MSP. The MSP explicitly defines the need to clarify the relationship with other leading institutions to better coordinate their actions. Fourteen state authorities in the field of maritime affairs, safety, and security are identified, along with 12 State and regional authorities in the field of marine environment protection. The activities related to the operational implementation and information provision are highlighted as particularly important. As they are related to the competencies of persons of different subordination, they should be regulated by an act approved by the Council of Ministers.

A similar approach was implemented by the Romanian government through the establishment of the Maritime Spatial Planning Committee, an interministerial body assigned to develop and monitor implementation of the MSP. The Committee includes 15 ministries with competences in maritime space, the competent authority on the safety of offshore oil operations, and representatives of other public institutions with responsibilities in the regulatory fields of Government Ordinance No. 18/2016. It also comprises three other national organisations. The national authorities, agencies, or institutes with responsibilities in the regulatory field of the Ordinance, subordinated or coordinated by the institutions provided above, each appoint a full member and an alternate member of the Planning Committee. The committee was set up so that each competent authority would be directly involved in every stage of the MSP process, from data collection to decision-making.

Cross-border coordination between Bulgaria and Romania on the implementation of the MSP Directive has been carried out entirely through two projects, MARSPLAN-BS and MARSPLAN-BS II.

The MARSPLAN-BS project supported the establishment of an institutional framework for cross-border MSP, promoted the development of cooperation with neighbouring countries in the Black Sea region, particularly the consolidation of cross-border cooperation and information exchange between Romania and Bulgaria. The subsequent MARSPLAN-BS II project brings together the competent authorities of the two neighbouring Member States in the implementation of a coordinated national and cross-border process of MSP and the establishment of a long-term mechanism for cross-border cooperation in the Black Sea Basin.

To support cross-border coordination between Bulgaria and Romania, the MARSPLAN project developed:

- A common methodology for analysis and spatial planning for the maritime cross-border area[85];
- A draft MSP for the Mangalia-Shabla[86] cross-border area.

The MARSPLAN-BS II project developed:

- A synthesis report on maritime use[87];
- Analyses of existing conditions in the cross-border maritime space[88];
- A common geodatabase (still in development).

Both countries emphasise the importance of the 'Common strategy for the management of maritime activities in cross-border area', which is still under development, and its integration into both countries' national MSPs. Some difficulties in cross-border coordination stem from the different levels of progress in developing the two countries' national MSPs

At present, there is no permanent bilateral mechanism for cross-border coordination between Bulgaria and Romania, given that the coordinated MSP implementation is carried out through projects. It is necessary to provide a mechanism that will continue the established operational cooperation.

The Advisory Council of the MARSPLAN – BS II project oversees implementation progress. It includes the involvement of representatives of other Black Sea countries (Turkey, Ukraine, and Georgia) and the Black Sea Commission (BSC).

The potential role of the ***BSC*** as a mediator of MSP between the Black Sea countries was discussed during the Black Sea workshop held in the framework of this study (Annex 2). Currently, the Black Sea Commission works on MSP issues only through its Integrated Coastal Zone Management (ICZM) Advisory Group. The initiative of the two Black Sea Member States and the BSC Secretariat could be a driving force for the operational involvement of the other Black Sea countries in the MSP process in the region. Recommendations from the workshop are summarised in Section 5.4 below.

[85] http://www.marsplan.ro/en/results/defining-common-methodology.html

[86] http://www.marsplan.ro/en/results/maritime-spatial-plan-for-the-cross-border-area-mangalia-shabla.html

[87] https://drive.google.com/file/d/136dUucSpiN9s6NWY9QO16JV0hR9n0aP_/view

[88] https://drive.google.com/file/d/1cJ4rWOksltMXeOBvxFwnJrRcEN7CkojO/view

5. BENEFITS AND OPPORTUNITIES TO IMPLEMENT EBA IN MSP VIA THE EXISTING EU REGULATORY FRAMEWORK

5.1 How has work under other EU legislation supported the integration of the EBA into MSP?

Integration is one of the fundamental principles of EU environmental policy. It provides that environmental protection and improvement should be addressed in the design and implementation of all relevant policies, both environmental and non-environmental.

In the WFD and MSFD implementation processes, a powerful toolkit and methodological basis have been developed to analyse and assess: the characteristics of aquatic (particularly marine) ecosystems; impacts; and mechanisms for their use and protection. That success stems from development of the knowledge base, accumulated experience and information, and the significant scientific and expert potential involved in the implementation process.

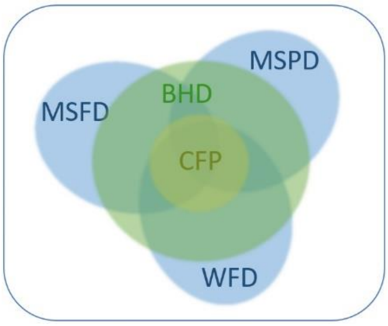
The WFD and the MSFD, as well as the Nature Directives, presuppose a form of adaptive management through their six-year implementation cycle, in which the analyses and assessments of each of the stages are reviewed based on the accumulated data and knowledge. The adaptive mechanisms of the CFP necessarily have shorter update periods, usually annually.

The MSP Directive (MSP preamble, recital 15) specifically refers to the need to achieve the goals of key directives and to take into consideration the Biodiversity Strategy to 2020 (in force at the time of the endorsement of the Directive, now replaced by the Biodiversity Strategy to 2030). Integration is recognised as a basic principle in the implementation of each of the directives. For example, the implementation of the WFD integrates the requirements and principles of EU legislation such as the Urban Waste Water Treatment Directive, the Nitrates Directive, the Nature Directives, the Environmental Quality Standards (EQS) Directive. The MSFD recognises the need to integrate the methods and indicators used in the WFD status assessment for coastal waters.

The new Biodiversity Strategy (2030) provides for a monitoring and review mechanism that will include a clear set of agreed indicators, enabling regular progress assessments and corrective action if necessary. The Strategy underlines the need for 'restoring the good environmental status of marine ecosystems', referring to the MSFD's objective (Section 2.2.6). The full implementation of the EU's CFP, MSFD and Nature Directives all play a key role in the Strategy.

Different policies and regulatory mechanisms support the integration and implementation of EBA. For example, the permit regime related to water use allows for the introduction of specific requirements to ensure the sustainable use of ecosystems and is in itself a regulatory mechanism for ensuring adaptability and meeting policy objectives. The measure envisaged in Bulgaria's draft MSP, on the development and implementation of regulations for the removal of abandoned aquaculture facilities after cessation of activities in order to prevent pollution of the marine environment (*Specific Objective 4.2. Cooperation for effective fisheries management and cessation of overfishing*), has already been addressed in the permitting regime under the Water Act, by placing the relevant conditions in the permits issued for use of a water body for aquaculture.

FIGURE 3: INTEGRATION BETWEEN MSP AND RELATED POLICIES



Similarly, it is essential to ensure compliance with the regimes for MPAs. Bulgaria's National MSP presents a good example of adaptability, presupposing compliance with the protection measures based on the Natura 2000 standard data forms[89], ahead of orders to establish the Natura 2000 sites and any subsequent management plans.

The integration process faces many challenges at each implementation stage of the various policies, from data collection (monitoring activities) to the establishment of effective regulatory management mechanisms, interaction between competent authorities, and effective stakeholder participation. Effective public participation requires a good communication strategy and coordination with stakeholders.

In developing its Maritime Strategy, Bulgaria applied a targeted approach to ensure phased, strategic planning and ongoing monitoring and upgrading of the necessary activities. The key national measure ***'Providing gradual implementation of the requirements of the MSFD 2008/56 / EC by providing the necessary information including funding mechanisms and management decisions'*, for example,** provides for the following main activities:

1. Development of an overall plan with necessary activities for MSFD implementation during the period 2017–2021 including necessary research, development of GES understanding, organising implementation of monitoring programmes, exchange of information, coordination and monitoring of the implementation of the measures, etc.
2. Updating and detailing the coming yearly plan and its approval before drawing up the annual national budget.
3. Regular expert meetings of the competent authorities to discuss specific activities for next year.

The expected results of the measure are:

- Better coordination and engagement of the relevant authorities, not only during the mandatory public consultations process;
- Timely planning and implementation of activities;
- Timely and secured funding for planned implementation of activities.

[89] Available via EEA's Natura 2000 Network Viewer: https://natura2000.eea.europa.eu/

A key element of the measure is the creation of a Supporting Expert Committee to the Advisory and Coordination Council for Protection of the Black Sea Environment. The Expert Committee will ensure operational cooperation at expert level for the exchange of information, ongoing monitoring of the implementation of the Marine Strategy and PoM, and discussion of corrective action, as necessary. Accordingly, the group includes representatives of the competent authorities relevant to Marine Strategy, stakeholders, scientific organisations, and NGOs. Different experts can be involved, depending on the topic of the discussion.

This coordination mechanism provides an opportunity for ongoing operational interaction between the competent authorities for related policies and legislation. This will be beneficial not only for the Marine Strategy but also for the implementation of related policies, including MSP. The development of the measure stems entirely from practical experience and the need to ensure actual progress and concrete results in the process of the MSFD implementation.

Key factors for the effective implementation of the measure are the p**rovision of expert and administrative capacity in the responsible institutions, a good communication strategy, and good coordination with the stakeholders**. The level of expertise of the lead institution is crucial for the effective functioning of the Supporting Expert Committee, strategic consistency and continuity in planning, raising issues for discussion, and monitoring and evaluation of the impact of implementation.

5.2 Has this work supported cross-border work on EBA and MSP?

Both the WFD and the MSFD set out a basic principle - synchronisation and comparability of assessments, according to its specifics, between countries for each ecoregion (WFD), and for each marine region (MSFD). Member States are required to take the necessary steps to ensure the appropriate level of coordination. Thus, Bulgaria and Romania successfully intercalibrated the Biological Quality Elements analysis methods for the identified common types of WFD coastal waters.

While the MSP Directive calls for **cross-border cooperation** to ensure that plans 'are coherent and coordinated', the MSFD requires that the GES assessment and monitoring programmes should be consistent, coherent, and coordinated across the marine region.

Coordination between Bulgaria and Romania on the implementation of the MSFD began with the initial assessment of the marine environment in 2012. Subsequently, good operational cooperation has been achieved through a range of bilateral meetings, supported by EU-funded projects for Technical and administrative support for the joint implementation of the Marine Strategy Framework Directive (MSFD) in Bulgaria and Romania – Phase I[90], II[91] and III[92] (2014-2017). Coordination continues through the **Black Sea Working Group,** established under the Agreement between the Ministry of Environment and Water Management of Romania and the Ministry of Environment and

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[90] https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/bucharest/pdf/Final_Report_020415.pdf

[91] https://www.bsbd.org/v2/bg/page_3058355.html

[92] https://slideplayer.com/slide/16268293/

Water of the Republic of Bulgaria on Cooperation in the field of Water Management facilitating further harmonisation of indicators and threshold values on the individual MSFD descriptors.

Two ongoing projects support this process:

- Assessing the vulnerability of the Black Sea marine ecosystem to human pressures – ANEMONE[93] - through collaborative efforts among its partners, the project aims to deliver a common strategy related to the Joint Monitoring of the Black Sea, using the most adequate commonly agreed assessment criteria and indicators, in order to assess the status of the Black Sea, as a basis for further actions; and to develop regional sea guidelines for the monitoring and evaluation of GES, in line with the revised Commission Decision;
- Support MSFD implementation in the Black Sea through establishing a regional monitoring system of cetaceans (D1) and noise monitoring (D11) for achieving GES – CeNoBs[94] – this aims to conduct investigations and further development of D1 (Cetaceans) and D11 (Underwater noise) - related regional indicators and threshold values.

The most common difficulties in conducting cross-border coordination concern:

- Varying levels of progress in the implementation of the different policies in the two Member States in the Black Sea region;
- Different timelines and deadlines for the various procedures for assigning the implementation of specific activities, whether the implementation of monitoring, development of plans, strategies, etc.;
- More difficult and conditional coordination with other non-EU Black Sea countries.

5.3 What are the main lessons learned?

The first and most important lesson for the effective implementation of any policy, including MSP, is the application of a consistent strategic approach together with the elements of adaptive management. Fundamental in this process are:

- Establishing the necessary legal and administrative mechanisms;
- Providing the necessary expert and administrative capacity;
- Timely planning and financing of the necessary activities;
- Providing comprehensive, up-to-date, validated, and well-structured information;
- Appropriate communication strategy and ongoing coordination with the related policies.

The experience and challenges identified in the MSP process in the Black Sea region, in particular for Bulgaria, where the draft national MSP has already been prepared, confirm the importance of effective integration between related policies. This requires a targeted strategy for capacity-building and maintenance within the institutions, which means a sufficient number of experts with appropriate qualifications, minimising turnover, and using the experience accumulated during the implementation process. Advisory Councils on the Marine Strategy and the MSP are good tools, but only if they are used effectively and not solely as formal administration. Given the specifics of

[93] http://anemoneproject.eu/

[94] https://www.cenobs.eu/

each of the related policies, the individual competent authorities must be involved operationally in the development of the MSP. Timely planning and funding are needed to ensure the consistent implementation of related policies. This is the only way to overcome the problem of fragmented data or their management, which is fundamental to any policy.

A good practice by Bulgaria is the implementation of related policies (WFD and MSFD) by a single institution (indeed by just one of its departments), which provides functional connections and consistency across implementation activities. This leads to much higher efficiency in conducting complex analyses of the pressures and impacts of human activities, risk assessment, and the planning of appropriate measures.

Good practices in the implementation of any of the related policies can be applied to MSP. One example is the adaptive approach applied under the ISMEIMP project (see section 4.1.2), through which the revised GES Decision under the MSFD was reflected in the monitoring programmes and entered into the Marine Strategy, so that Bulgaria has initiated the implementation of the revised monitoring programmes since 2017.

The joint work between the partner teams from Bulgaria's BSBD and the country's Institute of Oceanology in the implementation of the ISMEIMP project led to the establishment of good operational interaction and confirmed that a well-planned team is the main prerequisite for successful implementation.

In practice, all of the project goals were fulfilled (some above expectation). It thus became the main tool for overcoming the gaps in the initial assessment and setting GES targets and indicators, and - practically - for overall MSFD implementation in Bulgaria. The project has a key role at both national and regional level, through the sharing and discussion of the results with other Black Sea countries.

5.4 What steps could strengthen the use of other EU legislation as a tool for EBA in the MSP process?

The lessons learned answer the question of the steps that could be taken to strengthen the use of other EU legislation as a tool for EBA in the MSP process. The following main recommendations can be outlined to streamline EBA implementation:

5.4.1 Overall recommendations emerging from the study

The recommendations listed below are generally applicable for achieving the MSP process efficiency, in particular for achieving targeted implementation by ***both Bulgaria and Romania***.

1. It is important to carry out the monitoring required under the related Directives (notably the MSFD and WFD, but also the Nature Directives, and the CFP) in order to provide:
   - further development of the methodological basis for assessing the state of the marine environment with the necessary reliability and precision;
   - the necessary datasets to assess the status, impacts and subsequent identification of appropriate measures.
2. Data, assessments and objectives under the WFD (coastal waters) and under the MSFD, and the measures that affect coastal and marine waters, should be reflected when setting the objectives and priorities of the MSP, given that:

- They become mandatory for Member States with the adoption of their RBMPs and Marine Strategies and should also be coordinated on a transboundary level;
- Both the WFD and MSFD follow a consistent approach to synchronise assessment systems and methods that can be improved across successive cycles (this monitoring can then be used for multiple purposes, including MSP);
- Most of the measures under the WFD (in coastal areas) and the MSFD are related to the activities and priorities of MSP. They must be taken into account to achieve continuity and avoid conflict in the implementation of various activities and sectoral policies.

3. Current situation analyses, risk assessments, measure, and gap analyses are important elements of each of the related policies. Integrating them into the MSP process will avoid the problem of the different degrees of detail and accuracy of the information.
4. The involvement of qualified experts with practical experience in each of the specific areas to be integrated is crucial for the effectiveness of the MSP process. This will ensure completeness and functional coherence in the development of the MSP and its subsequent implementation.
5. When there are good synergies between related policies, continuity will occur naturally. Explicit efforts are still being made due to weak functional coherence in the implementation of different policies, although some countries have seen significant progress over the years.
6. It would be useful for the **Commission to assess the possibility of continuing to support cross-border cooperation** between Bulgaria and Romania or even to support cooperation within the Black Sea region, given the positive results achieved in facilitating operational cooperation, not only on MSP but also for the MSFD and the CFP.

5.4.2 Country-specific recommendations from the study

1. ***Both Bulgaria and Romania should*** set up a permanent bilateral mechanism for cross-border coordination on MSP issues after the completion of MARSPLAN-BS II in order to continue the established operational cooperation.
2. ***Bulgaria should*** provide a mechanism for the operational involvement of the various competent authorities in the MSP process, rather than just through consultation.
3. ***Romania should*** ensure integrated management of marine environmental monitoring data, currently held by various institutions conducting monitoring through assignments.

5.4.3 Key recommendations from the case study workshop[95]

The following recommendations are relevant for ***both Romania and Bulgaria***.

1. The complexity of ecosystems is not well understood by all, including by stakeholders mobilised in the MSP process. Efforts are required to enhance 'marine ecosystem literacy' for all.
2. It is important that professionals from all sectors (including fishing, tourism and maritime transport) are made aware of the MSP's role and objectives.

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[95] For further details on the workshop, see Annex 2.

3. Institutional set-up (vertical and horizontal) need to be strengthened to ensure better data exchange. This is particularly important for data from fields other than the marine area.
4. Working groups are needed for technical issues (e.g. data). A promising approach would be to take inspiration from HELCOM's experience with data management.
5. Stakeholder mobilisation requires mechanisms for bringing forward ideas from a wider group of people, including via small meetings at local level with good facilitators and communicators and building on existing networks of facilitators and sectors in countries (e.g. FARNET[96]). It is also necessary for government officials to have dedicated times for putting the MSP process in place and sufficient resources allocated to facilitation. It is essential to avoid putting in place a stakeholder process that (a) does not have any follow up and feedback (e.g. explaining results and implications) and (b) delivers a strategy that nobody applies.
6. SEA can address cumulative pressures and is a key instrument that can support the MSP process.
7. Good opportunities for addressing gaps and issues are sharing best practice, workshops to exchange and keep track of progress, and learning from mistakes.

The following recommendation was made for ***Romania***:

8. Romania needs to consider the development of sustainable marine aquaculture. Setting aside areas for aquaculture development can also drive actions for improving the quality of these areas, including when these measures are to be implemented under the WFD to address land-based polluting pressures.

The following recommendation was made for the ***BSC*:**

9. The role of the BSC in supporting a more synchronised integrated maritime policy in the Black Sea Region could be strengthened through the following actions:
   - Better funding to BSC to create more opportunities to streamline issues in the region;
   - Ensure more staff to support the process;
   - Given that many riparian countries are not EU Member States with the same obligations, developing a soft instrument that follows the same MSP Directive principles could be a way to mobilise non-EU countries;
   - Instruments in place in other regional seas – notably the experience in the Mediterranean Sea that builds on coastal zone management work for discussing MSP – could offer inspiration for addressing MSP in the Black Sea.

6. REFERENCES

- BG_Art. 17 habitats_report_2013-2018, https://cdr.eionet.europa.eu/bg/eu/art17/envxhyhkg/
- Black Sea River Basin District Management Plan 2016-2021, https://www.bsbd.org/bg/index_bg_5493788.html
- BSBD (2018). Annual report on the water status assessment in the Black Sea River Basin District, https://bsbd.org/UserFiles/File/annual%20reports/Doklad_2018.pdf
- Commission Decision (EU) 2018/229 of 12 February 2018 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the

[96] https://webgate.ec.europa.eu/fpfis/cms/farnet2/node_en

intercalibration exercise, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018D0229&from=EN

- Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32017D0848
- Maritime Spatial Plan of the Republic of Bulgaria 2021- 2035 (Draft), http://mspbg.ncrdhp.bg/pic/documents/20/MSPRB_ZAPISKA%20Final%20IV_15012021.pdf
- DG Environment, Project MISIS, Review of the existing and planned protected areas in the Black Sea (Bulgaria, Romania, Turkey) with a special focus on possible deficiencies regarding law enforcement and implementation of management plans, No. 07.020400/2012/616044/SUB/D2, https://projects.eionet.europa.eu/black-sea-marine-region-documents/library/mpa-report-review-existing-and-planned-protected-areas-black-sea-bulgaria/download/en/1/MPA%2520Report%2520-%2520Review%2520of%2520the%2520existing%2520and%2520planned%2520protected%2520areas%2520in%2520the%2520Black%2520Sea%2520%2528Bulgaria%252C%2520Romania%252C%2520Turkey%2529.pdf+&cd=5&hl=de&ct=clnk&gl=de
- Ecosystem Approach and the Common Fisheries Policy, https://brill.com/view/book/edcoll/9789004389984/BP000023.xml
- IO-BAS (2020). Annual marine waters monitoring campaigns data, 2017-2020, http://bgodc.io-bas.bg/documents/
- Kura II Project, Proposing Working Groups to Build Capacities for Improved River Basin Management and EU WFD Implementation, Policy Dialogue Meeting, Baku, Azerbaijan, 2018, https://unece.org/fileadmin/DAM/env/water/npd/Steering_Committee_meetings/The_7th_NPD_Steering_Committee/AZ_GEF_project_Policy_Dialogue_ToRs_Working_Groups_ENG.pdf
- Marine Strategy of Republic of Bulgaria 2026 - 2021, https://www.bsbd.org/UserFiles/File/Sea/%D0%9C%D0%BE%D1%80%D1%81%D0%BA%D0%B0_%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%B5%D0%B3%D0%B8%D1%8F_%D0%A0_%D0%91%D1%8A%D0%BB%D0%B3%D0%B0%D1%80%D0%B8%D1%8F.pdf
- MARSPLAN-BS Project, Draft Maritime Spatial Plan for the cross-border area Mangalia-Shabla (EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1), http://www.marsplan.ro/en/results/maritime-spatial-plan-for-the-cross-border-area-mangalia-shabla.html
- MARSPLAN-BS Project, Common methodology for analysis and spatial planning for maritime cross-border area (EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1), http://www.marsplan.ro/en/results/defining-common-methodology.html
- MARSPLAN-BS II Project, Synthesis report on maritime uses (EASME/EMFF/2018/1.2.1.5/01/S12.806725), Deliverable: WP1, Activity 1.1, 2020, https://drive.google.com/file/d/136dUucSpiN9s6NWY9QO16JV0hR9n0aP_/view
- ARSPLAN-BS II Project, Defining and analyssing existing conditions in the maritime space (EASME/EMFF/2018/1.2.1.5/01/S12.806725), Deliverable: WP1, Activity 1.1, 2020, https://drive.google.com/file/d/1cJ4rWOksltMXeOBvxFwnJrRcEN7CkojO/view
- MSFD Romania_roof-report_8a_8b_9_10.pdf, https://cdr.eionet.europa.eu/ro/eu/msfd_art17/2018reporting/textreport/envxzia0w/Romania_roof-report_8a_8b_9_10.pdf/manage_document
- Panayotov, V., Kamenova-Staykova, K., Barova, S. and Dimitrova-Deleva, S. (2017). Final report, Investigations on the state of the marine environment and

improving monitoring programmes developed under MSFD, ISBN 978-619-7244-03-8, https://www.bsbd.org/UserFiles/File/projects/ISMEIMP/ISMEIMP%20Project%20Final%20Report.pdf

- RO_Habitats Directive_Report Art. 17_2019, https://cdr.eionet.europa.eu/ro/eu/art17/envxhrpcw/
- Situational analysis of the state of the fisheries sector in Bulgaria, https://www.eufunds.bg/sites/default/files/uploads/pmdr/docs/2020-07/Final%20Draft%20Analysis%20All%2030062020_0.pdf
- Stanchev, H. (2020). Addressing the Multi-Use Concept with Maritime Spatial Planning in the Cross-Border Region (Bulgaria). MARSPLAN-BS II Project (EASME/EMFF/2018/1.2.1.5/01/S12.806725), Deliverable: WP2, Activity 2.4, June, 2020, 81 pp., http://www.marsplan.ro/en/results/marsplan-bs-ii-addressing-the-multi-use-concept.html
- Todorova, V., Milkova, T., Moncheva, S., Panayotova, M., Stefanova, K., Marinova, V., Trifonova, E., Doncheva, V., Mavrodieva, R., Stefanova, E., Slabakova, V., Hristova, O., Dzhurova, B., Hineva, E., Slabakova, N., Panayotov, V., Kamenova-Staykova, K., Barova, S. and Dimitrova-Deleva, S. (2017). Final report, Investigations on the state of the marine environment and improving monitoring programmes developed under MSFD, ISBN 978-619-7244-03-8, https://www.bsbd.org/UserFiles/File/projects/ISMEIMP/ISMEIMP%20Project%20Final%20Report.pdf
- Typology of Conflicts in MESMA case studies, Deliverable 6.1, A7.14 Case study report: The Bulgaria/Black Sea case study, http://www.homepages.ucl.ac.uk/~ucfwpej/pdf/MESMAD6-1.pdf

Relevant legislative acts

- Biodiversity Act, https://www.lex.bg/laws/ldoc/2135456926 [in Bulgarian, consolidated version with all amendments].
- Black Sea Coast Development Act, https://lex.bg/bg/laws/ldoc/2135555697 [in Bulgarian, consolidated version with all amendments], http://www.bsbd.org/uk/page_9640752.html [In English; consolidated version with amendments until 2014].
- Environmental Protection Act, https://www.lex.bg/laws/ldoc/2135458102 [in Bulgarian, consolidated version with all amendments]; http://www.bsbd.org/uk/page_9640752.html [In English; consolidated version with amendments until 2014].
- Fisheries and Aquaculture Act, https://www.lex.bg/bg/laws/ldoc/2135184393 [in Bulgarian, consolidated version with all amendments].
- Government Ordinance 18/2016 on the arrangement of the maritime space, adopted by Law № 88/2017, http://legislatie.just.ro/Public/DetaliiDocument/181227
- Government Ordinance 71/2010 on establishing the strategy for the marine environment, adopted by Law 6/2011, http://www.mmediu.ro/beta/wp-content/uploads/2012/06/2012-06-01_OUG_71_2010.pdf
- Maritime Spaces, Inland Waterways and Ports of the Republic of Bulgaria Act, https://lex.bg/bg/laws/ldoc/2134907392 [in Bulgarian, consolidated version with all amendments]http://www.marad.bg/upload/docs/Sea_Spaces_Act.doc [In English].
- Ordinance for the Protection of the Environment in Sea Waters,
- http://www.bsbd.org/bg/page_5376710.html [In Bulgarian].
- Ordinance H-4/2012 for surface waters characterisation, https://www.lex.bg/laws/ldoc/2135841270 [in Bulgarian, consolidated version with all amendments].
- Protected Areas Act, https://lex.bg/bg/laws/ldoc/2134445060 [in Bulgarian, consolidated version with all amendments]

http://www.bsbd.org/uk/page_9640752.html [In English, consolidated version with amendments until 2014].
- Water Act, https://www.lex.bg/laws/ldoc/2134673412 [in Bulgarian, consolidated version with all amendments]; http://www.bsbd.org/uk/page_9640752.html[In English, consolidated version with amendments until 2014].

ANNEX 1. LIST OF INTERVIEWEES

Bulgarian officials and experts[97]

Maria Georgieva - State expert at the Ministry of Regional Development of Bulgaria and MARSPLAN-BS II project coordinator

Veselina Troeva - Executive Director of the National Centre for Regional Development and head of the team working on the MSP of Bulgaria

Dimitrina Chacarova – CFP expert, Executie Agency of Fishery and Aquaculture

Marina Panayotova – Fish fauna and marine mammals expert (MSFD, CFP. HD), Institute of oceanology

Romanian officials and experts

Bogdan-Andrei Ghinea - Adviser at Directorate General for Regional Development and Infrastructure Policies and Strategies Department to the Ministry of Regional Development and Public Administration of Romania

Laura Alexandrov - Researcher, National Institute for Marine Research "Grigore Antipa", engaged in various aspects of the development of the MSP of Romania during the MARSPLAN-BS and MARSPLAN-BS II projects

Laura Boichenko - Pelagic habitats expert (MSFD, WFD), National Institute for Marine Research Grigore Antipa

Writen responses

Black Sea Basin Directorate, Bulgaria

Ministry of environment, waters and Forests, Romania

ANNEX 2. WORKSHOP SUMMARY

Background

The framework established under the Maritime Spatial Planning (MSP) Directive (2014/89/EU) is "aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine

[97] Due to complications related to the Covid-19 pandemic, an interview with the SEA Team Leader did not take place.

resources" (Art. 1(1)). In preparing and implementing their plans, Member States should apply "an ecosystem-based approach" (Art. 5(1)).

Specific attention thus is given to supporting the application of ecosystem-based approaches (EBA) in MSP to ensure the functioning of ecosystems and biodiversity are well accounted for. However, the practical application of EBA remains challenging, with limited practical examples on how to make it operational in a European context. The Executive Agency for SMEs (EASME) on behalf of DG MARE (Directorate General for Maritime Affairs and Fisheries) has established a specific service contract to conduct a study on the concrete application of the ecosystem-based approach in MSP. The main objective is to propose feasible and practical approaches and guidelines for applying the EBA in MSP with the presently available information and a practical method or tool for evaluating, monitoring and review the application of EBA in MSP. The study is coordinated by Milieu Consulting SRL with the following partners, ACTeon, Baltijas Vides Forums, Stichting Wageningen Research and Fresh-Thoughts Consulting GmbH.

Case studies focusing on different European regional seas are being carried out, including one case study on the Black Sea. The focus of this Black sea case study is to **investigate how the requirements and instruments of the existing legal framework address the management of (marine and coastal) ecosystems and resources.** It looks in particular at how the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD), the Common Fisheries Policy (CFP), NATURA 2000 and biodiversity legislation (Habitats/Birds Directives), as well as Integrated Coastal Management (ICM), **can support and facilitate the application of EBA in MSP, including in a transboundary context**.

In this context, a **stakeholder workshop** on 27 January 2021 from 13.00 to 17.00 EET **was organised** to discuss **how best to seize the opportunities offered by the implementation of the existing policy framework to support the application of EBA in MSP in the Black Sea**. The detailed programme can be found in the Annex.

Key Messages from the Speakers

Based on the presentations at the workshop, the following key messages have been derived. The presentations can be found at https://msp-eba-black-sea.fresh-thoughts.eu/programme/.

Welcome

Celine Frank (European Commission, DG MARE) highlighted key elements that can be used when implementing the EBA requirements in EU Legislation, including the MSP Directive. These are for example: the use of **s**ensitivity/pressure maps and sensitivity matrix and scores (each ecosystem components vs individual pressure), tools like ecosystem services assessments, cumulative Impact assessment (CIA) and scenario analysis.

She further highlighted the role of the European Marine Observation and Data Network (EMODnet), a network of organisations that work together to observe the sea, process data according to international standards and make that information freely available as interoperable data layers and data products.

Marijana Mance (European Commission, DG Environment) highlighted the **i**mportant links between MSFD and MSPD, which include:

- the value of the MSFD marine assessments when designing maritime plans;

- the use of maritime planning (both the plans and the process) as input for MSFD programmes of measures

She also highlighted the importance of "land-sea interactions" when developing MSP:

- Respect MS' responsibility for terrestrial ("town and country") planning
- Facilitate understanding of what "land-sea interactions" might mean in the context of MSP
- Acknowledge that coastal zones are environmentally sensitive, economically productive and socially / culturally / historically unique.

Irina Makarenko (Black Sea Commission) highlighted the importance of the Black Sea Commission for cooperation on the different policy processes of the bordering counties, including its role to promote and support ICM.

Implementing existing EU policies relevant to Maritime Spatial Planning: State of Play

Angel Gyorev, Ministry of Regional Development and Public Works, Bulgaria showed the status of the MARSPLAN Project, presenting an overview of the activities undertaken and those underways.

Laura Alexandrov and Laura Boicenco, National Institute for Marine Research and Development "Grigore Antipa", presented the use of ecosystem approaches in the MSFD and MSP in Romania. They made clear that there are MSP/MSFD areas of joint interest, namely more efficient & sustainable management of marine resources.

Tanya Milkova, Fresh Thoughts, presented the Bulgarian experience in WFD implementation and how each stage of this process reflects the ecosystem approach. She drew attention to the methodological framework and information base used in the characterization and assessment of impacts on aquatic ecosystems, and the planning of the necessary measures, emphasizing the importance of proper monitoring with an appropriate spatial and temporal resolution allowing for sufficient confidence of the status assessment.

Dimitrina Chakarova, Executive Agency of Fisheries and Aquacultures, Bulgaria presented instruments ensuring the application of the ecosystem approach in the implementation of the CFP, including regulatory mechanisms oriented to biodiversity preservation and sustainable exploitation of marine biological resources, and the areas of interactions with MSFD.

Nikolay Valchev, Institute of Oceanology of the Bulgarian Academy of Sciences, presented the EU MSP Platform, for which he is the focal point for the Black Sea, possible relations with MARSPLANII and the information and support that the Platform can offer those working on EBA and MSP in the region.

How can the implementation of the existing policy framework help to support EBA in MSP? Status of the assessment of the current situation

Tanya Milkova, Fresh Thoughts presented some key findings of the case study underway. She made a brief overview of the relationships between individual policy elements, along with a summary of the findings of MSP progress for the two Black Sea Member States, bringing attention to the areas of integration necessary or already achieved through the implementation of the MSFD, WFD, BHD, and CFP. These findings will be further developed and will be enriched by the discussions of the workshop.

Key findings

From the discussion, the following key findings relevant to the case study have been identified. The full reflection of the discussion held can be found on PowerPoint slides available here https://msp-eba-black-sea.fresh-thoughts.eu/programme/

Capturing the complexity of ecosystems

- The **current monitoring data** that exist for marine ecosystems are insufficient to make representative assessments that help capture the spatial diversity of these ecosystems. Still, the use of **data for MSFD descriptors coming from existing monitoring programmes** is recognized as an essential step in bringing the 'ecosystem approach' in the drafting of the MSP in Bulgaria and Romania.
- Strong links are required between the **MSFD and the MSP** in terms of data exchange on pressures on marine ecosystems, ecosystem functioning and relation to human activities.
- The complexity of ecosystems is not well understood by all – including by stakeholders mobilized in the MSP process. Thus, efforts are required to enhance "marine ecosystem literacy" for all stakeholders involved are relevant for both Romania and Bulgaria.
- Strategic Environmental Assessment (SEA) can address EBA, including cumulative pressures. Therefore, it is a key instrument that can support the integration of EBA in the MSP process.

Giving attention to the human-ecosystem connections and integration

- Socio-economic data related to different sectors are gathered and kept by different institutions. There is no common practice to share these data or to publish it.
- The future of marine activities needs to be considered when designing an MSP, including in relation to the ambition of the Green Deal (which is expected to impact significantly the growth of "blue" power, aquaculture and potentially other marine activities). We need to better consider how sectors will want to develop in the marine environment (including when these developments are linked to sectoral directives and strategies) so we can allocate these future developments to areas where there is the lowest (no) negative environmental impact.
- More attention is required to set the interface between ICM and MSP and find ways to better address the land-sea interface. Information on land-based activities and pressures can come from the WFD and MSFD. However, information gathered for these Directives do not provide all relevant information, e.g. there is not enough information on litter (quantity and type) that is discharged from land.

Organizing the MSP process

- Formal governance mechanisms are required for mobilising different sectors in the MSP process and supporting inter-sectoral integration. In Romania, for example, the sustainable exploitation of resources in the fisheries sector is defined by a common order for fisheries developed jointly by the Agriculture and Environment Ministries, building on studies done by scientific institutes (endorsed by the Academy). The application of this common order is expected to lead to improvements in fish stocks and related MSFD indicators.
- It is important that professionals (fishers, tourism, maritime transport…) from all sectors are made aware of the MSP role and objectives.

- Stakeholder mobilization requires mechanisms for bringing up ideas from a wider group of people, including via small meetings at local levels with good facilitators and communicators, building e.g. on existing networks of facilitators and sectors in and across countries (such as FARNET). It is important that government officials have dedicated times to put the MSP stakeholder process in place, and that sufficient (human) resources are allocated to facilitation. It is essential to avoid putting in place a stakeholder process that (a) does not have any follow-up and feedbacks (e.g. explaining its results and implications) and (b) delivers a strategy that nobody applies!
- New mechanisms are required to better connect "terrestrial" and "marine/maritime" planning processes.

The role of international Commissions

- The Black Sea Commission needs additional resources for improving its capacity, impact and political ambition, including on MSP.
- The Black Sea Commission could strengthen its connections and collaborations with regional fisheries organisations.
- It can plan the role of international coordinator for the implementation of MSFD and MSP. In particular, it can support the adoption of a soft agreement among all riparian countries (including non-EU countries) that includes the key principles of both directives and that can drive collective actions including from non-EU countries.
- It is important that the Black Sea Commission supports all countries with the "sharing of experience" on concrete projects and for concrete learning possibilities.

List of Participants

The following participants attended the workshop.

	Title	First Name	Last Name	Organisation	Member State
1	Ms.	Valeria	ABAZA	INCDM Grigore Antipa	Romania
2	Mr.	Paul	Adjin-Tettey	Fisheries Commission	Ghana
3	Ms.	Laura	ALEXANDROV	NCDM G.Antipa	Romania
4	Ms.	Ilze	Atanasova	Marine Cluster Bulgaria	Bulgaria
5	Mr.	Andrea	Barbanti	CNR-ISMAR	Italy
6	Ms.	Tatiana	Begun	GeoEcoMar	Romania
7	Mr.	Dimitar	Berov	IBER-BAS	Bulgaria
8	Ms.	Laura	Boicenco	NIMRD	Romania
9	Ms.	Cristina	Cervera Núñez	Instituto Español de Oceanografía (IEO)	Spain
10	Ms.	Dimitrina	Chakarova	EAFA	Bulgaria
11	Ms.	Anja	Detant	EASME	Belgium
12	Mr.	Boyko	Doychinov	Regional Cluster "North-East"	Bulgaria
13	Mr.	Mario	Doychinov	Blue Growth Society	Bulgaria
14	Ms.	Nadezhda	Drumeva	Black Sea Basin Directorate	Bulgaria
15	Mr.	Thomas	Dworak	Fresh-Thoughts Consulthng GmbH	Austria
16	Ms.	Natalia	Fedoronchuk	NorGeoEcoCentr	Ukraine
17	Ms.	Céline	Frank	European Commission	Belgium
18	Mr.	Tiago	Garcia	IOC-UNESCO / MSPglobal Consultant	France
19	Mr.	Guillermo	Gea	Milieu Consulting	Belgium
20	Mr.	Bogdan	Ghinea	Ministry of Public Works, Development and Administration	Romania
21	Mr.	Serge	Gomes da Silva	eellogic	France
22	Mr.	Mamuka	GVILAVA	BSC ICZM Advisory Group Member, ICZM National Focal Point for Georgia	Georgia
23	Mr.	Angel	Gyorev	Ministry of regional development and public works	Bulgaria
24	Ms.	Firdaous	Halim	IOC-UNESCO / MSPglobal Consultant.	France
25	Ms.	Yoanna	Ivanova	Association "Forum"	Bulgaria
26	Ms.	Kristel	Jurado	EASME - European Commission	Belgium
27	Ms.	Tamara	Kukovska	SSIMariGeoEcoCenter NAS Ukraine	Ukraine
28	Ms.	EVGENIA	LAGIOU	MINISTRY OF ENVIRONMENT AND ENERGY	Greece
29	Ms.	Gloria	Lazaro	Plan Bleu UNEP/MAP	France
30	Mr.	Dan	Lear	EMODnet Biology/MBA	United Kingdom
31	Ms.	Marina	Lipizer	OGS	Italy
32	Ms.	Iryna	Makarenko	Black Sea Commission	Turkey
33	Ms.	Marijana	Mance	European Commission	Belgium
34	Ms.	Michaela	Matauschek	Fresh Thoughts Consulting	Austria
35	Mr.	Meth	Methodieff	FARNET	Bulgaria
36	Ms.	Otilia	Mihail	Ministry of Environment, Waters and Forests	Romania
37	Ms.	Tanya	Milkova	Fresh-Thoughts Consulting GmbH	Austria

	Title	First Name	Last Name	Organisation	Member State
38	Ms.	Eolina	Milova	World Bank	International
39	Ms.	Mihaela	Mirea	Mare Nostrum NGO	Romania
40	Ms.	Leila	Neimane	University of Latvia	Latvia
41	Mr.	Oleksandr	Neprokin	Ukrainian Scientific Centre of Ecology of the Sea	Ukraine
42	Mr.	Florent	NICOLAS	HELCOM Secretariat	International
43	Ms.	Marina	Panayotova	Institute of oceanology - BAS	Bulgaria
44	Ms.	Monika	Peterlin	EEA	Denmark
45	Mr.	Alessandro	Pititto	EMODnet Human Activities	Italy
46	Mr.	Marko	Prem	UNEP/MAP Priority Actions Programme Regional Activity Centre (PAP/RAC)	Croatia
47	Ms.	Fatima	RAHMANI	Département of fisheries	Morocco
48		JUAN	RONCO	EU COMMISSION	International
49	Mr.	Oleg	RUBEL	Institute of market problems and Economic-Ecological reserches of Ukraine	Ukraine
50	Mr.	Edmond	Sanganyado	Shantou University	China
51	Mr.	Siegfried A,	Schmuck	Pew Charitable Trusts	Belgium
52	Ms.	Dieynaba	Seck	Centre de Suivi Écologique	Senegal
53	Ms.	Zeljka	Skaricic	PAP/RAC - UNEP/MAP	Croatia
54	Mr.	Henrik	Skovmark	Danish Maritime Authority	Denmark
55	Mr.	Thanos	Smanis	CLIMAZUL	Greece
56	Ms.	Margarita	Stancheva	Center for Coastal and Marine Studies (CCMS)	Bulgaria
57	Ms.	Elena	Stoyanova	Ministry of Regional Development and Public Works	Bulgaria
58	Mr.	Constantin	Stroie	National Agency For Fisheries And Aquaculture - Nafa Romania	Romania
59	Mr.	Pierre	Strosser	ACTeon	France
60	Mr.	Adrian	Teaca	GeoEcoMar	Romania
61	Mr.	Obed	Timakata	Organic Fish + Farm Mariculture Enterprise	Vanuatu
62	Ms.	Vesselina	Troeva	National Centre for Regional Development	Bulgaria
63	Ms.	Natasa	Vaidianu	Ovidius University of Constanta	Romania
64	Mr.	Nikolay	Valchev	Institute of Oceanology - Bulgarian Academy of Sciences	Bulgaria
65	Mr.	Tom	Woolley	Department of Housing, Local Government and Heritage	Ireland
66	Mr.	Tony	Zamparutti	Milieu Consulting	Belgium
67	Ms.	Sofiia	Zherebchuk	National antarctic research center	Ukraine

Programme

Time	Content
12.45-13.00	**Initiation of the virtual workshop** *(Thomas Dworak, Fresh Thoughts)*
13.00-13.25	**Welcome** *Celine Frank (European Commission, DG Mare)*

	Marijana Mance (European Commission, DG Environment) *Irina Makarenko (Black Sea Commission)*
13.25-13.30	**Setting the scene to the workshop** *Tony Zamparutti, Milieu LTD & Pierre Strosser, ACTeon*
13.30-14.15	**Implementing existing EU policies relevant to Maritime Spatial Planning: State of Play** Status of the MARSPLAN Project (*Angel Gyorev, Ministry of Regional Development and Public Works, Bulgaria*) Ecosystem approaches in the MSFD and MSP in Romania *(Laura Alexandrov and Laura Boicenco, National Institute for Marine Research and Development "Grigore Antipa")* Ecosystem approach in light of the WFD - Bulgarian experience in coastal areas *(Tanya Milkova, Fresh Thoughts)* Ecosystem approaches in the CFP *(Dimitrina Chakarova, Executive Agency of Fisheries and Aquacultures, Bulgaria)* The EU MSP Platform and possible relation with MARSPLANII *(Nikolay Valchev, Institute of oceanology -BAS)*
14.15-14.30	**How can the implementation of the existing policy framework help to support EBA in MSP?** Status of the assessment of the current situation *(Tanya Milkova, Fresh Thoughts)*
14.30-14.45	***Break***
14.45-14.50	**Introduction to the Working session** *(Thomas Dworak, Fresh Thoughts)*
14.50-16.55	Three topics discussed guided by a set of key questions. The main aim of these discussions is to identify how best to seize opportunities offered by other policies for supporting ecosystem-based approaches in Maritime Spatial Planning: • **Capturing the complexity of ecosystems:** including ecological integrity and biodiversity, ecosystem connections, the dynamic nature of ecosystems • **Giving attention to the human-ecosystem connections and integration:** consider cumulative impacts, identify ecosystem services and beneficiaries, account for global socio-economic changes, account for social/economic/environmental aspects in assessments carried out to define rules for sharing space and management, ensure interdisciplinarity in science that translate biophysical and human/decision-making processes…. • **Organizing the MSP process:** stakeholder mobilization, science-policy interface, synergies with other (sector/environmental) policy processes to deliver "integrated management" of space, coherence between the governance established and the functioning and dynamics of the human-ecological system.

ANNEX 3. KEY TRANSPOSING LEGISLATION IN BULGARIA AND ROMANIA

EC Directive/ Regulation	National legislation of Bulgaria	National legislation of Romania
Water Framework Directive 200060/EC	Water Act (1999) Ordinance 1/2007 on research, use and protection of groundwater Ordinance 1/2011 for monitoring	Water Act (1996)

EC Directive/ Regulation	National legislation of Bulgaria	National legislation of Romania
	of waters Ordinance 2/2011 on the issuance of permits for wastewater discharge into water bodies and determination of the individual emission limits of point sources of pollution Ordinance H-4/2012 for surface waters characterisation	
Marine Strategy Framework Directive 2008/56/EC	Ordinance on the protection of the marine environment (2010)	Government Ordinance 71/2010 on establishing the strategy for the marine environment, adopted by Law 6/2011
Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora	Biodiversity Act (2002)	Government Ordinance no. 57/2007 on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna, approved with amendments and completions by Law no. 49/2011
Directive 2009/147/EC on the conservation of wild birds		
Regulation (EU) 2017/1004 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy	Fisheries and Aquaculture Act (2001)	Government Ordinance no. 23/2008 on fishing and aquaculture amended by Law no. 126/2019
Directive 2001/42/EC oп the assessment of the effects of certain plans and programmes oп the environment	Environmental Protection Act (2002) Ordinance on the terms and conditions for carrying out environmental assessment of plans and programmes (2004)	Law no. 265/2006 for the approval of the Government Ordinance no. 195/2005 on environmental protection
Recommendation 2002/413/EC, concerning the implementation of Integrated Coastal Zone Management in Europe	Act on the Black sea coast spatial development (2008)	Law no. 280/2003 for the approval of the Government Ordinance no. 202/2002 on integrated coastal zone management

Note: The main pieces of legislation are listed in the table; the list is not exhaustive.

Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

IV

Task 4: Elaboration of MSP cases studies using an EBA
Assessing and valuing ecosystem services in the Northern Adriatic

Final report

Written by Vera Noon, Cloé Rivière, Pierre Strosser (ACT*eon*), Elisabetta Manea, Elena Gissi and Andrea Barbanti (National Research Council, Institute of Marine Science, Italy)

August – 2021

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1. Introduction

European seas face **many challenges in relation to the health of marine ecosystems**. Degraded marine and coastal ecosystems can be found in all European seas, as a result of many anthropic pressures, such as pollution (including organic, chemical, plastic and noise pollution), morphological alterations, and unsustainable extraction of marine resources. High population densities along Europe's coasts, tourism developments, fishing, agricultural and industrial developments, shipping, and renewable energy infrastructures are among the sectors that impact European seas[98]. The significant development of economic activities expected at sea in the coming decades heightens the need for sustainable blue activities and for a sustainable sharing of marine space that accounts for marine ecosystem protection priorities.

To respond to these challenges, the European Union (EU) adopted its **Marine Strategy Framework Directive (MSFD)** in 2008 (2008/56/EC)[99], which aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 while protecting the resource base on which marine-related socioeconomic activities depend. The Directive builds on different key management principles and promotes an **ecosystem approach** to the management of human activities with an impact on the marine environment. The MSFD was complemented in 2014 by the Maritime Spatial Planning (MSP) Directive (2014/89/EU), which aims to promote 'sustainable growth of maritime economies, sustainable development of marine areas and sustainable use of marine resources' (Article 1(1)). In preparing and implementing their plans, Member States should apply 'an ecosystem-based approach' (Article 5(1)) that adequately accounts for the functioning of ecosystems and biodiversity.

Today, experiences in the practical application of **ecosystem-based approaches** (EBA) in MSP are growing but as yet are not well documented or are limited to the scientific literature. The European Climate, Infrastructure and Environment Executive Agency (CINEA, formerly EASME), on behalf of the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE), has set a service contract for a study on the concrete application of EBA in MSP. Its main objective is to assess the current state of play in the practical application of EBA in MSP, and to develop a practical method or toolbox to support EBA applications, monitoring and evaluation. Building on different case studies developed in different European regional seas, the study seeks to address specific aspects of EBA. In line with the importance given to understanding the functioning and dynamics of the socio-ecological system and the role the assessment of ecosystem services can play in supporting MSP in general, and EBA in MSP in particular, a specific case study was launched in the **transboundary Northern Adriatic Sea** (NAS) to apply different methods and techniques for identifying, quantifying and providing monetary values for the services delivered by coastal and marine ecosystems.

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[98] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/europes-seas-and-coasts/#interesting-facts

[99] https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

2. Overview of the Northern Adriatic case study

2.1 Objectives of the case study

The main aim of the case study carried out in the Northern Adriatic is to illustrate the potential role of the assessment and valuation of services provided by marine ecosystems in supporting MSP.

More specifically, the case study addresses the following questions:

- Q1 – What are the **main characteristics of NAS marine ecosystems**? What are the main habitats that these ecosystems host, and the pressures imposed on these ecosystems by socioeconomic activities?
- Q2 – **What services are provided by marine ecosystems** in the NAS? What is the status of these services and some of the key threats they are facing? What is the spatial extent of the ecosystem services delivered, in terms of the marine area(s) that produce the services and the area(s) where beneficiaries of these services are located?
- Q3 – How **important are the services delivered by NAS marine ecosystems**? What activities and sectors benefit from these services? In particular, what value(s) do these services provide to specific activities and to society as a whole, including monetary values when these can be assessed? Is there a significant difference in the importance and values of these services, and of healthy marine ecosystems in general, between the three countries bordering the NAS (Italy, Slovenia, Croatia)?
- Q4 – How can the characterisation and valuation of services provided by marine ecosystems **support the MSP process and decisions**? What challenges and limitations are faced in quantifying and valuing ecosystem services, and what solution(s) are there for addressing these challenges and limitations?

2.2 Methodology

Building on the review of the different categorisation of ecosystem services in the literature[100], the study used the Common International Classification of Ecosystem Services (CICES; see categorisation in Annex I). It also included supporting services derived from ecosystem structures and functions. The ecosystem services analysed are presented in Table 1, addressing use and non-use values of these services.

TABLE 1: ECOSYSTEM SERVICES CONSIDERED IN THE NORTHERN ADRIATIC CASE STUDY

Type	List of ecosystem services considered
Supporting services	Habitat provisioning and biodiversity
Provisioning services	Food, sand/gravel, water, salt, ornamental products
Regulating services	Nutrient regulation and water quality, coastal protection, climate regulation
Cultural services	Tourism and recreation, scientific knowledge research and education

[100] See, for example, https://norden.diva-portal.org/smash/get/diva2:920382/FULLTEXT01.pdf for a review of the different systems.

The methodology aimed to reconstruct the flow of ecosystem services by: i) qualitatively describing the provisioning mechanisms of each service, focusing on the ecosystem structures and functions and identifying potential pressures that might affect the capacity of the ecosystems to provide services; ii) quantifying the effective or potential delivery of services to beneficiaries, identifying the benefit area; and iii) assessing, in monetary terms, the benefits delivered by these services. The analysis built on an extensive review of the available literature, complemented by the collection of available data and information in different **(public) databases, including general statistics**, and by **semi-structured interviews** with representatives from sectors for which data and information were not readily available.

Depending on the ecosystem services, different methods were used to assess their monetary values building on market data when these are available (e.g. for fisheries or sea salt extraction), the assessment of avoided cost (e.g. in relation to the benefits from reduce climate risk) or data obtained via a dedicated **willingness to pay (WTP) survey** for ecosystem services for which markets do not exist. For the latter, a dedicated survey was carried out in the three countries bordering the NAS, building on the choice-experiment framework that helps in assessing monetary values for different attributes (ecosystem services). In total, the views and perceptions of 1,000 inhabitants from Italy, Slovenia and Croatia (a representative sample of 333 respondents per country) were collected via an online survey. Annex V of the report provides the distribution of the sample among the three countries according to some basic characteristics (age, income, gender, etc.). The general structure of the questionnaire applied in the survey is presented in Box 1.

BOX 1: FOCUS OF THE QUESTIONNAIRE

In line with typical practice in WTP surveys, the questionnaire used in the Northern Adriatic survey included the following sections:

- An introduction - presenting the focus of the survey;
- Part 1 - questions related to the priority societal challenges faced by respondents, and their connection(s) to the NAS, including in terms of uses and practices related to personal or professional activities;
- Part 2 - challenges faced by marine ecosystems in the NAS and their familiarity to respondents;
- Part 3 - respondents were presented with choice cards presenting different scenarios in terms of the health of marine ecosystems, their level of biodiversity/water quality/possibility to carry out recreational activities and payment level, and asked to choose among scenarios. This was central to the WTP questionnaire;
- Part 4 - a series of questions aiming to understand respondents' reasons for choosing scenarios and being willing (or not) to pay for improvements in the health of marine ecosystems in the NAS;
- Part 5 – collected basic socioeconomic characteristics of respondents' households.

The results of the survey were **statistically analysed**. Descriptive statistics were complemented by an econometric analysis using a probit model (see Annexes VI, VIII for detail of the analysis, the regression model and results table) to identify key variables that might explain respondents' WTP, their choices in terms of scenarios, and the relative importance of the three attributes in this choice. The limited resources allocated to the case study similarly limited the econometric analysis carried out:

additional econometric models and relationships will be investigated after the end of the study.

All results obtained for the characterisation and valuation of ecosystem services were **summarised in synthetic tabular and schematic formats**, combining qualitative, quantitative and monetary information, and characterising the main uncertainties in assessment. Preliminary results of the study were briefly presented at a workshop on 10 March 2021 as part of the study addressing ecosystem service assessment and valuation for MSP.

2.3 Structure of the report

This report presents the main results of the case study and is structured as follows:

- The **context** of the EBA and MSP study that hosts the Northern Adriatic case study, the **objectives** of the case study, the **ecosystem services considered,** and the **methodology** applied for their quantification and valuation are summarised in Chapters 1 and 2.
- Chapter 3 presents the main **characteristics of the Northern Adriatic case study**, in terms of its boundaries, the main maritime activities that are present in the NAS, as well as its environmental conditions (current status of marine ecosystems and main threats to these ecosystems). It distinguishes between the context and situation for each of the three neighbouring countries (Italy, Slovenia, Croatia).
- Chapter 4 describes the different **ecosystem services provided by the NAS**, building on qualitative, quantitative and monetary information to characterise supporting, provisioning, regulating and cultural ecosystem services.
- Chapter 5 presents the main results of the **WTP survey.**
- Chapter 6 provides **an overview of the assessment results** and the case study **conclusions,** providing synthetic tables and figures on all ecosystem services analysed. It discusses the relevance of ecosystem service assessment and valuation for MSP and identifies areas that require further work beyond the scope of the present study.

3. Northern Adriatic case study

3.1 Case study definition and geographical scope

The Adriatic Sea is bordered by Italy to the west, and Slovenia, Croatia, Montenegro, Bosnia and Herzegovina and Albania to the east. The assessment of ecosystem services carried out under the EBA and MSP project was limited to the NAS, marked by Ancona on the western coast, and by Zadar on the eastern coast, as shown in Figure 1.

FIGURE 1: MAP OF THE CASE STUDY'S GEOGRAPHICAL EXTENT

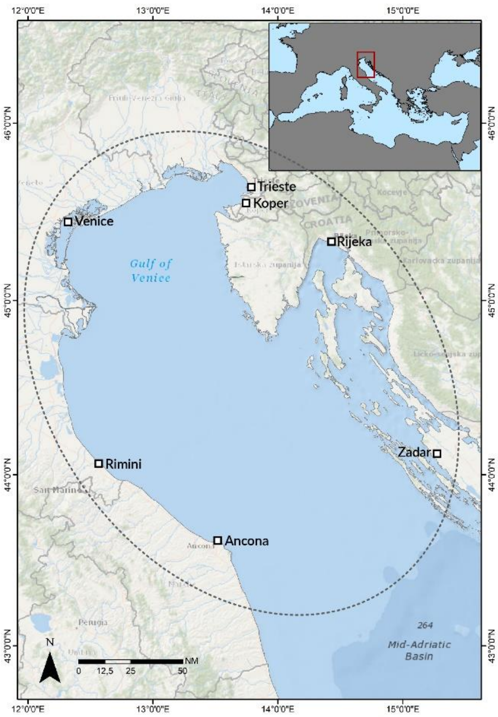


Table 2 presents some of the basis statistics of the case study area that highlight its importance.

TABLE 2: BASIC CHARACTERISTICS OF THE AREA CONSIDERED FOR THE NORTHERN ADRIATIC CASE STUDY

Country	Italy	Slovenia	Croatia
Population density (inhabitants/sq. km) Source: Worldometers (2021)	**206**	103	73 (97 in the coastal area (HR ESA,2019))
Total coastline (km)	7,500	47	1,880 + 4,398 for the islands
Administrative divisions considered in the case study.	Emilia-Romagna; Veneto; Friuli-Venezia Giulia regions	" Coastal–Karst"	Istria; Primorje-Gorski Kotar; Lika Senj; Zadar counties
Approx. coastline length for North Adriatic case study (km) (based on GIS shapefiles)	351	47	753

Country	Italy	Slovenia	Croatia
Total marine waters of the country (km²) Source: https://water.europa.eu/marine	587,155	214	55,492
Approximate area of marine waters for the North Adriatic case study (km²)	16,670	214	17,770

3.2 Main characteristics of the NAS - maritime activities, impacts and trends

The following section presents a general overview of the main maritime activities taking place in the NAS, based on results from the MedTrends Project report (Randone, 2015), and the PHAROS4MPAs project's reports recommendations on cruise ships and tour boats (Caric et. al., 2019; Petit et. al., 2019).

The strategic geographical location of the NAS connects the core of Europe to the sea, making it a hotspot for **commercial shipping activities** and thus substantial amounts of cargo traffic. The North Adriatic Port Association comprises the major ports of Venice, Trieste, Rijeka and Koper, with the latter having the largest share (Randone et al., 2015). In 2014, one-third of the total cargo handled by Koper Port was for Austria, traditionally Koper's most important market (Luka Koper, 2021). The Mediterranean Sea is the second largest market globally for **cruise shipping**, with the Adriatic being the second most-visited sea in the Mediterranean. Venice port's passenger share of cruise ships was 31.7% in 2016. Other important cruise ports in the NAS are Ancona, Ravenna, Trieste, Rijeka and Zadar. Besides the tourist-oriented cruise sector, the NAS is an important sea passenger traffic hub. Here again, Venice plays a significant role, but the Croatian side also hosts heavy passenger traffic, particularly the ports of Zadar and Rijeka. Impacts of the shipping and maritime transport sectors on the marine environment include marine pollution, oil spills, littering, noise pollution, light pollution, ballast water and transport invasive species and collision with marine mammals/sea turtles, among others.

Adriatic Sea **oil and gas production** represents 9% of the total Mediterranean region (Plan bleu, 2014). In the Northern Adriatic, Italy and Croatia are active in the industry. In Croatia, for example, extraction is carried at Istria height to three hydrocarbon exploitation fields (Izabela, North Adriatic, Marca), with 19 gas excavation voids and one compressor of 51 excavation wells. Annual production is around 1.2 billion m^3 gas (ESA HR, 2019). Impacts on the marine environment from oil production activities result from potential accidents such as spills and leakages, as well as damage to the seafloor from drilling and cable laying, pollution from chemicals, noise, light, and air pollution from rigs.

The **fisheries sector** in the Adriatic is largely composed of small-scale fisheries, on which many national economies (notably Italy and Croatia) rely. Based on numbers from 2014, Italy has the largest fishing fleet in the Adriatic, followed by Croatia. Slovenia's fleet is negligible in comparison. Trends show a decrease in the number of fishing vessels in Italy and an increase in Croatia. Over 80% of the fleet in the Adriatic consists of small vessels (<12 metres), making the role of **small scale/artisanal and recreational fisheries** particularly important. The Adriatic's geomorphological features make it suitable for trawl fisheries and dredgers. Small scale/artisanal fisheries that reach up to 50km from the shore or 200m depth play a key role in

Croatia in particular. Impacts of the fisheries sector on the marine environment stem from trawling activities (which have detrimental impacts on the seabed), overfishing and by-catch (which affect the ecosystem and fish stocks) and ghost nets (which cause injuries and suffocation to several species).

The Adriatic Sea constitutes 3-5% of total Mediterranean production value and Gross Value Added (GVA) of the **aquaculture sector** (Plan bleu, 2014)**.** Italy is by far the largest producer in the NAS, followed by Croatia. Growth in the Adriatic has not been as significant as in other parts of the Mediterranean - most of the western coast hosts shellfish farms, while the eastern coast is more dedicated to fish farms. The NAS area contains both types of farms, concentrated mainly within the Venice lagoon.

Impacts of aquaculture on the marine environment result from infrastructure, such as seabed damage from anchoring. Impacts also stem from operational activities leading to eutrophication and oxygen depletion due to unmanaged effluent discharges. Changes in benthic community structure are linked to overfeeding, in addition to potential transfer of diseases, parasites and non-indigenous species due to unintentional release of farmed organisms into the environment. Finally, marine litter is increased by abandoned cages, for example.

The Adriatic is an important **tourism destination** in the Mediterranean, hosting 6% of the regional tourism in the region, with 9% of international overnight visitors. Over two-thirds of total arrivals are registered in coastal areas. Italy and Croatia together account for 90% of the Adriatic sea's revenue from tourism. The three main categories are coastal tourism, nautical tourism and cruise tourism, and they are highly seasonal, peaking during summer (Plan bleu, 2014). Impacts of tourism on the marine environment include damage to benthic communities from diving and anchoring activities, marine pollution from motorised vessels and solid waste, and wastewater management issues due to seasonal pressures.

Marine mining is still in its exploratory stages in the Adriatic Sea. However, **dredging** is relatively common, especially in the North. Italy is leading in this sector, with dredged material mostly used for beach nourishment of coastal zones affected by erosion. In Slovenia, regular dredging is required to ensure maritime navigability within the Port of Koper. Sand extraction may have several impacts on natural resources and ecosystem services, such as the modification of benthic populations (Simonini et al., 2007), alteration of suspended particles along the water column and potential contaminants in solutions, and morphological modifications of the substrate (SUPREME, 2017).
Mining activities can have impacts for human activities such as fishing, and more generally on activities that rely on high water quality. Climate change and sea level rise will potentially exacerbate coastal erosion, with increased coastal vulnerability to sea flooding, especially during intense storms (SUPREME, 2018).

Military activities related to research, demining, rescue at sea, control of migration and borders, international exercises, and shooting areas are sporadic and mainly involve practice areas for submarines and military shooting, as well as dumping areas. Impacts of military activities on the marine environment come from unexploded ordinances (i.e. from World War II and the Kosovo war) that pollute the marine environment, underwater explosions causing physical damage to habitats such as Posidonia meadows, and noise pollution from sonar that affects marine mammals' orientation abilities.

According to the 2015 MedTrends report on the Adriatic Sea (covering Italian, Croatian and Slovenian waters), most traditional sectors (tourism, shipping, aquaculture, offshore oil and gas extraction, marine mining.) are **expected to grow** (Piante and

Ody, 2015). As fish stocks reveal a low recovery rate, some decreasing trends in the fisheries sector are noted, particularly in Italy. An emerging economic interest relates to the development of renewable energy infrastructure, with new wind farms proposed in the Adriatic.

3.3 Environmental characteristics: status and threats

The Adriatic Sea is a semi-enclosed basin that communicates with the Ionian Sea through the Otranto Strait. Its coastline is characterized by diverse geomorphological features: wetlands, dunes, lagoons, cliffed and rocky coasts, coastal plains, deltas, which make the basin highly heterogeneous. Circulation in the Adriatic Sea is complex and composed of different currents, gyres and jets, which alter their spatial variability with the seasons. The general circulation presents a northerly flow along the eastern coast that drops south along the West coast (reverse clockwise motion), with currents more intense along the eastern shore in winter and along the western shore in summer (Orlic et al., 1992). It is powered by the inflow of fresh water (especially Italy's Po River in the northwest), which causes lower salinity, heat losses, and surplus of water (Coll et al., 2007). Transversal currents are oriented mainly from the eastern to the western coast. Wind and heat have significant impacts on surface waters and can create deep (dense) waters in the Northern Adriatic, which influence the seasonality of the circulation (Artegiani et al., 1997).

Overall, the Adriatic Sea hosts substantial biodiversity and provides a wide range of natural resources of great economic value for people. Several protected areas were established to conserve these key ecosystems on which human rely. The following map illustrates the different types of protected areas within the NAS *(Map under preparation).*

TABLE 3: LIST OF RAMSAR SITES WITHIN THE NAS STUDY AREA

Country	Region	RAMSAR site
Italy	Friuli-Venezia Giulia	Valle Cavanata
		Laguna Di Marano: Foci Dello Stella
	Veneto	Laguna Di Venezia: Valle Averto
	Emilia Romagna	Pialassa Della Baiona E Risega
		Valle Bertuzzi
		Valle Di Gorino
		Sacca Di Bellocchio
		Valli Residue Del Comprensorio Di Comacchio
		Punte Alberete
		Ortazzo E Ortazzino
		Saline Di Cervia
Slovenia	Piran	Secovlje Salt Pans
Croatia	Dalmatia	Vransko Lake

Source: RAMSAR (2021).

Due to its large shelf area, smooth coastal area and gentle sloping bottom, the northern area of the Adriatic Sea is a hotspot for commercially valuable fish and shellfish species. The NAS attracts a wide variety of marine mammals, and its shallow areas and wetlands offer shelter for several species of seabirds. It is also one of the main feeding and wintering areas for three species of sea turtles: green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*) and loggerhead turtle (*Caretta caretta*), which is the only permanent resident of the Adriatic. Its strategic location at the core of Europe made it particularly vulnerable to exploitation by human activities and it has been recognised as one of the marine areas most affected by multiple pressures in the Mediterranean Sea (Gissi et al., 2017).

3.3.1 Italy

The Italian Northern Adriatic coast is relatively low, smooth and regular. Deltas and narrow coastal plains, generally occupied by wetlands and lagoons, define the landscape of the northwestern coastal area. The seabed sediments are predominantly sandy–muddy.

Among the habitats that characterise the northern area of the Italian Adriatic coast, **seagrass meadows** are recognised for their fundamental ecological role as a habitat of nursery, protection and foraging for several marine organisms. This habitat contributes to stabilising and protecting the coastline, as well as being a long-term carbon sink and contributing to the abatement of atmospheric CO_2 (Howard et al., 2018). Two types of **seagrass** are present in the area: *Posidonia oceanica* and *Cymodocea spp.* The Gulf of Trieste represents the northernmost distributional boundary of *Posidonia oceanica* of the Mediterranean Sea. The more extensive meadow of *Posidonia oceanica* is located near Capodistria, on the Slovenian coast of the Gulf of Trieste, while on the Italian side it has been defined as sparse and limited since 1938 (Benacchio, 1938; Simonetti, 1968). At the end of the 1960s, it had strongly reduced. At present, *Posidonia oceanica* along the Italian coast (total area covered around 5 ha) is in a limited area in front of the Grado Lagoon, between 3 m and 4.5 m depth (SUPREME, 2011). These formations do not have Posidonia meadow status because they are isolated and of limited dimensions (Cainer, 1993-94).

Located in the same area, *Cymodocea nodosa* creates dense meadows. Seagrasses require high light levels to provide enough oxygen to their tissues through photosynthesis, and for this reason they are vulnerable to changes in light availability due to changes in sediment loading, eutrophication or epiphyte cover on seagrass leaves (Najdek et al., 2020). Although *Cymodocea nodosa* shows large phenotypic plasticity and capability of adaptation to stressors, it has registered a severe decline during the last few decades in the coastal areas of the Northern Adriatic (Najdek et al., 2020). In Italy, the seagrass areas are subjected to high sedimentation and hydrodynamic conditions that disturb the habitat (SUPREME, 2017). The potential land-based pollution and organic inputs increase the level of stress on the habitat.

Other important benthic habitats are the **rocky outcrops - *tegnùe* or *trezze*** (local calcareous sediments cemented by seeping methane) - widely distributed on the muddy-detritic bottom of the Northern Adriatic between the Po Delta and the Gulf of Trieste. These bioconstructions represent biodiversity hotspots and display great morphological heterogeneity, depending on the environmental conditions and the associated communities (Falace et al., 2015). Indeed, they can present a distance from the coast, ranging between 0.5 km and 21 km and a depth range corresponding to 7-25 m. They are usually associated with reef or coralligenous in habitat classification methods (Habitats Directive, MSFD, and EUNIS classification), but in reality they have peculiar distinguishing characteristics. More than one thousand taxa inhabit these Northern Adriatic sublittoral biogenic outcrops. The main groups are molluscs, coralline algae (e.g. *Peyssonneliaceae*), polychaetes, crustaceans, sponges, and fish. A high variability in the number of species and their coverage has been recorded on the different outcrops. This variability relates to depth and coastal-related processes, such as river inflows, hydrodynamism, and diverse human-derived pressures (Falace et al., 2015). The hydrodynamic connectivity at the base of propagules recruitment processes was recently recognised as an important driver of habitat heterogeneity (Bandelj et al., 2020). These habitats are affected by diverse local stressors, such as fishing, dredging and anchoring, as well as mucilage and dystrophic crisis that can be due to nutrient unbalance events (Falace et al., 2015; Bandelj et al., 2020), driven by both terrestrial run-off and changes in environmental factors. The current state of these bioconstruction is unknown, but with an increase in the intensity of anthropogenic pressures and climate change, their exposure level to multiple stressors could increase in the future.

The **maërl bed** is another specific type of representative calcareous bio-constructed habitat with high ecological importance that is present in the North Adriatic. The maërl is formed by an accumulation of unattached calcareous red algae (*Rhodophyta*) growing in a superficial living layer on sediments within the photic zone (Barberà et al., 2003). The maërl beds are ecologically fragile due to growth rates of approximately 1 mm per year. The Habitats Directive mandates the conservation of two of the main maërl-forming species, *Phymatolithon calcareum* and *Lithothamnion corallioides*. The distribution of this habitat ranges between 9 m and 24 m depth and between Venice and the Grado lagoon, where both fossil and living thalli are present. For both tegnùe and maërl beds the main threats are trawling, artisanal and recreational fishing, anchoring, invasive species, global warming, wastewater discharges, aquaculture, changes in land use, coastal infrastructure construction and urbanisation, recreational activities (e.g. scuba diving), non-indigenous mucilaginous, and filamentous algal aggregates (SUPREME North Adriatic case study, 2018).

The endemic **mollusc species** *Pinna nobilis* (fan mussel) is a priority for conservation under the Habitats Directive. It occurs in coastal areas, between 0.5 m and 60 m depth, principally on soft sediment colonised by seagrass meadows, but also on bare sand, mud, maërl beds, pebbly bottoms or among boulders. Fan mussels usually have a patchy distribution. Diverse stressors affect the species, such as boat anchoring, habitat degradation, trawling, dredging, illegal extraction, coastal construction, sewage discharges, and other pollution factors, global warming, acidification and food-web alterations, and it is now experiencing a mass mortality event and is in severe decline (Öndes et al., 2020).

The Italian area of the case study hosts also diverse <u>pelagic species</u> identified to be of priority for conservation. These include:

- **Cetaceans**: *Tursiops truncatus* (bottlenose dolphin) is present with a numerous population and with a distribution hotspot situated off the Po River Delta (Bonizzoni et al., 2020). Other cetaceans can be encountered in the area, such as the striped dolphin (*Stenella coeruleoalba*), the fin whale (*Balaenoptera physalus*), the sperm whale (*Physeter macrocephalus*), Risso's dolphin (*Grampus griseus*), Cuvier's beaked whale *(Ziphius cavirostris)* and the long-finned pilot whale (*Globicephala melas*). Individuals of these species are rare visitors, however. In the past, individuals of the species *Delphinus delphis*, (short-beaked common dolphin) were also abundant, but the last 40 years saw the species became extinct (Fortuna et al., 2015). Bottlenose dolphins in the area are mainly affected by marine environmental degradation and prey depletion through fishing (particularly bottom trawling), with other pressures being climate change, pollution, drilling, geo-seismic prospecting and maritime traffic (Bonizzoni et al., 2020).
- **Reptiles**: The area is one of the most important Mediterranean feeding grounds of the loggerhead turtle (*Caretta caretta*) (Pulcinella et al., 2019). The loggerhead turtle movements in the Adriatic Sea include adult breeding migration from foraging (e.g. the Po Delta area in spring and summer) to breeding grounds (e.g. Croatian islands) and vice-versa (Casale et al., 2012). Genetic diversity

indexes indicate that the Adriatic Sea area receives individuals mostly from the Greek rookeries, followed by western Turkey, and Crete, Cyprus and eastern Turkey rookeries. This species is highly impacted by bycatch due to mid-water and bottom trawlers in the North Adriatic, especially the nearby Po Delta, which is the main foraging ground in the area, and in the central part of the Northern Adriatic (Pulcinella et al., 2019).

- **Fish**: The Italian North Adriatic has a high density of essential fish habitats (EFH), important spawning grounds for diverse species of great economic value for the entire Adriatic Sea. These are anchovies, pilchards, mullets, sole and pelagic sharks, and invertebrate species (e.g. crustaceans, molluscs). Fish stocks are far from sustainable fishing levels and the target of exploiting stocks at maximum sustainable yield (MSY) by 2020, according to the assessment carried out within the Italian National Triennial Fishing and Aquaculture Programme 2017-2019. For instance, the spawning and recruitment stock biomass of anchovies (*Engraulis encrasicolus*) shows a descending trend, with periodic fluctuations but a constant decrease. The landing trend of sardines (*Sardina pilchardus*) has declined during the last six years. Scarcella et al. (2014) reported overfishing of the common sole (*Solea solea*). The juveniles of this species aggregate inshore along the Italian coast, mostly in the area close to the Po River mouth, while individuals older than one year gradually migrate offshore and adults are concentrated in deepest waters (South West offshore Istria).
- **Cephalopods**: Common cuttlefish (*Sepia officinalis*) mainly aggregate in the Northern Adriatic, accomplishing seasonal migration, spawning in shallow waters between April and July, and laying their eggs on seagrasses and algal canopies (e.g. in the Venice lagoon). After a strong decrease between 2003 and 2013, this species biomass recovered, although it is still below estimated biomass maximum sustainable yields (BMSY).
- **Birds**: The seabird Mediterranean shag (*Phalacrocorax aristotelis desmarestii*) is widely distributed in the Italian coast of the North Adriatic. Their breeding areas are located in Croatia. However, other seabird species breed along the Italian coast. In 2008-2014, wader and seabird nesting pairs were counted along the Veneto and Friuli-Venezia Giulia regions' coastlines. The whole population of these seabird species was found to have increased. Their main nesting habitats are semi-natural (such as fish farms) and man-made sites (dredge islands), saltmarsh islets and the beach zones. The major threats affecting seabirds in the area are coastal erosion, uncontrolled exploitation of beaches for tourism, increasing frequency of saltmarsh submersion by high tides, and strong fluctuations of water levels inside fish farms (Scarton et al., 2018).

3.3.2 Slovenia

The portion of the NAS in Slovenian marine waters lies in the Gulf of Trieste. The Gulf has an average depth of 21 m, reaching a maximum depth of 35 m in its southeastern part. The Slovenian coast primarily has steep slopes and is gradual only between Koper and Ankaran, and Portorož and Sečovlje, at the mouths of the Rižana and Dragonja rivers. Elsewhere, **flysch cliffs, made of sandstone and marl,** are common. The area is heavily affected by meteorological phenomena due to the semi-closed shape of the Gulf and its shallow depth (Raicich et al., 2013). Littoral sediment, littoral rocks and biogenic reefs are unevenly distributed along the Slovenian coast and are covered by angiosperms, algae and cyanobacteria in brackish waters of inlets, shoals, abandoned salt facilities and estuaries. The extension of the habitats is declining due to new constructions along the coastline.

At least 30 km of coastline is covered by **littoral rocks,** which present biocenosis of upper and lower mediolittoral. The biodiversity in this belt is low due to high natural stress, and the associated biocenosis is decreasing due to new constructions along the coastline. Overall, these habitats have been assessed as in a poor state, primarily due to urbanisation of the coast, tourism pressure, changes in water and sedimentation regimes and illegal extraction of species used as fish bait (SUPREME, 2017).

The shallow sublittoral rock and **biogenic reef** with photophilic algae, dominated by species of the brown algae of the genus *Cystoseira* is distributed at a depth range of 1m to 5 m, and with precoralligenous formations (depth from 4 m to 12 m). The precoralligenous is the initial stage of the coralligenous biocoenosis, and in Slovenia, its formations are present in Fiesa and within the Rt Madona Natural Monument. This type of habitat covers approximately 10 km of coastline and has been assessed as being in a good state (SUPREME, 2017). However, key impacts affecting this habitat are fishing, coastal urbanisation and consequent changes in water and sedimentation regimes, and land run-off.

The shallow sublittoral mixed sediments are composed of mud, sand and detritus, and host seagrass meadows of *Cymodocea nodosa*, which forms large meadows wherever there is a sedimentary bottom at a depth ranging from 0.5 m to 10 m, and *Posidonia oceanica*. In the Gulf of Trieste, only one meadow of *Posidonia oceanica* is present, near the road that leads from Žusterna (Koper) towards Izola. According to old records, the **Posidonia meadows** were largely distributed in many areas in the Gulf of Trieste. After the 1960s, there was extensive degradation and today the species covers an area of approximately 0.64 hectares. Recently, a mild spread of this meadow was observed, and the species was assessed as being in a good status. Overall, the status of this habitat is assessed as variable, depending on the area, with main impact sources being anchoring, bottom trawling, sedimentation regime modifications and land-based pollution (SUPREME, 2017).

The Mediterranean **stony coral** *Cladocora caespitosa* occurs in the coastal zone as individual colonies, between 3 m and 8 m depth. Near Rt Ronek, the colonies appear below 14 m of depth in the form of a reef. The distribution of this species is driven by the presence of hard substrata and appropriate hydrographic conditions. It is also influenced by water transparency, as solar light is necessary for endosymbiontic zooxanthellae. Being zooxanthellate, *Cladocora caespitosa* can be affected by bleaching events. The status of the species has not been assessed. Its main pressures derive from fishing (mainly demersal net), anchoring and urbanisation, which increase the rate of sediment resuspension and sedimentation (SUPREME, 2017).

The area also hosts**:**

- Different **fish** species, such as the European anchovy *(Engraulis encrasicolus*), European pilchard *(Sardina pilchardus)* and the common sole (*Solea solea),* which have substantial economic value. They present altered populations due to overfishing (SUPREME, 2017). Overall, bony fish are represented by more than 200 species, including Gobiidae, Blenniidae, Sparidae, Labridae, Serranidae and Mullidae. The highest biodiversity of fish is present in association with *Cystoseira spp* and the rocky bottom. This macroalgae forms the most important habitat for the species of Labridae. Coastal species of fish are impacted by habitat loss due to urbanisation and pollution.
- **Cartilaginous fish -** 34 species of cartilaginous fish have been identified, including 20 sharks and 14 rays. The basking shark (*Cetorhinus maximus*), the grey shark (*Carcharhinus plumbeus*), blackspotted smooth-hound shark (*Mustelus punctulatus*), the pelagic stingray *Pteroplatytrigon violacea*, the bull ray (*Pteromylaeus bovinus*), and the marbled electric ray (*Torpedo marmorata*) have occasionally been recorded. These are species that, worldwide, show a

decline; however, there are no data on their distribution and status in Slovenian waters.

3.3.3 Croatia

The coastline of Croatia includes 1,244 islands, islets and rocks (78 islands, 524 islets, 642 rocks and reefs). The seabed morphology is mainly sedimentary in nature, with deposits of organic and inorganic origin brought by Adriatic-basin streams – Neretva, Cetina, Krka and Zrmanja. Abrasive processes affect the coastline and the seabed is mainly sandy. The infralittoral rocky bottom is present and reaches up to 35 m depth, hosting abundant photophilic algal communities. The most exposed sites in the upper boundary present *Cystoseira* amentacea var. *Spicata* coverage, while below *C. compressa, C. crinitophylla, C. crinita, C. barbata, C. Agardh, C. spinosa,* and C. *foeniculacea* are present. In the upper infralittoral - the habitat mainly affected by anthropogenic sources of contamination - a macroalgal community represented by individuals of the genera *Ulva* and *Enteromorpha* (green algae), *Pterocladia* and *Gigartina* (red algae), and *Dictyota* and *Phylitis* (brown algae) is present. P. *oceanica* and C. *nodosa* meadows distributional range is 5 m to 35 m depth. They develop on sedimentary and solid seabeds.

Most of the area is characterised by very good or good condition of the macroalgal benthic communities. The **Posidonia meadows** have good or very good ecological status, with the exception of isolated sites that are directly influenced by human activities (SUPREME, 2017). Recently, however, a severe decline has been registered in seagrasses in certain coastal areas (Najdek et al., 2020). Key impacts affecting this species in the area are anchoring, changes in oxygen content and concentrations of nutrients, changes in sedimentation regime, changes in granulometric composition, redox potential and nutrient content of sediments (SUPREME, 2017).

The **coralligenous** is widely distributed in the Croatian part of the Adriatic. It is a calcareous bio-construction principally constituted by coralline red algae and develops under stable current, temperature, salinity, and dim light conditions (Ballesteros, 2006). It is considered a key habitat because of its role in hosting a high biodiversity and contributing to carbon regulation processes and ocean acidification mitigation (Rastelli et al., 2020; Costanzo et al., 2020). Data scarcity limits the knowledge on its distribution to small areas and up to 70 m depth. The main impacts affecting this habitat are fishing, changes in sedimentation regimes and pollution (marine litter). *Corallium rubrum is* a characteristic coralligenous species, listed in Annex V of the Habitats Directive. It has great economic value and for this reason is commercially exploited. Normally, its distribution range falls between 15 m and 130 m, although deeper records have been reported (up to 180-200 m depth). Although there is no information on its distribution and status, it has significantly decreased in recent decades due to over-harvesting and illegal harvesting.

Among the benthic species of priority for conservation, the fan **mussel** (*Pinna nobilis)* is historically widely distributed along the Croatian coast. However, a recent study carried out at the Nature Park Telašćica and Elaphiti islands reported the species to be experiencing a mass mortality event that has spread from the western Mediterranean to the entire Adriatic Sea (Čižmek et al., 2020). The date mussel (*Litophaga litophaga)* (illegally) and two sponges - *Spongia officinalis* and *Spongia lamella* – are both of commercial interest and are harvested.

The presence of submerged features, such as Rogoznica Lake, anhialine speleological features and **sea caves,** in shallow areas deserve to be mentioned. Formations of submerged karst are part of the Croatian heritage, as records of past climatic conditions and sea-level changes. Submerged karst springs, marine lakes, submerged river canyons and strongly karstified submerged areas are reservoirs of biodiversity and have substantial paleo-environmental significance.

Different species present in the area include:

- **Marine mammals**: Diverse marine mammals can occur in Croatian waters, including the Mediterranean monk seal (*Monachus monachus*), bottlenose dolphin (*Tursiops truncatus*), Cuvier's beaked whale (*Ziphius cavirostris*), false killer whale (*Pseudorca crassidens*), fin whale (*Balaenoptera physalus*), Minke whale (*Balaenoptera acutorostrata*), North Atlantic right whale (*Eubalaena glacialis*), northern bottlenose whale (*Hyperoodon ampullatus*), Risso's dolphin (*Grampus griseus*), short-beaked common dolphin (*Delphinus delphis*), sperm whale (*Physeter macrocephalus*) and striped dolphin (*Stenella coeruleoalba*). The bottlenose dolphin is the only permanent marine mammal in the Adriatic Sea, with most individuals observed at a depth of 150-200 m. The status of bottlenose dolphin populations is not fully known, although it is known that their numbers have halved in the second half of the 20th century due to hunting, degradation of habitats and prey overfishing. *Stenella coeruleoalba* is mainly present in the southern Adriatic at depths greater than 200 m. Occasionally, smaller groups appear in the Central and North Adriatic areas. According to the Croatian Red List of Mammals (2006), the Mediterranean monk seal was then considered extinct in Croatia. In recent years, sightings are increasing, however, with regular spotting in different parts of the Adriatic, especially along the eastern coast of Istria and the west coast of Cres and Lošinj. The main sources of impact on this species are bycatch, marine litter and pollution.
- **Fish:** Fish diversity is high, and decreasing northward (Jardas, 1996). According to the Institute of Oceanography and Fisheries[101] the biomass of commercially important species has decreased in recent years, especially in open sea areas, mainly due to excessive fishing effort. The worst situation is in the extraterritorial waters of the Adriatic Sea, where fishing effort is most intense and the most important nursery and spawning areas for a large number of economically important species are located (IZOR, 2012). The largest decrease in abundance was recorded at depths of 50 m to 200 m, where the main fishing areas are located (Jakl, 2015). However, the coastal stocks along the eastern Adriatic are also largely depleted and some areas are in state of overfishing (Kornati, wider area of cities and some islands off the mainland, Malostonski Bay and others) (SUPREME, 2017). The most important small pelagic stocks of commercial value are sardines (*sardina pilchardus*) and anchovies (*engraulis encrasicolus*), while among the demersal species are European hake (*Merluccius Merluccius*), Norway lobster (*Nephrops norvegicus*), common sole *(Solea solea*), red mullet (*Mullus barbatus*) and deepwater rose shrimp (*Parapenaeus longirostris*).
- **Cephalopods**: Curled octopus (*Eledone cirrhosa*) primarily inhabits the middle Adriatic, at depth greater than 100 m, while the musky octopus (*Eledone mmoschata*) generally inhabits the shallow areas. The largest population density is along the western coast of Istria (MZOIP, 2012). According to the Institute of Oceanography and Fisheries, all cephalopod stocks show high fluctuation in biomass and catch (mainly due to the fluctuation in recruitments). Croatia is experiencing an increase in the number of new species, primarily due to aquaculture activities and shipping, and species coming from other Mediterranean subregions. A checklist of introduced species in Croatian waters contains 113 species (15 phytoplankton, 16 zooplankton, 16 macroalgae, 44

[101] http://baltazar.izor.hr/azopub/bindex

zoobenthic, 22 fish species), of which 61 species are alien and 52 introduced (Pečarević et al., 2013).

- **Birds**: In the Croatian part of the Adriatic, there are several important seabird populations, although with a relatively small number. Scopoli's shearwater (*Calonectris diomedea*) nesting areas are the offshore islands of the South Adriatic: Sv. Andrija, Kamnik, Palagruža and several islands of the Lastovo archipelago. This species counts 700-1,250 nesting pairs. These islands are also the breeding sites of the species *Falco eleonorae*, which counts 65-100 nesting pairs. Mediterranean shearwater (*Puffinus yelkouan*) has three breeding sites in Croatia: the Lastovo Archipelago and islands Svetac and Kamnik, and its population counts 300-400 nesting pairs. *Larus audoinii* has an estimated population of 60-70 nesting pairs in the area of the islands of Korčula, Mljet, Lastovo and Pelješac peninsula. The Mediterranean shag population (*Phalacrocorax aristotelis desmaresti*) nests on small islands along the entire Adriatic and numbers 1,600-2,000 nesting pairs. More than 30% of the birds' populations nest in the mid-Adriatic, as part of the ecological network and the Special Protection Area (SPA) in the northern part of the Zadar archipelago. The griffon vulture populations (*Gyps fulvus*) are mainly present in the large northern Adriatic islands. Over the last 15 years, its population has risen, likely due to active protection measures. Nonetheless, marine birds in Croatia are endangered due to the increased pressure of commercial fishing in feeding areas and the impact of invasive organisms (rats) in their nesting areas (SUPREME, 2017).

4. Ecosystem services in the Northern Adriatic Sea

This chapter presents the different ecosystem services supplied by the marine ecosystems of the NAS, combining qualitative, quantitative and monetary information. Where monetary data are not available from the NAS case study area, estimates are provided, based on information available for other marine ecosystems/sea basins.

4.1 Supporting ecosystem services: habitat provisioning and biodiversity

Supporting ecosystem services represent the array of ecological processes and functions that allows the delivery of all such services to humans (MA, 2005; Costanza et al., 2017; Manea et al., 2019). Their consideration is essential to enable sustainable management of marine resources, yet they are rarely considered in conservation planning because of the difficulty in assigning them a monetary value. The North Adriatic is an area of great ecological value because of the high level of multiple supporting ecosystem services it provides (Manea et al., 2019). Unfortunately, it has few sites of conservation and these are scattered and of limited size, mainly belonging to the Natura 2000 network and only partially managed and protected (Claudet et al., 2020). In addition, these protected areas are largely coastal. The exclusion of offshore waters and their limited extension in the marine space means they do not capture all important habitats of priority for conservation (Manea et al., 2020). One new protected offshore area is under development in front of the Italian coast shared between the Veneto and Emilia Romagna regions, in front of the Po River Delta, intended to protect cetaceans, primarily bottlenose dolphins.

Beyond the limited protection tools present in the area, the North Adriatic has been designated an Ecologically or Biologically Significant Area (EBSA) (SCBD, 2021), recognising that it is one of the most productive areas in the entire Mediterranean Sea at several trophic levels, from phytoplankton to fish (Fonda Umani, 1996), and that it houses important biodiversity, unique habitats and several threatened species.

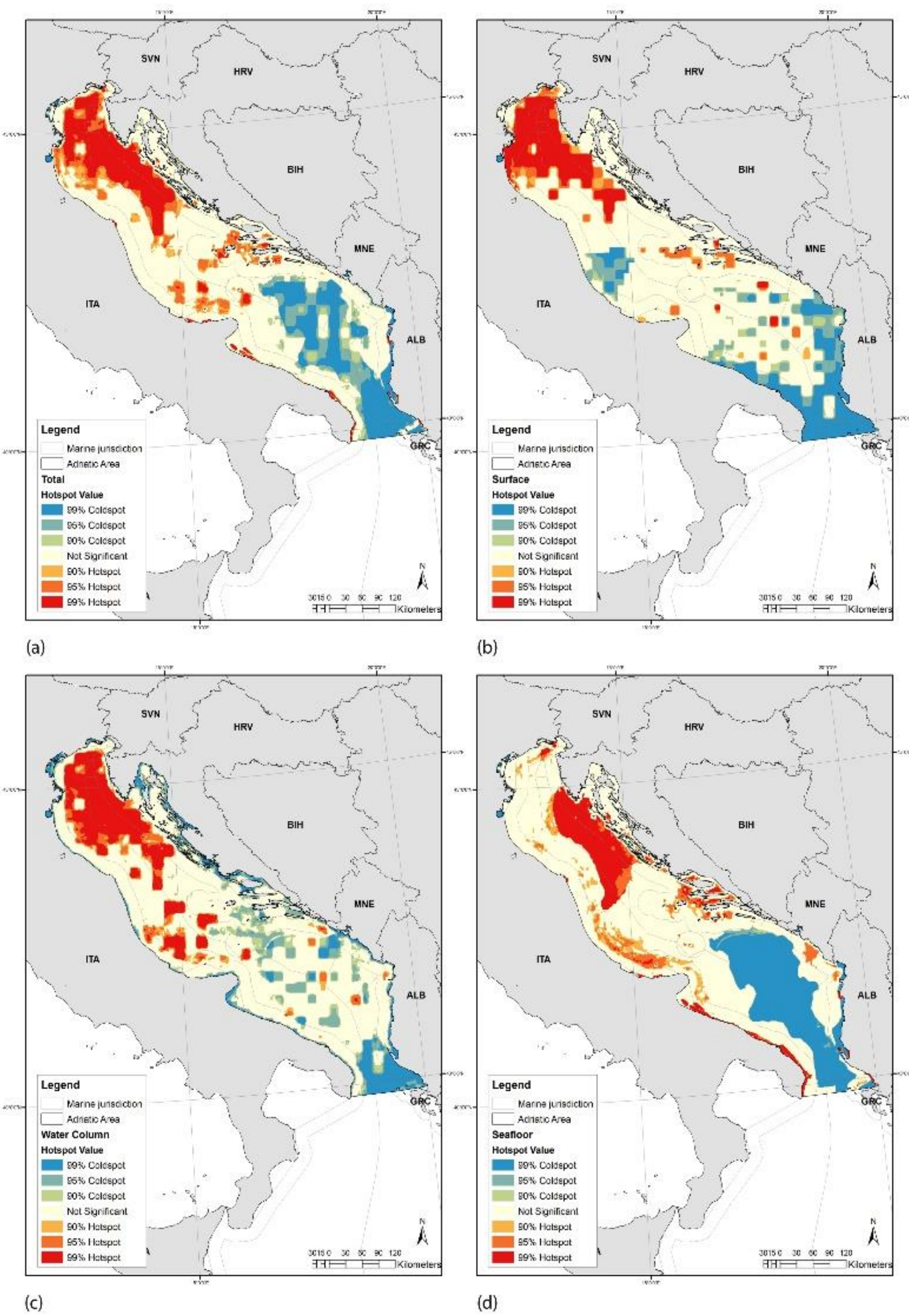
The area includes a diversity of **bottom habitats**: mobile, sandy and muddy, seagrass meadows (including *Posidonia oceanica*, *Cymodocea nodosa*, *Zostera marina* and *Zostera noltii),* **hard bottom** associations (such as coralligenous formations, maërl beds) and **unique rocky outcrops** called 'trezze' and 'tegnùe', which exist only in this marine area. These outcrops in the Northern Adriatic play an extraordinary ecological role because they are the only hard substrates located offshore and able to offer shelter, breeding and feeding sites for numerous fish and invertebrate species (Falace et al., 2015), and is one of the densest populations of bottlenose dolphin (*Tursiops truncatus*) in the Mediterranean. In fact, the Cres-Lošinj Archipelago (Kvarnerić area) hosts a resident sub-population of bottlenose dolphin (Jones et al., 2011), which cross the entire North Adriatic, feeding on its western side (in front of the Po River Delta) (Bonizzoni et al., 2020). This Archipelago is a key area for Mediterranean shags (*Phalacrocorax aristotelis desmarestii*). Large aggregations of shags forage in the area in late summer and autumn, with average counts of 2,000–4,000 individuals (highs of 10,000), exceeding half of the entire breeding population in the Adriatic. This area is also important for the common tern (*Sterna hirundo*), which nests on little islands in the North Adriatic area, and is the most northern natural population of griffon vultures (*Gyps fulvus*) in the Mediterranean (SCBD, 2021). The area is one of the most important feeding grounds in the Mediterranean for the loggerhead turtle (*Caretta caretta*) and is a nursery area for a number of vulnerable species, such as the blue shark (*Prionace glauca*), and the sandbar shark (*Carcharinus plumbeus*), as well as species of great commercial value, such as anchovies (*Engraulis encrasicolus*), sardines (*Sardina pilchardus*) and common sole (*Solea solea*).

Recently, Manea et al. (2019) assessed and mapped the supporting ecosystem services delivery in the Adriatic Sea and identified several suitable indicators for developing the supporting ecosystem services assessment: marine mammals, seabirds, giant devil rays, loggerhead turtles, primary producers, seabed habitats, and areas suitable to provide nursery grounds. Each was assigned the capability of provide diverse supporting ecosystem services, including:

- **Nutrient cycling -** the flow of nutrients in nature that support biodiversity;
- **Biodiversity maintenance** - support key ecosystem processes affecting the maintenance of ecosystem functioning;
- **Habitat provision** - availability and status of habitats that enable the presence of biodiversity.
- **Primary production** - fundamental to supporting marine life in both benthic and pelagic environments, it includes nutrient production of both photosynthetic and chemosynthetic origin.

The North Adriatic was found to be a hotspot of multiple overlapping supporting ecosystem services delivery (Manea et al., 2019). This was particularly true for the marine components (marine mammals, giant devil rays, loggerhead turtles, and primary producers) living in the pelagic habitats of the North Adriatic. When focusing on the seabed habitats, some hotspot areas were found, chiefly aligned with the coralligenous outcrops, trezze and tegnùe, and some areas suitable to host nursery habitats (Figure 2).

FIGURE 2: IDENTIFIED HOTSPOTS (RED AREAS) AND COLD SPOTS (BLUE AREAS)

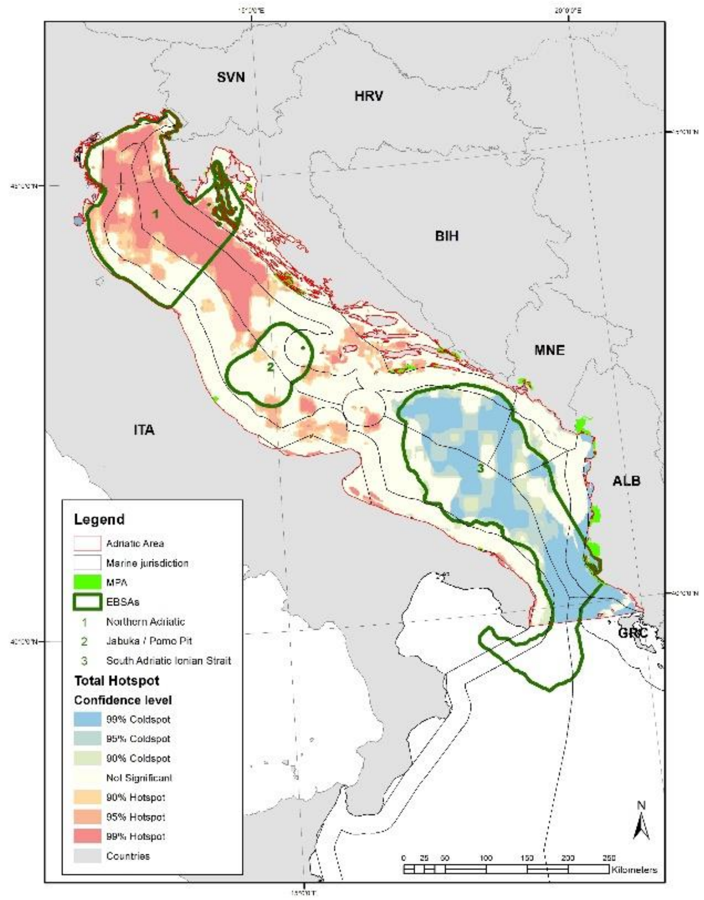


NOTES: (A) TOTAL HOT AND COLD SPOT AREAS NOT DISTINGUISHING THE MARINE DOMAINS; MAP (B) SURFACE HOT AND COLD SPOT AREAS; MAP (C) WATER COLUMN HOT AND COLD SPOT AREAS; MAP (D) SEABED HOT AND COLD SPOT AREAS.

SOURCE: MANEA ET AL. (2019).

The hotspot identified in the North Adriatic overlaps with the North Adriatic EBSA (Figure 3).

FIGURE 3: SPATIAL COINCIDENCE BETWEEN HOT AND COLD SPOT AREAS, NOT DISTINGUISHING THE MARINE DOMAINS, AND MPAS AND EBSAS IN THE STUDY AREA



SOURCE: MANEA ET AL. (2019).

Looking to the threats and pressures impacting the delivery of these supporting ecosystem services in the North Adriatic, all excessive and uncontrolled human activities in the area represent a source of impact. Fishing, coastal and maritime tourism, coastal urbanisation and run-off, land-based and maritime-based pollution, oil and gas exploration/extraction and seismic activities, maritime transport, pipelines and cable installations, are all activities that can deteriorate the coastal and marine environment and have an impact on all marine life (species and habitats). Climate change, global warming and extreme events (e.g. extraordinary high tide events) have already begun to alter the state of the marine environment and its organisms. These multiple stressors together are changing the capacity of delivering supporting ecosystem services in the North Adriatic. Indeed, the North Adriatic has been listed as one of the main impacted areas in the Mediterranean Sea due to anthropogenic activities (Micheli et al., 2013), and its level of naturalness (criterion 7 of the EBSA definition process) was defined as low.

Estimated monetary values of the *Posidonia* meadows' contribution to supporting ecosystem services are presented in Table 4.

Table 4: Ecosystem services considered in the Northern Adriatic case study

	Italy	Slovenia	Croatia
Area of NAS covered by Posidonia meadows in ha (Telascica, 2015)	Negligible	9 ha (2004)	31,437 ha (2010)
Value of supporting ecosystem services provided by Posidonia Oceanica in the Mediterannean (EUR/ha/year) (Campagne et. al., 2015) Considering two supporting ecosystem services	Water purification: 60 EUR/ha/year Fisheries contribution (habitat provisioning): 27-35 EUR/ha/year >> Total contribution: 87-95 EUR/ha/year (2014)		
Total value of supporting ecosystem services provided by Posidonia Oceanica in NAS (approx.) (EUR/year)	Between 2,735,802 and 2,987,370 EUR/year.		
Value of supporting ecosystem services provided by Posidonia Oceanica in the Med (Vasallo et al., 2013) Considering 25 ecosystem services	Between 283 and 513 EUR/ha/year		
Total value of supporting ecosystem services provided by Posidonia Oceanica in NAS (approx.) (EUR/year)	Between 8,899,218 and 16,131,798 EUR/year		

Source: Telascica (2015); Campagne et. al. (2015); Vassallo et al. (2013); Plan Bleu (2014).

This example reveals how important the Croatian ***Posidonia* meadows** are in providing supporting ecosystem services for the entire NAS area, and how important it is to account for all ecosystem services. The value differed dramatically depending on the number of ecosystem services considered. Building on the values presented in Table 4, the total value of supporting ecosystem services provided by *Posidonia Oceanica* in the NAS could **range from EUR 8.9 million to EUR 16.1 million per year.**

4.2 Provisioning ecosystem services

Provisioning ecosystem services refers to the benefits people obtain and extract directly from nature (MA, 2005). Along with food, other services are provided by the marine environment, such as water, sand, salt and energy. The use and subsequent transformation of ecosystems for the purpose of meeting human food needs is something that, historically, has always been done.

The capture and farming of fish and shellfish, both from marine and freshwater environments, contributes significantly to humans' protein supply. In addition, the fishing sector provides important incomes and employment opportunities, as well as aquaculture, which already provides important amounts of fish worldwide and is continuing to grow[102]. The main source of food extracted from the Adriatic Sea as a provisioning service is from pelagic and small pelagic fish species, molluscs, crustaceans and cephalopods captured through fishing (wild capture) or farming in aquaculture facilities. The North Adriatic corresponds to geographical sub-area 17 (GSA17) and it is known as an area where fishing effort greatly exceeds MSY of most species of commercial interest (Bastardie et al., 2017). In generally, professional fishing and harvesting activities are usually located inside the national water limits but also extend into international waters.

The target fish stocks are often shared between Italy, Slovenia and Croatia, creating substantial competition at transboundary level. The state of fish resources is not only linked to fishing effort but also to the quality of the marine environment. Any type of stressors potentially altering environmental conditions can strongly affect the capacity of the marine environment to provide food sources.

In the Adriatic Sea, fish products represent income in respect of both the national market and for export. The following sections will provide an overview of both the wild capture and farmed seafood sectors, the main species of commercial importance, their quantities, value and contributions to the national economy. Each section will be divided by country for readability. A summary table is provided at the end, together with an illustration of the import origin and export destination of seafood products, to help to understand the geographical extent of the ecosystem services.

4.2.1 Food – wild capture

This section presents the key features of the fisheries sector in the three countries, describing: fishing techniques and methods, main target fish species and the status of fish stocks, per capita fish consumption, landing volumes (per region, if relevant, and per species), along with the economic importance of the sector for employment and economic value (potentially disaggregated by region and species).

The fishing sector in the North Adriatic recorded a steady decrease in the period 2010-2015, which has stabilised in recent years. That decreasing trend was in line with trends registered at EU level. Over the coming years, a further reduction in industrial fishing capacity is expected. This means that the provisioning service of seafood directly captured through fishing is severely over-exploited and the capability of this particular marine environment to deliver ecosystem services is decreasing to a worrying degree.

Italy

In Italy, the fisheries sector depends on various **fishing techniques** that target diverse marine species and are distributed differently in the case study area. Bottom otter trawling (OTB), pelagic pair trawl (PTM), Rapido trawl, purse seining and hydraulic dredging are among the main techniques used, especially in GSA17.

Small-scale fishing refers to vessels smaller than 12 m, with the use of set gears. It is characterised by high seasonality, depending on the ecology of the target species. It **is concentrated within 6-7 nautical miles (nm) for all set gears**. The exception is some forms of fishing using gillnets, hydraulic dredging for clams, and purse seining off the coast of Emilia-Romagna and Friuli. This small-scale fishing represents the

[102] http://www.fao.org

most important sector in terms of numbers of fishing vessels, with over 600 units in GSA17 (MIPAAF National Programme Data Collection 2016, North Adriatic case study, SUPREME, 2018). The most commonly fished species are sole, mantis shrimps, turbot (*Scophthalmus maximus*), cuttlefish (*Sepia officinalis*) and sea snails (*Tritia mutabilis*).

Commercial OTB for demersal species is legal off 3 nm and the main targets are mantis shrimp, cuttlefish, and red mullet (MIPAAF National Programme Data Collection 2016, North Adriatic case study, SUPREME, 2018). PTM for small pelagic species is practised off 3 nm from the coast and targets anchovies and sardines. The distribution of both bottom and pelagic trawling effort is diverse in the study area (North Adriatic case study, SUPREME, 2018). OTB covers the whole study area beyond 3 nm, presenting greater intensity between 10 and 14 nm and in international waters.

Rapido trawl has greater intensity outside 6 nm between Venice, Chioggia and the Po River Delta, in the southern part of the Emilia-Romagna coasts and in international waters offshore the Po River Delta. PTM is distributed over the entire study area off 3 nm, with greater intensity between 3 nm and 6 nm in front of the Veneto region and in the southern part of the Emilia Romagna.

The Italian National Triennial Fishing and Aquaculture Programme 2017-2019 confirmed **excessive fishing exploitation** in the Adriatic, although the situation is not homogeneous in all GSAs. In GSA17, the fish species' European hake (*Merluccius merluccius),* red mullet (*Mullus barbatus),* and sole (*Solea solea)* are in a state of overexploitation. The mantis shrimp (*Squilla mantis*) fishing effort has slight exceeded in recent years and is now overexploited too. The small pelagic species', anchovy (*Engraulis encrasicolus*) and European pilchard (*Sardina pilchardus*) are strongly overfished.

Employment in the fisheries sector in Italy in 2017 was estimated at 20,268 (STECF, 2019a). Employment in the fish processing industry in Italy was 4,568 in 2017 (STECF, 2019b).

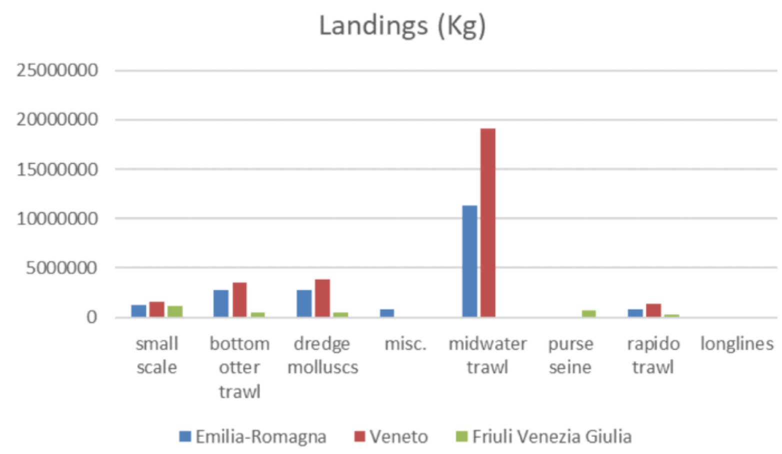
According to Martin (2008), numbers from 2005 revealed that the NAS region (mainly Veneto and Emilia Romagna) accounted for 7% of total employment in fisheries, or around 1,420 employees, in the NAS region. According to Martin (2008), the Veneto region alone accounted for 12% of total employment in the sector, some 550 employees in the NAS region in Italy.

In terms of quantities, the main landed species in Italy in 2012 are anchovies (~22%) sardines (~10%), mussels/clams (~10%) hake (~5%) and deepwater rose shrimp (~5%) (Statista; FAO). In 2018, in the GSA17, Italy landed 1,852 tonnes of European hake, 1,763.2 tonnes of sole, 2,517.1 tonnes of red mullet, 1,476 tonnes of cuttlefish, 3,169 tonnes of mantis shrimp and 835 tonnes of deep-water rose shrimp (STECF, 2019).

Looking at fishing activities and values, the most important fishing in the Italian North Adriatic is the midwater trawl (EUR 38,693,000), followed by OTB (EUR 16,776,000) and dredging for molluscs (EUR 15,200,000) (2016 data, North Adriatic case study, SUPREME, 2017).

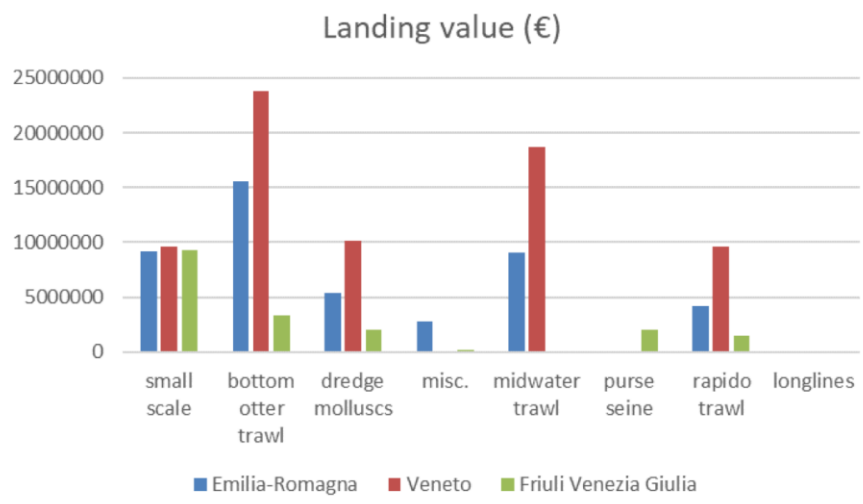
In terms of geographical distribution, the Veneto region presented the highest abundances (kg) and economic incomes value (EUR) in 2016, followed by the Emilia-Romagna and Friuli-Venezia-Giulia regions (EUR 71,997,028.72, EUR 46,259,430.59 and EUR 18,503,741.79, respectively) (Figures 1 and 2, North Adriatic case study, SUPREME, 2018). While in Friuli-Venezia-Giulia, the most productive fishing activity is small-scale fishing (EUR 9,256,614.81), in the other regions, both pelagic and bottom trawling activities (bottom, midwater and rapido) are more productive. In Emilia-Romagna, the biggest income is from the catch of mantis shrimp (EUR 10,545,695), followed by Venus clams (*Chamelea gallina)*, sardine, anchovy and sole. In Veneto, the most important incomes are those from anchovies (EUR 10,969,847), followed by cuttlefish, sole, sardine and Venus clams (*Chamelea gallina)*. In Friuli-Venezia-Giulia, the species that provides the highest revenue is cuttlefish (EUR 2,216,540), followed by gilthead (sea) bream, smooth clam (*Callista chione*), European bass and sole. In terms of value, **hake is still the most valuable species:** at EUR 86.1 million, it accounts for 7.9% of the total value of domestic landings[103].

FIGURE 4: WEIGHT LANDING VALUE OF EACH REGION, BY TYPE OF FISHING ACTIVITY, 2016



SOURCE: NORTH ADRIATIC CASE STUDY, SUPREME (2017).

FIGURE 5: ECONOMIC LANDING VALUE OF EACH REGION, BY TYPE OF FISHING ACTIVITY, 2016.



SOURCE: NORTH ADRIATIC CASE STUDY, SUPREME (2017).

Slovenia

In **Slovenia**, unlike in Italy and Croatia, the fisheries sector is not a leading sector. There are three fishing ports, Koper, Izola and Piran, and the fishing fleet consists

[103] http://www.fao.org/fishery/facp/ITA/en

mostly of vessels of up to 12 m in length (91%), which primarily fish along the coast. In 2018, Slovenia had 134 active fishing vessels. The main targeted species are whiting (*Merlangius merlangus*), musky octopus (*Eledone moschata*), gilthead sea bream (*Sparus aurata*), the common sole, European squid (*Loligo vulgaris*) and European sea bass (*Dicentrarchus labrax)*, which are fished using standing nets (FAO, 2019). The average seafood consumption is 10.8 kg/capita (EUMOFA, 2014).

In 2018, 28 tonnes of whiting, 20 tonnes of musky octopus, 15 tonnes of gilthead sea bream, 10 tonnes of sole, 8 tonnes of European squid, 6 tonnes of red mullet, 4 tonnes of European bass and common Pandora, 1.6 tonnes of cuttlefish, 1 tonne of mantis shrimp and 28 tonnes of other species were landed, with a total landing of 126 tonnes (FAO, 2019; STECF, 2019).

According to the Economic and Social Analysis (ESA) of the MSFD carried out for Slovenia, 171 fishing vessels were registered in 2016 (Ministry of Agriculture, Forestry Food). The production value in 2019 was estimated at EUR 2,016,280 and added value at EUR 547,360. Fish and shellfish processing had a production value of EUR 4,278,004 and an added value of EUR 1,808,688 (ESA SI, 2019). Over the years, there has been a decline in catch landed (SUPREME, 2017), a trend that has also been observed for recreational fishing activity.

In 2017, **employment** in the fisheries sector was 63 (STECF, 2019a), with 130 employed in processing (STECF, 2019b). While these numbers vary according to sources and the nature of the employment (seasonal or full-time equivalent (FTE)), they are nevertheless representative of the importance of the processing industry for the sector.

Croatia

In Croatia, the fisheries sector is an important economic income and participates significantly in the export of food products. A positive foreign trade balance of the sector is maintained. The species of greatest commercial interest are sardines and anchovies, followed by mackerel, European horse mackerel, red mullet and hake. The role of recreational and sport fishing is growing, especially after Croatia's accession to the EU (SUPREME, 2017). In 2019, Croatia counted 7,536 vessels (FAO, 2019).

Estimates of the value of **direct production** from the fishing, fish farming and processing sectors varies between 0.2% and 0.7% of total Gross Domestic Product (GDP). When the value of associated assets is included, the contribution to the national GDP exceeds 1%. In addition, the fisheries sector is significant in the export of Croatia's food products. Approximately **14,000 people** (fishermen, employees in fisheries companies, farming and processing) are **directly employed** in the sector, with a further 11,000 indirectly employed.

The **total landing** in 2016 was 72,003 tonnes, chiefly sardines and anchovies, followed by red mullet and hake (SUPREME, 2017), while in 2017 the total landings decreased to 68,875 tonnes, which included 48,333 tonnes of sardines, 10,880 tonnes of anchovies, 1.981 tonnes of mackerel, 1,000 tonnes of red mullet, 928 tonnes of European hake, 841,5 tonnes of red mullet, 89 tonnes of cuttlefish, 13.1 tonnes of mantis shrimp and 912.49 tonnes of deepwater rose shrimp (FAO, 2019; STECF, 2019).

The average total catch of sea fisheries in the period 2012-2017 were 72,545 tonnes, of which 90.8% were blue fish (sardines, anchovies, tuna, bluefin tuna, horse mackerel and others), 5.5% other fish (hake, red mullet, mullet, common sole, gilthead sea bream and others), 1.7% molluscs (squid, cuttle fish, octopus, muccap and other), 1.1% crustaceans (Norway lobsters, crawfish and others) and 0.9% oysters, mussels and other bivalve molluscs. The biggest single species' were sardines, with a share of almost 75%, and anchovies, at almost 15%.

The average total value of annual catch by **commercial fisheries** during the period 2014-2017 was estimated to be less than HRK 440 million per year, or just below EUR 60 million per year. Parallel annual revenue from fishing activities in the coastal areas exceeded HRK 10 million in 2016 and 2017 (around EUR 1,318,000) (ESA HR, 2019). For **recreational fisheries**, assuming that there are around 10,000 recreational liners (only those previously active in small-scale fishing for their own use) and that each fishes 5 kg of fish per day and catches every third day, the total potential catch volume is 9,000 tonnes per year or around 10% of the volume of catch from commercial fishing (ESA HR, 2019).

In 2017, **employment** in the fisheries sector in Croatia was 1,665 (STECF, 2019a) and in processing it was 1,672 (STECF, 2019b). **Sport fishing** activity has grown in recent years, with over 78,000 permits issued in 2011. Production and trading of vessels, equipment and tools for sport and recreational fisheries provide jobs for over 3,000 people (SUPREME, 2017). In terms of **trade**, fisheries represent 7% of total export of agricultural products. Croatia is a net exporter of fish and seafood products, with about EUR 50 million surplus in 2017. Japan is the most important destination for Croatian tuna, while within the EU, Italy, Slovenia and Spain are the main export destinations for fresh and salted fisheries products. Demersal fish and cephalopods are exported fresh to Italy. Export of fish and seafood in 2017 amounted to EUR 208.1 million and 62,000 tonnes (eurofish (Croatia).

4.2.2 Food – farmed seafood

In addition to the food resources that are directly captured and extracted from the marine environment, the cultivation of fish and shellfish (i.e. aquaculture) represents a key sector in the blue economy scenario in the North Adriatic. While the fishing sector marked a steady decrease between 2010-2015 and many species are suffering from overexploitation, the ecosystem services linked to the food provided by the marine environment and cultivated in **aquaculture** facilities in the North Adriatic is gaining importance.

Italy

In **Italy**, national aquaculture production was 140,846 tonnes in 2013, with a total value of around EUR 393 million, equivalent to 33% of the total seafood sector. Mussel production accounted for 63% in weight and 44% in value (FAO, 2015). The Northern Adriatic, particularly Emilia-Romagna, Veneto and Friuli-Venezia-Giulia are the most productive regions for shellfish and finfish in Italy (MIPAAF, 2015; SUPREME, 2017). The aquaculture in the Emilia-Romagna and Veneto regions is primarily based on shellfish production, while in Friuli-Venezia-Giulia, it centres on finfish production. The Emilia-Romagna and Veneto regions contribute 66% of the national production of shellfish (45.7% and 20.6%, respectively), in particular clams (*Tapes philippinarum)* in transitional waters and Mediterranean mussels (*Mytilus galloprovincialis)* in marine waters. In Emilia-Romagna, production areas are concentrated along the coast, while in Veneto, the mussel farms are located along the coast from Chioggia to Venice, and out of the Po Delta. The mussel farms in Friuli-Venezia-Giulia are mainly located in the Gulf of Trieste. The Emilia-Romagna and Veneto regions represent the highest shellfish production in Italy, particularly for clams (*Tapes philippinarum*) and mussels (*Mytilus galloprovincialis*).

Emilia-Romagna produces 40,000 tonnes/year, followed by Veneto, with 18,000 tonnes/year, of shellfish. In Veneto, the production of mussels in the Po Delta accounts for almost 88% of the regional total. Friuli-Venezia-Giulia is mainly based on finfish aquaculture (trout farming), with an average of 14,000 tonnes produced per year, or 26% of national production. This region also produces 4,000 tonnes/year of shellfish (2013 data from MIPAAF, 2015; North Adriatic case study, SUPREME, 2018). In 2015, 16 companies and 42 employees were involved in mussel farming in Trieste.

The **occupational trend** in aquaculture in Italy showed an increase between 2002 and 2011, with 79% in the shellfish sector, 12% in marine aquaculture and 9% in freshwater (FAO, 2015).

In 2016, **employment** in the aquaculture sector in Italy was 3,289 (STECF, 2018). According to Martin (2008), the Emilia-Romagna region accounted for 25% of employment in aquaculture, while the Veneto region was around 16%. In total, this would amount to around 1,350 employees in the aquaculture sector in the NAS region in Italy. Some statistics reveal that FTEs are only 60% of total employees in the sector, reflecting high seasonality (Eurofish (Italy)).

Despite the growing demand for fish and shellfish products, the Italian side of the study area observed a general **decrease** in production from 2002 to 2015. Indeed, production decreased from more than 180,000 tonnes in 2003 to 140,000 tonnes in 2015. This was due to an intense storm between 5 and 8 February 2015, characterised by waves higher than 7 m that destroyed most of the rows of the longline facilities offshore, causing 10,000 tonnes of product loss. Aquaculture and food provisioning can therefore demonstrably be strongly affected by extreme climate events.

Looking at **future trends** in aquaculture, substantial stability can be expected for clam farming, alongside an increase in mussel farming in the whole area (North Adriatic case study, SUPREME, 2018).

Molluscs, cephalopods, sea bass and sea bream are commonly consumed products. Fresh fish is the most frequently consumed product (84%). This share is significantly higher than the EU average (68%) (Eurofish (Italy)).

Slovenia

In **Slovenia**, the predominantly cultivated organisms are European sea bass (*Dicentrarchus labrax*) and Mediterranean mussels (*Mytilus galloprovincialis).* This activity is dominated by small family-run businesses, with few workers, with an objective limit to growth, given the limited space available for this activity (SUPREME, 2017). In 2016, around 20 persons were **employed** in the aquaculture sector (STECF, 2018).

The annual average aquaculture production in the period between 2005 and 2010 was 213 tonnes of mussels and 37.7 tonnes of sea bass. The sector is expected to grow over time, as it is recognised that the demand for sea products will not be able to be met by fishing. However, the opportunity for production increase is limited by the current size of officially designated mariculture areas (Slovenian case study, SUPREME, 2018).

In terms of species and quantities, the Mediterranean mussel (*Mytilus galloprovincialis*) consitutes around 83% of total mariculture production in Slovenia, while the European sea bass (*Dicentrarchus labrax*) is around 17% of total production (FAO, 2021).

In 2016, the total production value amounted to EUR 4,976,000 (Ministry of Agriculture, Forestry and Food, 2016), and around EUR 3,705,508 in 2019 (ESA SI, 2019).

TABLE 5: EXPORTS AND IMPORTS OF FISH AND FISH PRODUCTS IN SLOVENIA, 2010-2016

Export and import	2010	2011	2012	2013	2014	2015	2016
Exports (net weight in 1,000 kg)	3,166	3,534	3,186	3,251	4,247	3,871	4,789
Imports (net weight in 1,000 kg)	15,845	16,166	14,911	14,718	15,816	15,724	17,285
Exports (EUR 1,000)	13,886	16,061	16,646	17,982	24,082	22,324	26,071
Imports (EUR 1,000)	55,679	64,363	63,501	64,872	69,456	75,249	90,407

Source: SURS (2017), from ESA SI (2019).

In terms of value, the two most valuable species are sole (18.59 EUR/kg, sea bass (14.47 EUR/kg), squid (12.87 EUR/kg) and sea bream (12.78 EUR/kg). These are followed by mullet, which show a radical decrease (4.08 EUR/kg), whiting (3.67 EUR/kg) and musky octopus (3.44 EUR/kg). The species with the lowest value are sardines (1.97 EUR/kg) and anchovies (2.84 EUR/kg). These values represent the purchase price in 2016, based on average on values or quantities of landing in the period 2010-2016 (ZZRS, 2018, in ESA SI, 2019).

TABLE 6: AVERAGE QUANTITIES AND AVERAGE VALUES OF LANDINGS OF SLOVENIAN FISHING VESSELS, BY SPECIES, 2010-2016

Type	Landings (tonnes)		Value of landings (EUR)	
	Average Quantity (tonnes)	Average Share (% of total landings)	Average value (EUR)	Average share (% of total value of landings)
Sardine	129.4	34.1	198,877	13.4
Anchovy	60.8	16.1	124,653	8.4
Whiting	44.2	11.7	140,039	9.4
Musky octopus	18.0	4.8	62,669	4.2
Squid	13.7	3.6	166,200	11.2
Sea bream	13.5	3.6	148,963	10.0
Mullet	13.1	3.5	33,126	2.2
Sole	12.0	3.2	184,067	12.4
Golden grey mullet	7.0	1.8	19,911	1.3
Pandora	6.4	1.7	47,623	3.2
Cuttlefish	6.3	1.7	39,010	2.6
Horse mackerel	4.8	1.3	10,932	0.7
Sprat	4.8	1.3	8,154	0.5
Flounder	4.8	1.3	21,651	1.5
Salps	3.9	1.0	9,615	0.6
Red mullet	3.3	0.9	11,636	0.8
Sea bass	3.1	0.8	49,934	3.4
Mackerel	2.4	0.6	16,337	1.1
Sea bream	2.0	0.5	4,713	0.3
Mantis shrimp	2.0	0.5	12,138	0.8

Type	Landings (tonnes)		Value of landings (EUR)	
	Average Quantity (tonnes)	Average Share (% of total landings)	Average value (EUR)	Average share (% of total value of landings)
Other species	23.5	6.2	174,089	11.7
Total landings	**379.0**	**100**	**1,484,339**	**100**

Source: SURS (2017), from ESA SI (2019).

Croatia

In **Croatia**, the mariculture industry includes both fish and shellfish farming (SUPREME, 2017). European sea bass *(Dicentrarchus labrax),* gilthead (sea) bream (*Sparus aurata)* and Atlantic bluefin tuna (T*hunnus thynnus)* are the main species bred. Shellfish are mostly produced in the area along Pelješac peninsula near the Mali Ston. There are also some shellfish farms along the west Istrian coast and in Velebit channel, Novigrad sea and the mouth of Krka River. Other areas along the Croatian coastline are devoted to aquaculture, such as Zadar County, Šibenik-Knin County, and the area of Malostonski Bay and Malo More in Dubrovnik-Neretva County. The aquaculture sector is important to Croatia's growing export market. In 2013, there were a total of 148 registered farmers (117 shellfish farmers and 30 fish farmers). The total production in mariculture in 2015 was 12,043 tonnes. Mariculture activities in Croatia are recording steady growth that is likely to last into the future: the share of aquaculture in total fish production in Croatia is only around 20% therefore (especially given limitations on fishing quotas), the development of this sector is very important to supply the fish market (SUPREME, 2017).

Fish consumption in Croatia amounts to 110 EUR/year of fish on average, or 8kg/capita (Soullard and Bencetic, 2016). The total annual income of Croatian aquaculture in the marine environment of the coastal area represented an average of HRK 691 million, or around EUR 91 million. The average annual newly created value was about HRK 200 million (ESA HR, 2019). According to these sources, the defined NAS area accounts for over 90% of total aquaculture production in Croatia.

148 breeders were registered in 2013, with up to a maximum of (117) shellfish farmers, 30 white fish growers, and 4 tuna growers. Production was carried out in 330 locations, 45 for white fish, white fish and shellfish in polyculture at 10 sites, tuna in 14 sites and 4 sites for white fish hatcheries (MP, 2015). Approximately half of this number was employed by Cromaris d.d. (established and operated for processing and sorting fish in Zadar and Istria) (ESA HR, 2019).

Employment in Croatia in aquaculture (in 2016) was 1,625 (STECF, 2018). The annual average total newly created value of the fish/shellfish processing industry over the period 2012-2017 was about HRK 170 million, or around EUR 22 million. A significant trend has been observed towards shifting activities from the narrower coast down to its hinterland (ESA HR, 2019).

4.2.3 Food: summary of fisheries products

Table 6 combines values gathered from multiple sources, including some estimations for the NAS region.

TABLE 7: SUMMARISING THE FISHERIES AND AQUACULTURE SECTORS' ECONOMIC VALUATION IN THE NAS

	Italy	Slovenia	Croatia	NAS (approx.)
Consumption	28.4 kg/capita	11 kg/capita	8kg/capita	~ 15 kg/capita
Import value (2017)	EUR 6,000 million (2017, Trade Data Monitor)	EUR 64.5 million (2017, SURS)	EUR 145.5 million (Eurostat, 2017)	~ EUR 6,210 million
Export value (2017)	EUR 792 million (2017, Trade Data Monitor)	EUR 8.76 million (2017, SURS)	EUR 208.1 million (Eurostat, 2017)	~ EUR 1,008 million
Trade balance (2017)	(-)5,208,000,000	(-)64,336,000	(+)62,600,000	~ (-) EUR 5,210 million
Employment in fisheries in 2017 (FTE)	20,268 >> 1,420 in NAS	63	1,665 >> ~ 1,500 in NAS	~ 2,983
Employment in Aquaculture in 2016 (FTE)	3,289 >> ~ 1,350 in NAS	20	1625 >>~1,465 in NAS	~ 2,835
Employment in processing in 2017 (FTE)	4,568 >> ~ 550 in NAS	130	1,672 >> ~ 1,500 in NAS	~ 2,180
Production value (EUR) fisheries	EUR 951 million (2018) (Statista) >> ~ EUR 220 million in NAS (~23%)	EUR 4,976,000 (2016)	~ EUR 60 million/year (based on 2014-2017 ESA HR)	~ EUR 285 million/year
Production value (EUR) aquaculture	EUR 393 million (2013) >> ~ EUR 250 million in NAS (~65)	EUR 3.98 million (2015, ESA SI)	~ EUR 92 million (2017) (ESA HR, 2019)	~ EUR 346 million/year

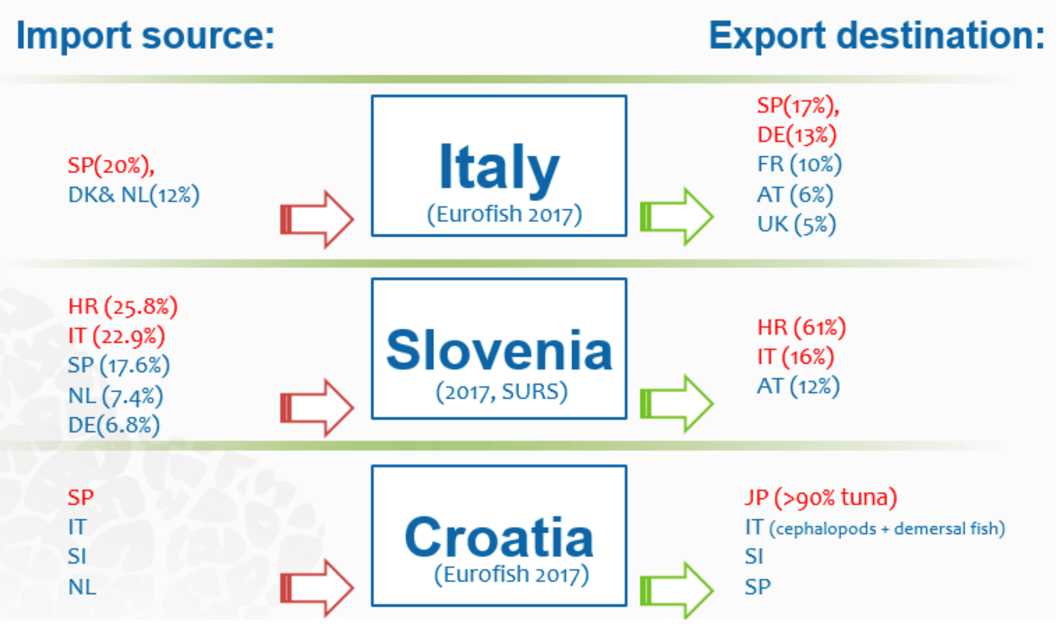
Overall:

- Per capita consumption varies significantly between the three countries and is also reflected in their import/export trade balance (Italy is the largest consumer and the largest importer).
- Italy and Slovenia have a negative trade balance, unlike Croatia, whose exports exceed its imports by over EUR 60 million. However, the general NAS trade remains negative.
- The sector's economic role is highly important in Italy and Croatia, although not in Slovenia. This can be linked to the limited spatial extent of the Slovenian marine waters, thus the limited fishing grounds and fish resources.
- The relative importance of the NAS for the fisheries and aquaculture sectors is primarily evident in Italy. While the NAS part of Italy represents only 3% of its entire marine area and 5% of its coastline, it contributes to around 23% of its national production value, and around 63% of its national aquaculture values.

- The fish processing industry is almost as important as the fisheries sector and the aquaculture sector in both employment and value.
- The **total production value of fisheries** in NAS amounts to around **EUR 285 million per year** (values varied 2014-2017). This can be compared to a total value for the Mediterranean of around EUR 3.2 billion in 2008 (Plan Bleu, 2014), the NAS value representing around 9% of the Mediterranean value.
- The total **production value of aquaculture** in the NAS amounts to **EUR 346 million per year** (values varied 2013-2017) versus around EUR 2.6 billion for the Mediterranean in 2011 (Plan Bleu, 2014). The NAS represents around 13% of the total aquaculture production value of the Mediterranean Sea.

Note: there are gaps and discrepancies in the data collected - some outdated information, some with blurry definition of the values included. For instance, the fish processing industry, which contributes considerably to GVA, is not always or not clearly accounted for in calculations.

FIGURE 6: IMPORT ORIGIN AND EXPORT DESTINATION FOR FISH AND SEAFOOD PRODUCTS IN THE NAS, 2017



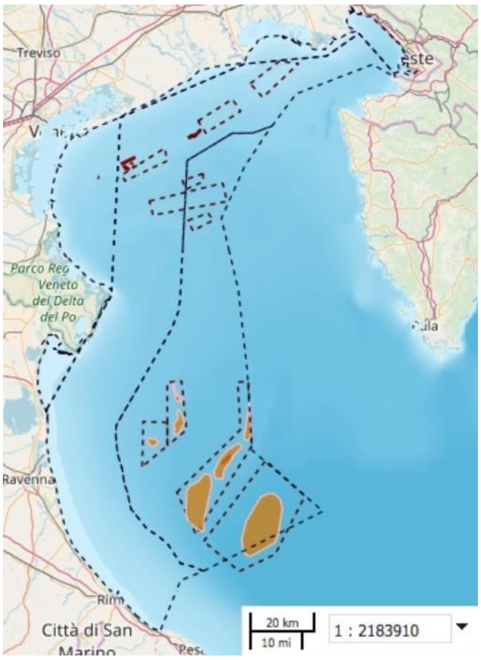
4.2.4 Sand and gravel extraction

In the NAS, **especially along the Italian coast,** there are long stretches of coastline and wide coastal areas under erosion and risk of flooding, particularly in the Emilia-Romagna and Veneto regions (SUPREME, 2017). Beach retreat in the Italian Northern Adriatic sandy beaches is driven by the following factors: a scarcity of natural sediment supply by rivers, natural and anthropogenic subsidence, and strong urbanisation of the coastal zone (Grottoli et al., 2020). Currently, the set of preventive actions includes so-called soft defence works, e.g. interventions realised through the reshaping of sedimentary deposits or the addition of new sediments that may/may not come from the same coastal area (beach nourishments, creation or reconstruction of coastal dunes) (MATTM-Regioni, 2018). The reduction in the use of infrastructure is enabled by the increased use of artificial sand nourishment as an integrated system to protect coasts.

In the recent past, sediment used for nourishment works came mainly from coastal accumulations and dredging activities at ports and river mouths, according to their environmental quality (SUPREME, 2017). Coastal sediment accumulations are mainly used for the so-called ordinary maintenance of beaches and coastal areas. Relict sand deposits dredged offshore are used for extraordinary maintenance, e.g. structural restoration of coasts (ICZM Guidelines, 2005; Barbanti et al., 2017).

In the Northern Adriatic, sands accumulated in these offshore deposits, called **relict sands** (Figure 7), derive from ancient beaches (8,000-11,000 years ago) formed during the marine transgression phase following the last Ice Age, then submerged after the sea-level rise (Simonini et al., 2005; SUPREME, 2018). These deposits are an important strategic resource for **beach nourishment** as their composition is similar to that of current beaches. For instance, analysing the long-term effects of sand extraction on macrozoobenthic communities in an offshore area in the NAS characterised by relict sands in front of Emilia Romagna Region, Simonini et al. (2007) found 'a rapid initial recolonisation phase by the dominant taxa present before dredging, which took place 6–12 months after sand extraction, and a slower recovery phase, that ended 30 months after the operations, when the composition and structure of the communities were similar in the dredged and reference areas' (p. 574) (SUPREME, 2017).

FIGURE 7: RELICT SAND DEPOSITS OF VENETO REGION (IN BROWN) AND OF EMILIA ROMAGNA REGION (IN ORANGE), AND POTENTIAL REQUESTS OF CONCESSIONS FOR EXTRACTION (HATCHED AREAS)



Source: SUPREME (2017).

In **Italy**, due to the nature of the coast of the North Adriatic (which presents a morphology largely characterised by sandy beaches with minor slope), sand deposits have been assessed to quantify the potential availability of sand to manage the effects of ongoing erosion. The volume of dredged sand in the NAS in the period 1997-2017 amounted to 10,511,005 m^3 (Annex II). The National Guidelines on Coastal Defence identified the origin and destination sites of dredged sediment (Annex III), representing the flow of the provisioning service related to sand extraction.

- Several compatible sand deposits have been detected in the Italian Northern Adriatic (SUPREME, 2017). Regional Decree 505 of 28 December 2017 authorised the dredging of 7,600,000 m3 from the RV_H[104] sand deposit[105].
- **Beach nourishment** has taken place in Emilia Romagna and Veneto. About 8.3 million m3 of sand taken from offshore deposits have been used for beach accretion (Consorzio Venezia Nuova, 2000; Correggiari et al., 1996a, in Correggiari et. al., 2002). The costs per cubic metre are particularly low (6 EUR/m3) when the source of borrowed material is from dredging an adjacent estuary or port. For the remainder, the unit costs typically vary between 10 and 20 EUR/m^3 (Valloni and Barsanti, 2007).

In **Slovenia**, there is no extraction of sand and gravel (SUPREME, 2017). However, sand dredging is a regular activity within the Koper Port harbour to facilitate navigation of vessels in and out of the port. Around 80,000 m^3 of muddy sediment is removed annually, with the sediment often reused for port structure and service facilities construction (Randone, 2015).

In **Croatia,** there are very small reserves of fine sand deposits for **sand extraction** from the seabed in the northern part of the territorial waters (SUPREME, 2017). The sand and gravel are used for beach nourishment. Current exploitation of sand and gravel from the seabed is carried out in extraction fields *Crvene stijene* (1.01 ha), *Vidiskala-Zigovac* (0.73 ha), *Krklant* (0.84 ha) and *Samotorac* (0.64 ha), all close to the Island of Rab in Primorje-Gorski Kotar County (data from the Croatian Ministry of Economy, mining sector, 2012, according to the Mining Act, Officiai Gazette 75/09 and 49/11). Extraction is minimal (about 2,000 m3/year) with very low economic profitability (SUPREME, 2017).

Minerals extraction, mainly in coastal areas (sand, clay, gravel, architectural stone) is valued at HRK 200 million/year (2012-2017), or around EUR 23,800,000 each year. This revenue is mainly from the construction sector, representing 0.5% of total Croatian Adriatic employment (ESA HR, 2019).

TABLE 8: SUMMARISING SAND AND MINERAL EXTRACTION VALUES IN THE NAS

	Italy	Slovenia	Croatia
Quantities of sand extracted (m^3 per year)	~ 525,550 m^3/year (1997-2017)	80,000 m^3/year	2,000 m^3/year
Average cost of sand extraction and beach nourishment per m^3 (EUR/m^3)	10-20 EUR/m^3 (Valloni and Barsanti, 2007)	N/A	N/A
Average cost of sand extraction and beach nourishment (EUR/year)	~ EUR 5,255,500 – EUR 10,511,000	EUR 800,000 – EUR 1,600,000	EUR 20,000 – EUR 40,000
Total cost of sand extraction for beach nourishment in the NAS (EUR/year)	EUR 6,075,500 – EUR 12,151,000 per year		

104 Spatial reference for the sand deposit RV_H is the following: Vertex (Lat WGS 84, Long WGS 84) A (45.178302, 12.909594), B (B 45.178302, 12.935257), C (45.169151, 12.935231), D (45.169154, 12.909782).

105 https://www.regione.veneto.it/web/ambiente-e-territorio/difesa-dei-litorali

The differences in costs and needs for beach nourishment in the NAS reflect the biophysical nature of the NAS countries (Italy's dominant muddy bottoms and sandy beaches, as opposed to Croatia's rocky outcrops and karstic caves). The estimated **total costs of extraction of sand for beach nourishment** in the NAS range from **EUR 6.1 million to EUR 12.2 million per year**.

4.2.5 Water

The demand for different sources of water supply is especially urgent in the coastal islands of Croatia and in Slovenia. Water supply is a major problem in the Adriatic islands of Croatia, especially during the summer tourism season, and represents a limiting factor to the islands' economic development (Vlahovic and Munda, 2012). Marine water may be a solution to the increasing water demand for drinking or other uses. There are examples of desalinisation plants in the Mediterranean, such as those in Spain (e.g. Capò et al., 2020; Palomar and Losada, 2008). However, desalinisation can cause potential harm to marine coastal ecosystems. The high salinity can affect aquatic plants, altering the rate of germination, growth and photosynthesis (Parihar et al., 2015). For instance, hypersaline water spills reduce the growth of *Posidonia oceanica* (Capò et al., 2020), which provides several ecosystem services.

At present, **Italy** has no programme to construct desalination plants in the Northern Adriatic, though in Veneto and Emilia-Romagna, there are all favorable conditions for developing the production of desalinated water, relieving pressure on traditional sources (SUPREME, 2017).

Abstraction of sea water for human use is regulated in **Slovenia**. Geographically, this activity is distributed along the Slovenian coast (SUPREME, 2017). Abstraction of sea water can be detrimental to both ecosystem services provision and natural ecosystem functioning. However, due to heavily regulated usage of water abstraction in Slovenia, ecosystem level impacts remain negligible. The water is used for a variety of economically profitable sectors (tourism, energy production, technology), thus sea water abstraction is seen as beneficial to human society, supporting jobs and recreational activities (SUPREME, 2017).

Water abstraction is regulated through permits and the granting of rights for the use of sea water, which is under the jurisdiction of the Slovenian Water Agency and monitored by the Environmental Agency of Slovenia. In 2015, 31 permits for the use of sea water were approved (SUPREME, 2017), for four different activities: pool bathing areas, other uses (e.g. fire water), water for production of heat, and water for technological uses. The maximum approved annual extraction is 3,630,544 m^3, with a maximum momentary extraction of 1,266.42 L/s (Table 8). The use of sea water for technological, heat production, and bathing activities is linked to different economic sectors, such as energy production, tourism and industry.

TABLE 9 NUMBER OF WATER ABSTRACTION PERMITS AND USERS FOR FOUR DIFFERENT ACTIVITIES, WITH MAXIMUM YEARLY AND MOMENTARY EXTRACTIONS OF WATER

Activity	No. of water permits	No. of users	Maximum yearly extraction allowed	Maximum momentary extraction allowed
Pool bathing areas	18	13	265,540 m3/leto	339.2 L/s

Activity	No. of water permits	No. of users	Maximum yearly extraction allowed	Maximum momentary extraction allowed
Other uses	3	2	15,964 m3/leto	422.2 L/s
Production of heat	3	2	1,067,000 m3/leto	80 L/s
Technological uses	7	3	2,282,040 m3/leto	425.02 L

Source: SUPREME (2017).

In **Croatia**, Vlahovic and Munda (2008) explained that the **Croatian islands** are 'built predominantly of karstic carbonate rock with the surface hydrographical network poorly developed. In such terrains, due to increasing karstification, major water quantities infiltrate and flow underground. The freshwater systems on the islands are also limited due to the wide, open influence zone of the sea, which causes large freshwater quantities to flow diffusely into the sea' (p. 6211). The zone of explicit saltwater impacts on coastal aquifers covers most of the Istria coast and significant parts of coasts of Croatia in the Northern Adriatic that are part of the Dinaric karst belt (Vlahovic and Munda, 2008; Figure).

Extraction of sea water in **Croatia** is carried out exclusively by desalination processes, and the most developed systems are located on the islands of Mljet and Lastovo (SUPREME, 2017). Both desalination systems work according to the principle of reverse osmotic desalination of water droplets, and the potable water obtained is used as water supply for the island population. The water produced in Lastovo had a very high cost (EUR 2.05 per m^3) (Sambrailo, 2005). Desalinisation technology has been assessed for its capacity to potentially respond to the water supply demand on small and distant islands. Of 66 permanently inhabited Croatian islands, 10 have secured their water supply partially or completely from their own resources (Borovic et al., 2019).

FIGURE 8: GEOGRAPHICAL LOCATION OF THE COASTAL AREAS IN CROATIA IN THE DINARIC KARST BELT CHARACTERISED BY POTENTIAL RISK OF SALTWATER IMPACT ON COASTAL KARSTIC AQUIFERS

Source: Vlahovic and Munda (2008).

Long-term sustainable water supply must be ensured, in light of demand, existing desalination practices, and connection of water supply system to the mainland, as well as water availability in the context of climate change (Borovic et al., 2019). The Silba island of Croatia is considering using solar power to turn sea water into drinking water[106]. A desalinisation system powered by photovoltaics was proposed for Silba in a pre-investment study produced within the PROSEU project, funded by the EU. The small Adriatic island in Croatia is struggling with its external drinking water supply and a solar power plant could be the solution. Excess electricity could then be delivered to the grid or stored.

In general, studies show that over the years, desalination costs in the Mediterranean have decreased to around 0.5 USD/m^3, or around 0.45 EUR/m^3 (Verdier and Viollet, 2015).

TABLE 10: AVERAGE VALUE OF WATER EXTRACTION AND DESALINATION IN THE NAS REGION

	Italy	Slovenia	Croatia
Volume of water extracted from the sea (m^3/year)	N/A	Maximum approved annual extraction is 3,630,544 m^3/year (SUPREME,2017)	N/A
Volume of fresh water produced (m^3/year)	N/A		54,000 m^3/year (Lastovo)

[106] balkangreenenergynews

Cost of water desalination (EUR/m^3) (Verdier and Viollet, 2015)	**Estimated at 0.45 EUR/m^3**		
Average total cost (EUR/year)	N/A	EUR 1,633,745	EUR 24,300

Accounting for the available information, the **value of water extracted from the NAS is at least EUR 1.7 million per year,** estimated on the basis of desalination costs and data on volumes extracted. Despite the absence of comparable numbers, the available data reveal an increased need for water extraction from the sea for both domestic or commercial purposes. In Croatia with many islands, in particular, there is a particular need to ensure access to water for residents. Another issue to be addressed is the adverse effects from brine water discharge in coastal fields or marine ecosystems.

4.2.6 Salt

Of the multiple areas for the extraction of salt previously available in the Northern Adriatic, very few remain. Since prehistoric times, the Northern Adriatic coast was characterised by the presence of saltworks, such as those of Aquilea, Chioggia, Grado, Padua, Venice, Cervia, Comacchio, Cesenatico, and Ravenna[107], facilitated by low clay coasts that naturally lent themselves to receive sea water at high tide and expose it to evaporation in summertime. The Gulf of Trieste and Istria had several smaller and larger pans, such as at Muggia, Koper and Izola, in addition to the Old Piran salt pans at Sečovlje, Lucija and Strunjan (KPSS, 2011).

In **Italy**, the saltworks of Cervia and Comacchio in Emilia-Romagna are the sole remaining witnesses of the practice of salt production, but only the saltworks of Cervia are still active. **The saltworks of Cervia** extend for 827 hectares, in a natural park at the southern gate of the Po Delta Park[108]. The saline of Cervia is made up of over 50 basins, surrounded by a channel of over 16 km, which allows the water of the Adriatic Sea to enter and exit the salt pan. The saltworks are part of a natural population and nesting reserve for many animal and plant species. The saltworks' activities and production are managed by the *Parco della Salina di Cervia* company, established in 2002 by a partnership of local authorities. The company is responsible for environmental and ecological management, cultural and leisure activity enhancement, and for tourism and ecological purposes.

The saltworks of Comacchio is a protected area located in Emilia-Romagna, in the province of Ferrara. It protects about 600 ha of saltworks, which were last used to produce salt in 1984. Due to the high number of bird species, such as the greater flamingo (*Phoenicopterus roseus*) and the black-necked grebe or eared grebe (*Podiceps nigricollis*), the Comacchio saltworks are parts of the Emilia-Romagna Po Delta Regional Park[109].

In **Slovenia**, the Sečovlje and Strunjan saltpans are the only ones in that part of the Adriatic still producing salt and where the traditional method of daily gathering has been preserved. The extraction of salt is carried out in a traditional, sustainable way, developed in the 15th century. Annually, 2,000-4,000 tonnes of salt are produced, with the potential to produce more, should there be higher demand (SUPREME, 2017). Sečovlje and Strunjan saltworks are both protected nationally, as part of landscape parks and under international policies and conventions, including the Ramsar

[107] www.arpae.it
[108] salinadicervia
[109] Salinadicomacchio

Convention, the Birds and Habitats Directives and the Barcelona Convention, and are also part of the Natura 2000 network. The salt extraction activity employed 117 people in eight different companies in 2015 (SUPREME, 2017). The trends between 2002 and 2009 showed a general increase in the value added in products and in numbers of employees, but employment began to decrease from 2012, while the number of companies have grown (SUPREME, 2017).

In **Croatia**, sea salt extraction has developed in three locations: solana Pag, solana Nin and solana Ston (the latter being outside the NAS study area). Salt production is of local and regional economic significance. Considered part of cultural heritage by the government, the saltworks host a series of recreational activities and visits, showcasing the heritage value of traditional activities (ESA HR, 2019). The average annual production is around 19,000 tonnes of salt, of which nearly 18,000 tonnes are from solana Pag production[110]. Only 0.01% of the total number of employees in Croatia are employed in the salt production sector (SUPREME, 2017). Additional sources indicate that total annual production can reach 25,000 tonnes (ESA HR, 2019).

TABLE 11: SALT PRODUCTION ECONOMIC VALUE IN THE NAS REGION

	Italy	Slovenia	Croatia
Employment	N/A	108 FTE (2019) 117 (2015)	0.01% of total employment
Salt production company	Cervia/ Comacchio: Il sale dei Longobardi	Piranske sol/ Secovlje salina	Solana pag
Total production (tonnes)	N/A	2,000–4,000 tonnes (SUPREME, 2017)	solana pag: 19,000 tonnes/year
Approx. market value (EUR/g)	N/A	PiranSelGris: 26 USD/214g; 11 USD/78g; 7 USD/31g Piranske sol: 29 USD/250g; 12 USD/70g; 19 USD/125g.	solana Pag: 8.09 EUR/150g or 10.12 EUR/150g depending on type of salt
Approx. value of 100g (EUR)	According to the various prices available for the three salinas, the price per 100g sold in shops (as souvenirs for tourists) varies between EUR 6 and EUR 10		
Total production value (EUR/year)	NA	~ 12 million EUR/year (ESA SI, 2019)	Around 72 million EUR/year, using the estimates for Slovenia as basis for calculation

In the NAS, salt production is often linked to traditional practices, taking place within natural protected areas such as RAMSAR sites (wetlands, salt marshes, etc.). These sites also offer shelter to several species, therefore their value encompasses several ecosystem services. **Total salt production is 2,000 to 4,000 tonness/year and 18,000 tonnes/year for Slovenia and Croatia**, respectively, with an estimated **sale value of EUR 84 million/year** for the two countries.

[110] Solana Pag dates as far back as 999 CE and produces two-thirds of Croatia's total salt production (link).

4.2.7 Ornamental products

Croatia produces other non-food goods with direct economic value, that are provided and collected from the marine environment (SUPREME, 2017). **Red coral** (*Corallium rubrum)* is collected traditionally on the island of Zlarin in Šibenik. The first records of such activity date from the 13th century. In 2010, the Croatian Tourist Board proclaimed the Adriatic red coral on stone the best souvenir of the year (Elitetravel, 2021). **Sea sponges** are collected traditionally, especially on the island of Krapanj in the Šibenik aquatorium. Sea sponge collection is also carried out in Istria, around Kornati, and in Dubrovnik aquatorium with sea sponge habitats being today endangered as a result of excessive collection.

Red coral is reportedly valued at about USD 1,000 per gramme, compared to between USD 250 and USD 300 five years ago. Scognamiglio also reports that 90% of their clientele is Chinese (Sidell, 2015). Red coral product value can be valued through online shopping platforms for red coral accessories: 10ml bottles of raw branches of red coral USD 15.38, 48 cm necklace USD 65.51, 18 cm bracelet, 10.35 grams, USD 121.79 (ETSY shop).

Both sea sponges and coral hunting are recognised as a tourism product of Croatia, thus can be considered part of the cultural ecosystem services. While the exact value that these products create is not available, Chinese market demand appears to play a major role in the extraction of red coral.

4.3 Regulating ecosystem services

Thanks to the species and habitats they host, ecosystems provide key regulating services that help to maintain GES. These are diverse and, in the marine environment, relate mainly to water quality, local and global climate regulation (e.g. carbon storage, moderation of extreme events, protection from erosion) and biological control to avoid proliferation of pathogens and parasites (MA, 2005).

4.3.1 Nutrient regulation and water quality

River inputs in the North Adriatic basin play a fundamental role in modulating its biogeochemistry. In **Italy**, the Po River is the major source of freshwater and nutrient inputs in the basin, carrying 47 $km^3 yr^{-1}$ of water, $6x10^6$ t yr^{-1} of solid transport, $255x10^3$ t C yr^{-1} of Total Organic Carbon (TOC), and $155x10^3$ t N yr^{-1} of Total Nitrogen (TN) and, together with the Adige and Brenta rivers, contributing to 84% of the river input (Pettine et al., 1998; Cozzi and Giani, 2011). Most of these nutrients come from livestock, agriculture activity, civil and industrial sectors (Trombino et al., 2007).

In **Slovenia**, river run-off mostly originates in the Julian Alps and flows through Isonzo, whereas from **Croatia,** the Mirna River, situated in the Istria Peninsula, is the most important tributary (Knežević, 2003; Comici and Bussani, 2007; Frantar, 2007; Cozzi and Giani, 2011). They contribute 16% of the total river input in the basin. Such high river inputs support primary production in an area that depends on the precipitation and snow melting regime in the Alps, as well as on the flow of nutrients from the Po River, creating strong seasonality. A variation on primary productivity and an increase in salinity has been observed in the basin due to oscillations of river inputs and run-off in the past (Cozzi and Giani, 2011). Such variations were mainly due to changes in precipitation and their intensity and snow-melt in the mountains, and future projections suggest that such variations will increase with time due to climate change, with important consequences for biogeochemical cycles and nutrient regulation, and for water circulation, not only in the North Adriatic basin but in the whole Adriatic Sea (Cozzi and Giani, 2011). Overall, the main impacts affecting nutrient and freshwater regulation are water usage and climate change (Cozzi and Giani, 2011). Excessive **nutrient inputs** of anthropogenic origin, such as nitrogen, associated with other pressure sources (e.g. climate change) have caused eutrophication phenomena, with consequent hypoxia events (that can cause mass mortality events of marine communities), mucilage and toxic/harmful algal blooms (HAB) in the North Adriatic (Malone and Newton, 2020), greatly affecting the quality of the marine environment and diverse maritime sectors, such as fisheries and tourism.

Microbial activity is fundamental to supporting water quality and nutrient regulation in the North Adriatic, not only in terms of organic matter remineralisation processes, but also for microbes' ability to transform and sequester potentially toxic contaminants from the environment, as heavy metals and polycyclic aromatic hydrocarbons. Indeed, the marine areas affected by higher river flood impact correspond to areas with higher prokaryotic C production rate (Zoppini et al., 2019). River deltas can represent hotspots of nutrient regulation service.

The **lagoons and coastal dunes** are key habitats for regulating water quality (Newton et al., 2018; Drius et al., 2019). Their spatial localisation in the case study area guides the identification of hotspots of this regulating service delivery. The economic value of the water quality service provided by lagoons around EUR 6 million per year for the different lagoons assessed (Newton et al., 2018). This study includes the Italian Grado e Marano and the Venice lagoons in the ecosystem services assessment.

The role of **seagrasses** is relevant to both regulating nutrients in sediment and to supporting good water quality by improving its transparency. Indeed, seagrass roots modify the chemical conditions of the sediment (e.g. promote sulfate reduction, modify redox potential and O_2 concentration) and their canopies and dense meadows can trap substantial amounts of sediment particles and organic matter, enhancing water transparency (Najdek et al., 2020). The mollusc fan mussel (***Pinna nobilis)*** contributes to water clarity, being a filter-feeder organism able to retain large volumes of organic matter from the suspended detritus (Basso et al., 2015).

4.3.2 Coastal protection

In Italy, coastal erosion processes affect the coastline on the Italian side of the NAS (MATTM-Regioni, 2017).

TABLE 12: APPROXIMATE QUANTITIES AND VALUES FOR COASTS NEEDING DEFENCES FROM EROSION PHENOMENA AND THE EFFECTS OF CLIMATE CHANGE

	Surfaces (sq.km)		Coastline (km)		Surface balance (sq.km)
Region	Retreating	Advancing	Retreating	Advancing	
EMILIA-R.	20	6.2	65.6	62.3	-13.8
FRIULI-V.G.	1.1	3.2	32.1	50.5	2.1
MARCHE	3.2	1.9	67.1	60.0	-1.3
VENETO	17.9	7.5	70	80.7	-10.4

Source : Tavolo Nazionale sull'Erosione Costiera MATTM-Regioni con il coordinamento tecnico di ISPRA; Project SUPREME (Campostrini et al., 2017).

Liquete et al. (2013) listed the diverse coastal habitat typologies able to deliver coastal protection service in order of capacity (Table 1) and mapped the capacity of delivering this service, its flow and benefit to European countries. Among the habitats able to deliver this regulating service were **rock, hard substrata or biogenic reefs (e.g. coralligenous), coarse or mixed sediments, shallow sands and seagrass beds**.

For instance, **seagrass meadows** are recognised for their fundamental ecological role as a nursery, protection and foraging habitat for several marine organisms. Seagrasses strongly contribute to stabilising and protecting the coastline, as their canopies and dense meadows are responsible for trapping substantial amounts of sediment, enhancing their stability and contributing to coastal protection from erosion (Ondiviela et al., 2013; Najdek et al., 2020). In addition, seagrasses can generate the 'banquette', accumulations of dead leaves carried by the waves on the coastline that provide protection to the sandy shore.

Lagoons and coastal dunes are key habitats to provide coastal protection (Liquete et al., 2013). Indeed, the vegetation present in these habitats and its root systems act as a stabiliser by retaining coastal sediment (Barbier et al., 2011). In the Italian North Adriatic, most of the dune habitats fall within a Natura 2000 site because of their ecological value. Drius et al. (2019) assessed their capacity to deliver erosion regulation service on the basis of their integrity and typology of vegetation present. This assessment was done for each Natura 2000 site with coastal dunes in Veneto, Friuli-Venezia-Giulia and Emilia-Romagna in the North Adriatic (see Table 2 of Drius et al., 2019).

An economic assessment of coastal erosion in Italy is reported in Table 12 (MATTM-Regioni, 2017; MATTM-Regioni con il coordinamento tecnico di ISPRA; Italy Country Fiche, SUPREME, 2018). These evaluations estimated the cost per km of hard coastal defences, sand replenishment (>20 m) or mixed typology defences.

TABLE 13: COASTLINE LENGTH, BY REGION, FOR POTENTIAL EROSION RISK AND RELATIVE NOURISHMENT NEEDS

Region	Coastline length exposed to erosion potential risk (km)	Economic needs (EUR million)		
		Needs for hard defences (4.5 million EUR/km)	Needs for beach nourishment (20 m broad) (4 million EUR/km)	Average needs (mixed type) (6.5 million EUR/km)
EMILIA-R	28.5	128.25	114	185.25
FRIULI-V-G	11.9	53.55	47.6	77.35
MARCHE	47.7	214.65	190.8	310.05
VENETO	18	81	72	117
TOTAL in Italian NAS	106.1	477.45	424.4	689.65

In summary, in Italy's NAS, the economic needs for coastal erosion protection based on different defence typologies, amounts to around **EUR 1.6 billion**. Protecting ecosystems such as lagoons would help to reduce erosion risk and thus reduce these costs.

In Slovenia, the areas most impacted by coastal erosion are the right bank of the Drnica River (Piran municipality) and the Rižana River (Koper municipality) (Slovenia case study, SUPREME, 2018).

The Croatian coast presents a high risk of erosion events. Its geomorphology is complex, it is mainly karstic and includes small scattered beaches. Longer beaches occur more frequently within flysch zones, spread to a lesser extent along the coast. The erosion events are affecting the beaches due to coastal urbanisation, while nourishment activities and the numerous artificial hard structures are not resolving the situation (Pikelj et al., 2019). At the beginning of the 21st century, coastal development in Croatia was affected by unplanned and expanding construction that strongly affected coastal stability, and Croatian beaches are still the main component of tourist resources (Pikelj et al., 2019). At present, two sites on the Croatian coast have noticeable coastal erosion problems: the island of Susak and an area of Nin town. However, research has shown that the tendency of most of today's strands is 70% erosion (Campostrini et al., 2017).

TABLE 14: APPROXIMATE ECONOMIC VALUE PROVIDED BY *POSIDONIA* MEADOWS' REGULATING ECOSYSTEM SERVICES IN THE NAS

	Italy	Slovenia	Croatia
Area of NAS covered by *Posidonia* meadows (Telascica, 2015)	Negligible	9 ha (2004)	~ 31,437 ha (2010)
Regulating ecosystem service value based on sediment retention services (Vassallo et al., 2013)	1.72 million EUR/ha/year		
Total value	**= ~ 54 x10^9 EUR/year (for a total of 31,446 ha)**		

Croatia's *Posidonia* meadows provide considerable economic value for the entire NAS in relation to protection from erosion. Using available estimates of *Posidonia* retention values and the total areas of NAS covered by *Posidonia* meadows, this service would amount to **EUR 54 billion per year**, a number that requires further scrutiny. This accounts for the retention of sediment, but also other chemicals such as CO_2, nitrogen, phosphorous, that are relevant to climate regulation (see section 4.3.3).

4.3.3 Climate regulation

The **NAS** is one of the main productive shelf areas of the Mediterranean Sea (where high amounts of inorganic carbon are transformed in organic form) and one of its dense water formation and downwelling sites. It contributes significantly to the continental shelf carbon pump process by enhancing the vertical transport of carbon in the deep sea and the sequestration of CO_2 from the atmosphere (Cossarini et al., 2015). Cossarini et al., 2015 estimated that the area is a sink of CO_2 able to capture 0.46 TgC/y and to contribute with an annual flux of approximately 2.9 mmol/m^2/d. The Northern Adriatic corresponds to 0.15% of the Mediterranean Sea surface, and its CO_2 sink rate represents a substantial fraction of the estimated CO_2 sink rate of the whole Mediterranean Sea, which ranges from 0.24 TgC/y (d'Ortenzio et al., 2008) to 4.8 TgC/y (Canu et al., 2015). This CO_2 flux presents high spatial variability, with strong south–north and onshore–offshore gradients. It also presents great seasonality, with highest peaks in winter. This means that climate change-induced warmer winters can highly affect the delivery of this ecosystem service by the NAS. Some of the benthic habitats present in the Northern Adriatic also contribute to carbon sequestration.

Seagrass meadows are recognised as a long-term carbon sink able to contribute to the abatement of atmospheric CO_2 (Howard et al., 2018). Duarte et al. (2017) reported that, of the net primary production of seagrass meadows, at least 5% is buried within the sediment meadows, 30% of which is exported to the deep sea, becoming a long-term carbon stock. The contribution of **lagoons** to carbon sequestration is also relevant: Newton et al. (2018) assessed the mean capacity of coastal lagoons to retain carbon and found an average of $0.32x10^6$ Mg C, an economic contribution of **around EUR 6 million per year**.

4.3.4 Biological control

A recent study demonstrated that high biodiversity systems, such as that represented by **coralligenous**, are fundamental to ensuring higher stability and resilience to climate change and environmental variation by limiting the proliferation of opportunistic species that might parasitise vulnerable organisms (Rastelli et al., 2019). Sites with coralligenous outcrops can be considered able to deliver biological control as a regulating ecosystem service. Biological control is also provided by **coastal lagoons,** with a study on the estimated economic value derived by the delivery of this service finding it to be in the order of some EUR 10 million per year (Newton et. al., 2018).

TABLE 15: ESTIMATED VALUE OF CARBON SEQUESTRATION ECOSYSTEM SERVICES FROM BIOLOGICAL PROCESSES IN THE NAS

	Italy	Slovenia	Croatia
Value of carbon sequestration ecosystem services from all processes (EUR/km²/year)	119.9	230.3	96.1
Value of carbon sequestration ecosystem services from biological processes (EUR/km²/year)	101.7	186.2	73.7
Approx. NAS marine area (km²)	16670	214	17770
Total value of carbon sequestration from biological processes in NAS (EUR/year)	1.7 million	0.04 million	1.3 million

Source: initial values based on Canu et al. (2015).

These results reveal an economic contribution of NAS biological processes to carbon sequestration of **around EUR 3.04 million per year.**

4.4 Cultural ecosystem services

Cultural ecosystem services are 'the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences' (MA, 2005). In the NAS, the main beneficiaries of cultural ecosystem services are the inhabitants who profit from recreational activities along the coast, as well as tourists and visitors who profit from those same activities, albeit irregularly.

In the NAS, tourism and recreational cultural ecosystem services are provided by a variety of ecosystem functions related to different processes and structures, as well as tourism and recreation activities and facilities. Coastal tourism mainly consists of beach tourism, profiting from the presence of accessible beaches and beach facilities along shorelines with a certain water quality. Maritime tourism mainly consists of motorised boat activities or nautical sports and activities.

The capacity to provide cultural ecosystem services is linked to ecological integrity, particularly the positive effect of biodiversity, which sustains a larger number of recreational activities (Chung et al., 2015; Drius et al., 2018). For instance, there is evidence that biodiversity in the NAS represents a determining factor for diving locations (Ruiz-Frau et al., 2013).

4.4.1 Tourism and recreation

General statistics

The Adriatic Sea is an important coastal tourism destination in the Mediterranean. Italy and Croatia host most of the tourists targeting this region, representing 71% (>40 million arrivals, with over 90 million overnight stays) and 18% (>10 million arrivals, with over 50 million overnight stays), respectively, of the total tourist arrivals (Campostrini et al., 2017).

In Italy, the key natural characteristics that attract coastal and diving tourism are the sandy beaches, dune habitats, and the rocky outcrops distributed along the Northern Adriatic. The Italian Northern Adriatic sandy beaches with main dune habitat types (e.g. beaches with pioneer annual vegetation, herbaceous dune vegetation) are highly visited by tourists, as are those in the Po River Delta (Drius et al., 2019). Diving activities are popular on the rocky outcrops (tegnùe or trezze, local calcareous sediments cemented by seeping methane) widely distributed on the muddy-detritic bottom of the Northern Adriatic between the Po Delta and the Gulf of Trieste. *Posidonia oceanica* and coralligenous assemblages have also been found to provide cultural ecosystem services to divers in the NAS (Zunino et al., 2020).

In 2019, of a total of 118,376,000 overnight stays, around **45% took place within the NAS study area** (Veneto, Friuli-Venezia Giulia, Emilio-Romagna) (Statista, 2021). Drius et al. (2019a) calculated that the important coastal tourism resorts are **Rimini** (1.6 million arrivals per year, Regione Emilia-Romagna, 2016), **Jesolo** (over 1 million arrivals per year, Turismo Venezia, 2018), and **Caorte** (over 600,000 arrivals per year, Turismo Venezia, 2018). Regarding **Venice** municipality, only 5% of total arrivals are connected to beach tourism and recreational boating, according to regional statistics (over 200,000 arrivals per year recorded in the Lido of **Venice,** Turismo Venezia, 2018).

According to the SUPREME initial assessment (Campostrini et al., 2017), the overall tourism sector is characterised by over EUR 170 billion added value, contributing to 11.8% of Italy's GDP and approximately 12.8% of employment, with positive growth prospects over the coming years (Italian Plan of Sustainable Tourism 2017-2022). In fact, Italy is a major attraction for international tourists from the United States (US) and China, and to a lesser extent Germany, France, UK and Austria. Around 60% of foreign tourists choose the NAS as destination (Organisation for Economic Co-operation and Development (OECD), 2019), with the coastal destination's cultural role possibly overtaking the attraction from the sea. Like the Venice Lagoon, its key role resides in its overall cultural value, estimated at **EUR 530 million (2017)** for cultural ecosystem services (Newton et al., 2018).

In **Slovenia and Croatia,** rich underwater flora and fauna make their coasts attractive destinations for diving. More than **60 diving centres** are distributed along the coast and profit from the submerged karst springs, marine lakes, submerged river canyons and strongly karstified submerged areas, which are reservoirs of biodiversity and are of great paleoenvironmental significance[111].

Slovenia has a very short coastline compared to its total boundary (4.3% of its boundary is coastal), yet coastal tourism and recreational activities reflect the existence of accessible beaches. Two nature parks attract visitors throughout the year (Strunjan Nature reserve and Landscape park; Secovlje Salina Nature park, which is also a RAMSAR site) and are known for birdwatching activities and recreational facilities. In 2018, the total number of tourists visiting Slovenia was around 5,933,267, of which 1,350,971 chose the Mediterranean Macro region as a destination (~23%). Overnight stays reached 15,694,705, of which 3,011,243 were in a seaside municipality (~19%). (Slovenian Tourist Board (STO), 2019). In 2016, 8,637 rooms were available in the coastal municipalities (Campostrini et al., 2017). Although the capital city, Ljubljana, is the most popular destination for tourists in Slovenia (1.1 million, or around 30%), Piran is the second most attractive city with 620,000 tourists (16.4%). Coastal tourism in Slovenia is unevenly distributed across the four municipalities, with most of the tourist and recreational activities based on use of the sea. In fact, the coastal destinations of Piran and Izola together constituted around 20% of total tourist destinations (Statista, 2019).

Summer is high season for maritime and coastal tourism: in 2018, seaside municipalities attracted the biggest percentage of domestic tourists in summer (~33.4%), while foreigners preferred the mountains (38.6%) and only about 18.4% choosing the seaside. Piran ranked first in number of overnight stays in summer 2018 (~21%), followed by Ljubljana (~18%). In Slovenia, in 2016, 52% of tourists saw beach tourism as their primary holiday type, the highest preference in Europe[112].

Among the top five countries accounting for overnight stays, three come from the Northern Adriatic (41.7% domestic, 12% Italian, 4.7% Croatian). Other tourists' origins are Germany (~15%), the Netherlands (~10%) Austria (7%) and Czechia (6%) (STO, 2019). The real estate market reveals a preference among Russian and Ukranian real estate buyers to invest in the Adriatic coastline (Fetyukov, 2015). Although coastal tourism in Slovenia is highly seasonal, trends show it is a fast-growing sector (STB, 2017).

Croatia has a coastline of 6,278 km, of which 70.1% is island coastline (there are 1,244 islands off the coast of Croatia). According to the coast length, the indigenous coefficient is 11, making Croatia's coast one of the most rugged in the world (Campostrini et al., 2017). The richness of the Croatian coast is exploited for tourism purposes, with most tourist activities taking place within natural coasts and beaches for beach tourism activities. In fact, the most attractive dive locations in Croatia are underwater cliff faces and reefs, caves, and wrecks of ships and airplanes. In 2011, the number of registered and licensed diving centres exceeded 100, with the largest number in Istria and Kvarner, and in the area of Central Dalmatia (ESA HR, 2019).

111 https://www.iliveunderwater.com/scuba-diving-map

112 https://www.cbi.eu/market-information/tourism/sun-beach-tourism/market-potential

Coastal activities in Croatia are crucial to the national economy: in fact, the four counties considered in the NAS case study together contribute to 19% of GDP. The tourism sector in Croatia is the most vital economic sector, with a revenue contributing to almost 20% of GDP, the highest proportion among all EU countries (ESA HR, 2019). 95% of this tourism activity takes place on the coast, making coastal tourism the most important sector, employing over 6.8% of total tourism employment in 2016 (Campostrini et al., 2017) and attracting over 88% of total tourist arrivals and 96% of overnight stays (ESA HR, 2019). According to Croatia's publication for 2017, there were 17,430,000 tourist arrivals in total. The NAS region attracted 52.5% of tourists (71.2% if Split-Dalmatia is included): Istria 23.5%, Primoje Gorski Katar 16%, Zadar 8.9% and Lika Senj 4.2%. These numbers were also reflected in overnight stays, whereby NAS accounted for 60.6% (79.9% if Split-Dalmatia is included).

The most popular coastal destinations are all in the NAS, reflected in their number of visitors: Rovinj (561,023), Poreč (511,898), Opatija (413,848), Umag (408,213), Medulin (365,547) and Pula (330,950) (2016 data). KRK is the most visited island, while the largest tourist capacity in 2016 was in Istria (294,339 beds), Split-Dalmatia (239,329) and Primorje-Gorski Kotar (194,126) counties.

In **Croatia**, nautical tourism is widespread throughout the Adriatic coast, with a higher concentration in Istria. By region, the greatest turnover in tourism ports came from Zadar (HRK 102.2 million), Šibenik-Knin (HRK 102 million) and Istria (HRK 84.2 million) (ESA HR, 2019). Unlike in Slovenia, the majority of tourists (89%) are foreigners (Republic of Croatia, 2018). The tourism sector has recorded continuous growth since 2010 (Campostrini et al., 2017). The intense **seasonality,** concentrated in July and August, means that coastal tourism in Croatia results in overcrowding and overcapacity of coastal areas, with significant impacts on the same marine resources on which it relies. This seasonality is also leading to challenges in local businesses operation, and to waste management issues (European Commission, 2018).

Tourism activity leads to a higher than average quantity of municipal waste and is thus a significant source of marine litter: tourism constitutes 8% of municipal waste (ESA HR, 2019).

Birdwatching activities are located in Natura 2000 sites along the coast that host species of importance for conservation in coastal wetlands and other transitional environments, such as the Po River Delta, the Venice Lagoon, the Piave River Estuary. In the Italian NAS, there are **11 coastal RAMSAR sites** (RAMSAR (Italy) that host habitats for breeding and passage birds (e.g. Cavanata Valley in Friuli-Venezia-Giulia, Averto Valley in the Venice Lagoon) or that have international importance for several species of nesting, staging and wintering waterbirds (e.g. Marano-Grado Lagoon). The previouisly mentioned parks in Slovenia attract birdwatchers year-round.

Despite the notable presence of marine megafauna in the NAS, such as the diverse marine mammals inhabiting the Italian, Croatian and Slovenian waters, **dolphin watching activities** are still in their infancy, with few activities organised by local non-governmental organisations (NGOs) in collaboration with local tourism operators as educational or awareness-raising activities.
In **Slovenia,** the Morigenos Slovenian Marine Mammal Society has organised so-called

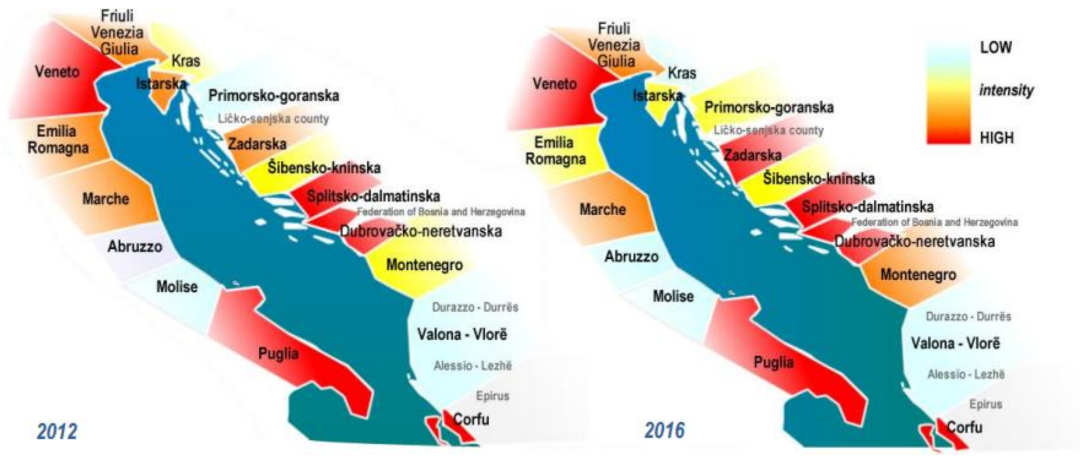
dolphin days[113], while, in **Croatia**, some dolphin watching activities are available in Istria[114].

Looking at **maritime/nautical tourism**, the NAS is a major cruise destination. Venice is the largest cruise ship port in the NAS, with 2,200,328 passengers in 2017, followed by Trieste (121,219), Ravenna, Monfalcone and Chioggia. In Croatia, cruising tourism takes place in Dubrovnik, Split, Zadar, Pula, Opatija, Rijeka, Rovinj and Šibenik, (Campostrini et al., 2017).

Boating, yachting and nautical sports are popular in protected areas characterised by a high natural value and biodiversity, such as high-quality bathing waters and protected areas in Croatia and Slovenia.

There are 253 marinas in Italy's NAS, while there are 81 in Croatia, with over 16,000 moorings at sea (Campostrini et al., 2017). In **Slovenia**, nautical tourism is mainly centered in Izola, which offers 700 quays for vessels up to 45 m long and anchoring sites, and, to a lesser extent, Portorož and Koper. Italy leads the ranking in cruise passenger movement, and Croatia in terms of ferry, hydrofoil and fast catamaran traffic (Adriatic Sea Forum, 2017) The development of nautical tourism is showing extremely positive trends and future growth is expected.

FIGURE 9: MARITIME TOURISM INTENSITY IN THE ADRIATIC REGIONS (CRUISE, FERRY, SAIL AND YACHT TOURISM), 2012 AND 2016



Source: Riposte turrismo (2017).

Mass tourism can exert negative impacts on cultural ecosystem processes and structures because of their significant impacts on water resources and disturbance to wildlife. **Solid waste production** (primarily plastic items and debris), **air and water pollution**, mass **consumption of resources and energy** (mostly accommodation), and **onsite activities and transportation** are other sources of threats to cultural ecosystem services from mass tourism (Plan bleu, 2016). Mazaris et al. (2019) found that in Mediterranean marine Natura 2000 sites, outdoor sports, leisure and recreational activities were the most widespread threats reported by the Member States' national monitoring programmes. Considering that recreational activities can

[113] https://www.morigenos.org/en/

[114] https://www.dolphin-watching.com/

both benefit and harm ecosystems, the **tradeoffs** between benefits and threats should be made explicit as part of the management process (Mazaris et al., 2019).

Another source of threats to cultural ecosystem services from beach tourism in coastal habitats is **urban expansion** and **land use change**, which can produce natural dune habitat loss, and reduce the related cultural ecosystem services supply, as measured by Carranza et al. (2020) in their analysis of multi-temporal land cover maps (1954, 1986, 2006) in the Adriatic (Molise Region). **Coastal erosion** is also a source of threats for beach-based activities (Drius et al., 2018), which are possible because of the presence of sandy beaches and related facilities. Drius et al. (2018) analysed multiple threats to and from coastal tourism in the NAS. Areas with highest pressures from tourism are located in areas with high urbanisation (e.g. Ravenna, Venice, Trieste), while the areas with higher levels of pressures from boating activities are Venice and the Gulf of Trieste (Drius et al., 2018). The Adriatic is one of the top **nautical tourism** destinations in the Mediterranean, with the **pressures** from this sub-sector being significant.

TABLE 16: TOURISM IN THE NAS AND KEY ECONOMIC INDICATORS

	Italy	Slovenia	Croatia
Total tourists/year in the country	89,931 million (2017) (OECD)[115]	5,933,267 (2018) (STB, 2018)[116]	17,430,000 (2017) (Republic of Croatia, 2018)[117]
Total tourists/year in the NAS region	Overnight stays in NAS >> **45%** ***>> ~ 40 million (est.)***	1,350,971 (2018) >> **23%** (STB, 2018)	9,150,075 (2017) >> **52.5%** (Republic of Croatia, 2018)
Total revenue from tourism	USD 51,602 billion (2018) (ceicdata) ~EUR 43 billion	USD 3,377 billion (2018) (ceicdata) ~EUR 2.81 billion	USD 11,917 billion (2018) (ceicdata) ~EUR 9.93 billion
Total revenue from tourism in NAS (approx., based on tourist number/ overnight stays)	Around EUR 19.35 billion (2018)	Around EUR 646.3 million (2018)	Around EUR 4.46 billion (2018)
Key markets	Domestic[118]: ~ 50% **Germany** (13.8%) France (8%) UK (5.4%) **Austria** (4.1%) USA (3.7%) (2017)[119] (OECD)	Domestic: 25% Italy (15.5%) **Austria** (13.3%) **Germany** (10.8%) Croatia (7.1%) Serbia (4.6%) (2017) (STB, 2018)	Domestic: 11% **Germany** (16.7%) **Austria** (8.5%) Slovenia (8.3%) Italy (7.1 %) Poland (5.9 %) (2017) (Republic of Croatia, 2018)

[115] Other sources indicated different values: 123 million arrivals at tourist accommodation (2017) (Istat), 60,523,190 (2017) (Ceicdata). The median value by OECD was selected.

[116] Other sources indicated different values: 3,991,000 (2017, World Bank). The Slovenia Tourism Board figure was retained for consistency.

[117] Other sources indicated much higher values, but were not considered: 59,238,000 (2017, World Bank).

[118] This number is based on the following sources: (Statista>>Domestic) (Statista>>Intl).

[119] Other sources had different values, but OECD values were retained for consistency with the above-mentioned numbers of tourists: Germany (28.2%); France (6.5%); UK (6.3%); US (6%); the Netherlands (5.2% (2017) Statista).

Overall:

- The Italian NAS attracts the largest number of tourists and also brings the biggest revenue. It hosts the largest share of internal/domestic tourism (explained by its vast territory compared to the other two countries).
- The Croatian NAS attracts over 52.5% of total tourist arrivals to Croatia, Italy's northeastern region attracts 45% of total overnight stays, while Slovenia's coasts attract only 23% of the total tourists coming to Slovenia.
- The largest population of tourists visiting all three countries are from Germany and Austria. Other key European markets are France, UK, and Balkan/Central European countries. International (non-EU) tourists are mainly from the US and China.
- If the marine ecosystem in the NAS deteriorates, this would mean the loss of at least two or three major tourist markets that together form a large portion of the region's visitors.
- While Croatia and Slovenia each receive among their top five visitors their two NAS neighbours, Italy attracts higher numbers of tourists from outside the NAS.

4.4.2 Scientific knowledge research and education

When referring to scientific knowledge and educational benefits from the NAS as cultural ecosystem services, the focus is on the scientific knowledge and capabilities environmental spaces and cultural practices deliver or contribute to delivering. Capabilities are defined as 'the role ecological phenomena play in shaping individual and social capacities to understand and do things. For instance, ecological phenomena are used in processes of knowledge acquisition at the level of general intellectual and scientific advancement (such as making sense of biodiversity), but also in patterns of individual development, such as the acquisition of personal skills and knowledge through which people flourish as individuals (such as wisdom, judgement, insight) and advance their situation in life (for example through acquiring gainful employment). The idea of capabilities is therefore about capturing how people and human cultures more generally, equip themselves, through nature to prosper (Fisher et al., 2016).

Scientific research and educational activities are widespread in the NAS area, with several ecosystems, and related processes and structures increasing beneficiaries' capabilities to understand natural processes and engage in natural conservation to support human well-being. The quantification and valuation of cultural ecosystem services related to scientific knowledge and education is challenging, as there is no simple way to assess their importance. NAS ecosystems are intensively studied, with a vast number of research centres and academic institutions, and several permanent and temporary offshore observation facilities. The following examples help to capture the importance of science and education in the NAS, although it is not possible to provide an exhaustive list of all relevant scientific and educational activities:

- Of the 42 rescue centres for marine megafauna in the Mediterranean, six are located in the NAS (Ullmann and Stachowitsch, 2015).
- Six **LIFE-funded projects** concerning *Posedonia oceanica* were funded between 2001 and 2014. The average annual funding from LIFE related to *Posidonia oceanica* is estimated at 0.33 EUR/ha/year between 2001 and 2014 (Campagne et al., 2015). If extrapolated to the NAS, it would mean an average of 10,377

EUR/year for the region. An interesting LIFE project is LIFE VIMINE[120], designed to prevent erosion of valuable salt marshes in the Venice Lagoon via bio-engineering methods, coupled with monitoring and maintenance efforts. The project ran from September 2013 to September 2017, with a total budget of EUR 2,024,295. The LIFE-funded SERESTO project[121] aimed to restore and consolidate the aquatic seagrass ecosystems in the Northern Venice Lagoon, mainly through transplantation activities involving local fishermen and communities. The project ran from January 2014 to April 2018, with a total budget of EUR 1,563,898.

- **ADRI.BLU** promotes a cross-border sustainable process of socioeconomic development for the fisheries sector of the Northern Adriatic area. Partner countries are Italy (Veneto, Fruili-Venezia-Giulia and UNIPROM consortium), Croatia (Istria region and the coastal mountain county), Slovenia (Izola municipality) and Bosnia-Herzegovina (NORFISH, and the Chamber of Commerce of the Federation). The total financial resources allocated to the project are EUR 2,706,707[122].
- Another initiative targeting ecosystems is **Long-Term Ecosystem Research (LTER) Europe,** which aims to better understand ecosystems' functions and structures, as well as their long-term responses to various drivers. These targets are achieved through research and monitoring, and capitalise on research infrastructure (E-LTER). Various national networks have been established in Italy (LTER Italia) and Slovenia (LTER Slovenia). LTER Italia has established 25 research parent sites, of which six are coastal/marine and three are located within the NAS (Northern Adriatic Sea, the Venice Lagoon, Po River Delta). ISMAR is the coordinating institution of LTER Italia. In the context of LTER Italia and the NAS marine ecological observatory, the **EcoNAOS** (Ecological Northern Adriatic Open Science Observatory System) task was developed to test and apply the open science approach (Minelli, 2018).
- The **ECOSS (Ecological Obsersive System in the Adriatic Sea)** project[123]: oceanographic observations for biodiversity contribute to the protection and restoration of biodiversity. ECOSS aims to establish the ECOlogical observing system in the Adriatic Sea (ECOADS[124]). The project duration is from January 2019 to June 2021, and the total budget allocated is EUR **3**.390.551,05.

5. Learning from the willingness to pay survey

Respondents to the survey frequently (>5 times a year) **visit the seaside** to enjoy the scenery and the sounds and smells of the sea, to swim and spend time on the beach (e.g. sunbathing, jogging, cycling). These activities are free and thus are accessible to a large number of inhabitants, irrespective of their level of income. The least popular activities are fishing, hunting, cruising and other water sports (e.g. diving, stand-up paddleboarding, water skiing).

Inhabitants of the three countries are aware of the **current challenges facing their societies** and the environment. All respondents agreed or strongly agreed that the state of their environment, climate change, social issues, health (beyond the COVID-19 pandemic) and economic well-being are key challenges for themselves and for their community. The **state of the environment and health** are the two challenges most

[120] https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=4555
[121] https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=4838
[122] https://keep.eu/projects/3591/Adriatic-Blue-Table-for-a-Su-EN/
[123] https://www.italy-croatia.eu/web/ecoss
[124] https://ecoads.eu/sites/fixoss/

often cited by respondents[125]. A significant majority of respondents 'strongly agree' or 'agree' that the NAS is essential to the development of their country.

The main result of the WTP survey found that **biodiversity, water quality and recreation are elements that matter to the respondents** of the three countries in their choice of scenario[126]. These are elements that have an impact on the probability of choosing the good state option. Looking at the socioeconomic variables, the level of education is significant and positive, i.e. the higher the level of education, the higher the chance of choosing the good health option. Household revenue is also significant and positive, i.e. higher revenue makes people more willing to pay to improve the status of NAS ecosystems). Age, sex and experience do not influence the choice of scenarios.

On average for the three countries, respondents' WTP for healthy marine ecosystems in the NAS is equal to **EUR 54 per household per year (EUR 21 for biodiversity, EUR 23 for water quality, EUR 10 for recreation)[127]**. Accounting for the total population of each country, the total value of the NAS healthy ecosystems is estimated at around **EUR 1 billion annually[128].** Differences were observed between the three countries: inhabitants of Slovenia are willing to invest higher amounts to contribute to improving the environmental status of the NAS, followed by inhabitants from Italy and then Croatia. The latter do not see recreation as an important (and positive) attribute in their choice of scenario. This may be because tourism in Croatia - an important source of income during the summer and a major industry dominating the Croatian service sector and accounting for up to 20% of Croatian GDP[129] - has a large mass tourism component, which might not be well considered (and experienced) by inhabitants from Croatia. Indeed, they see tourists as responsible for pollution, thus they are not willing to pay to solve pollution problems or for additional recreational services[130]. In addition, many Croatian citizens go outside Croatia to enjoy recreational activities. This was reflected in answers to the question 'to which criterion did you attach the least importance', with the majority (28%) of Croatian respondents choosing the option 'Ensure the availability of recreational services'.

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[125] It is unclear how the current COVID-19 crisis affected answers to these questions.

[126] This is evident in P>(Z), which is very close to zero (between 0 and 0.05) or with high statistical significance ('***') for these variables.

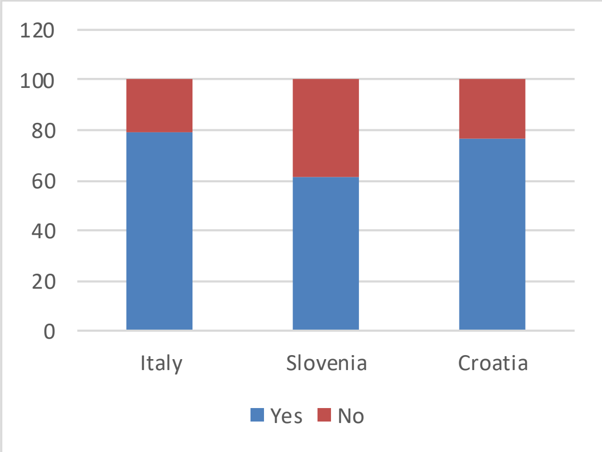
[127] In the Baltic questionnaire, the total WTP was between EUR 105 and EUR 123 per person per year. This is quite an important difference, but is mainly due to the use of different methodologies. Nieminen et al. (2019) designed a contingent valuation where people are asked an open question to reveal their WTP for the achievement of GES of the sea. In the choice modelling, the WTP was obtained for each attribute and people did not have an open question but were offered three financial contributions: 20, 50 and 100.

[128] This estimation is based on the number of persons per household in Italy, Croatia and Slovenia (INSEE, 2019). Croatia has around 2.7 people per household, 2.4 in Slovenia and 2.3 in Italy. The total number of inhabitants in 2019 was: Italy: 59,729,081; Croatia: 4,067,206; Slovenia: 2,088,385 (Eurostat data). This was used to assess the total value, accounting for the share of households willing to pay (73% of the sample) in these three countries and multiply it by 54.

[129] https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en

[130] UNESCO warned that Dubrovnik's world heritage status was at risk due to the significant number of tourists 'in regard to the sustainable carrying capacity of the city'. In 2017, the city introduced a 'Respect the City' plan to limit the number of tourists from cruises visiting the Old Town to 4,000 at any one time (https://www.reuters.com/article/us-croatia-dubrovnik-idUSKBN1KP0BF).

FIGURE 10: IN GENERAL, WOULD YOU BE WILLING TO PAY FOR THE IMPLEMENTATION OF ADDITIONAL MEASURES THAT ARE NECESSARY TO ENSURE THE GOOD HEALTH OF THE NAS ECOSYSTEM?



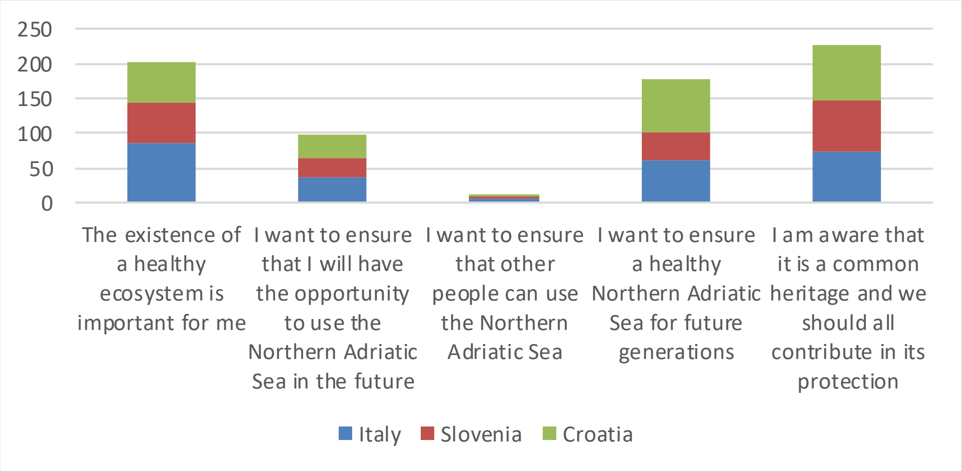
73% of the respondents (similar across the three countries) are willing to pay for the implementation of additional measures for the good health of the NAS[131]. The most common reason for not being willing to pay for an improvement in the NAS ecosystem was that the respondents **do not want to pay an extra charge (30%)** or they believe that **those who pollute and harm the ecosystem should pay more (34%)**. Another result found that **among the individuals who always choose the scenario without restoration (business as usual), 85% justified it by 'I do not believe that the money collected with the tax would actually be used for that purpose'**, a response rate even stronger for Slovenian respondents[132].

The WTP survey found that **water quality and biodiversity are the most important elements for respondents.** Factors that strongly affect the experience of respondents on the NAS or the coast are the presence of litter on the beach (64%) or in the sea (e.g. plastic items, debris) and water pollution (54%). It is therefore understandable that they wish to pay to remove these pollution issues.

[131] A similar study in Finland for the Baltic Sea found that 86% had a positive WTP.

[132] In Slovenia, only 24% of people are satisfied and have confidence in their national government (the average across OECD countries is 45%) (OECD, 2019, https://www.oecd.org/gov/gov-at-a-glance-2019-slovenia.pdf).

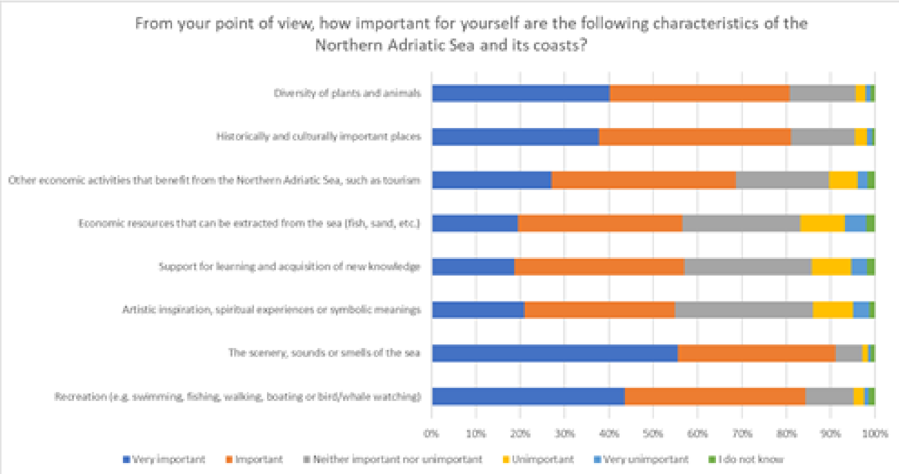
FIGURE 11: WHAT IS THE MOST IMPORTANT REASON FOR YOU TO BE WILLING TO PAY FOR SUPPORTING THE ACHIEVEMENT OF THE GOOD HEALTH OF THE ECOSYSTEM OF THE NORTHERN ADRIATIC SEA?



The existence of a healthy ecosystem is important for respondents (28%), as is the use of the sea (13%). They want to ensure this use for future generation (24%)[133] (Figure 12). This allows for conclusions to be drawn on the existence of both bequest and existence value of this ecosystem.

[133] In the Baltic Sea survey, the most important reason for WTP was that the respondents wanted to ensure a healthy Baltic Sea for future generations (52%). The existence value was also seen as an important reason (35%), whereas altruistic (5%), recreational (4%) and option values (3%) were less important.

FIGURE 12: WHAT ARE THE MOST IMPORTANT CHARACTERISTICS OF THE NAS?



Recreational activities and the scenery, sound and smell of the sea are very important characteristics of the NAS for a vast majority of respondents, at a personal level. The least popular NAS characteristics at the individual scale for respondents (i.e. artistic and spiritual meaning, support for learning and acquisition of new knowledge, economic resources provided by the sea) are all more valued at the community/country scale. The sea also represents a way to reduce stress levels, with a majority of respondents agreeing or strongly agreeing that spending time at the coast or at sea improves their health and reduces their stress level (88% and 87%, respectively).

6. Conclusions

6.1 General synthesis

Table 16 summarises the socioeconomic importance of the ecosystem services provided by the marine ecosystems of the NAS. Those marine ecosystems of NAS are **very diverse:** they **provide benefits to a wide range of economic sectors, professionals and inhabitants**, directly or indirectly, on the NAS coast and other EU countries, including landlocked countries such as Austria.

Some of these ecosystem services directly benefit **local populations** (e.g. small-scale fisheries from the coastal areas of the three riparian countries), while others deliver ecosystem services that benefit **people and economic sectors located outside of the ecological and administrative boundaries of the NAS** (e.g. carbon sequestration).

> *The protection and management of marine ecosystems concerns many stakeholders and parties benefitting from these services, going far beyond (a) traditional maritime sectors that are mobilised in MSP planning processes and (b) political borders.*

The assessment of the monetary value of the benefits provided by NAS ecosystem services built on **a wide range of methods and approaches**. It attempted to provide qualitative, quantitative and monetary values for all services, but monetary values could not be obtained in all cases (e.g. cultural services). For some sectors, such as the tourism sector, the monetary values represent the importance of the sector as a whole rather than assigning a share of the sector's socioeconomic importance specifically to the (health of) NAS marine ecosystems. Many factors drive tourists to the NAS, including man-made facilities and services. Thus, only a portion of the market-based values presented are connected to marine ecosystems *per se*.

> *It is not possible to compare or add the monetary values estimated for different services as these cover different socioeconomic realities and variables (e.g. revenues, gross margin, added value, importance of exports). Figure 13 presents the diversity and (qualitative, quantitative and/or monetary) importance of benefits obtained from ecosystem services: (1) demonstrating that the protection and sustainable management of marine ecosystems are important for many sectors and inhabitants; (2) contributing to the (ocean) literacy of all relevant stakeholders[134]; and (3) providing integrated knowledge facilitating discussions between interested parties.*

[134] Who may be unaware of the importance of services delivered by marine ecosystems to other sectors and interest groups.

TABLE 17: KEY EVIDENCE ILLUSTRATING THE SOCIOECONOMIC IMPORTANCE OF SERVICES DELIVERED BY NAS MARINE AND COASTAL ECOSYSTEMS

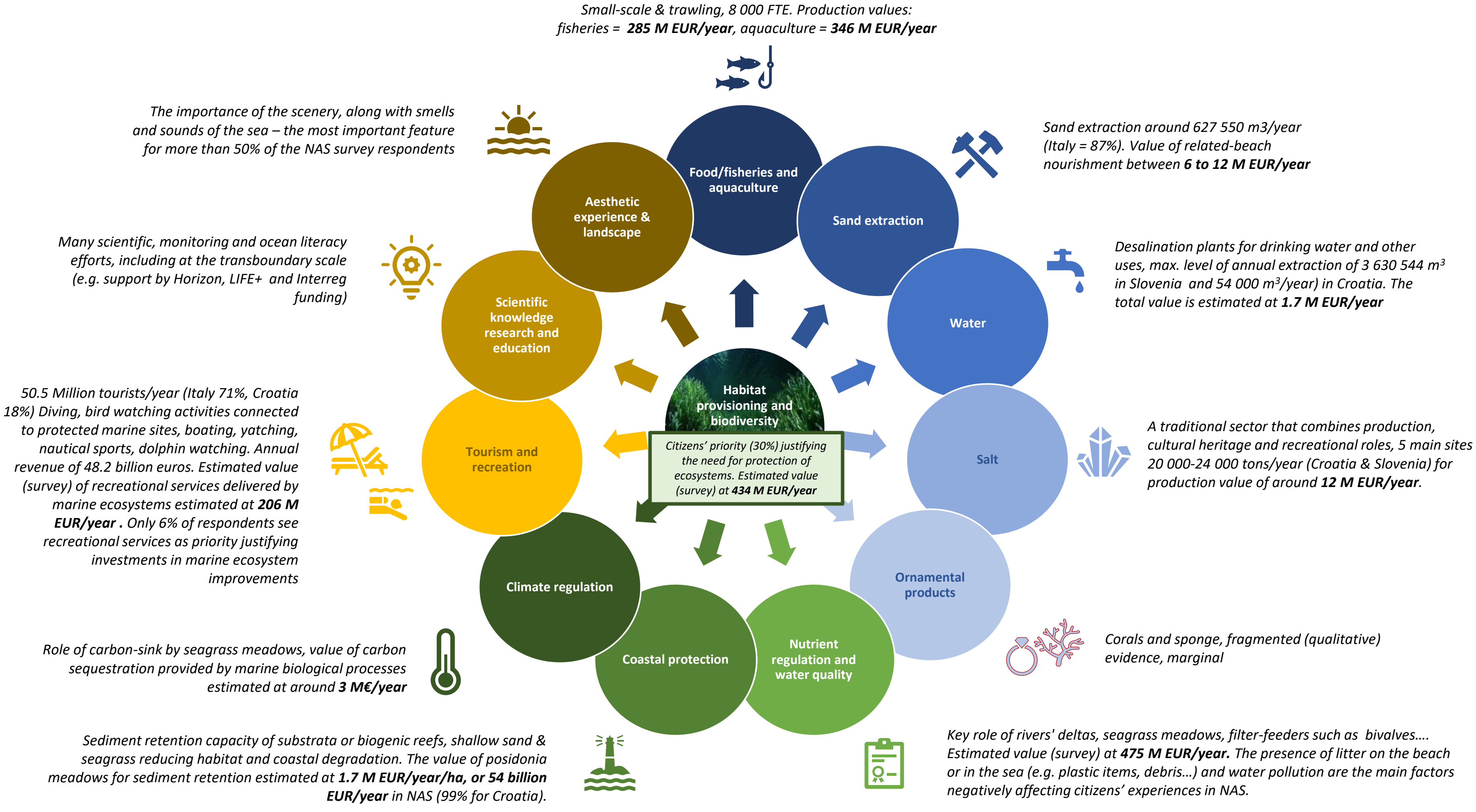
Service category	Service type	Socioeconomic importance of services at the scale of the NAS	Comments
Supporting	Habitat provisioning and biodiversity	Sandy and muddy habitats, seagrass meadows, unique rocky outcrops (trezze and tegnue), pelagic habitats provide nursery and feeding habitats (area with high primary production) for benthic and pelagic species of protection priority and economic value. High biodiversity that provides a great array of ecological functions (e.g. nutrient cycling). The importance of habitats and biodiversity is captured by: • Valuation of **supporting services provided by *Posidonia* meadows** ranging from **EUR 8.9 million/year to EUR 15.9 million/year** (using unit value of EUR 283-513 per ha/year from Vassallo et. Al., 2013), and a total area of meadows around 31,500 ha (most on the Croatian coast); • Biodiversity and the protection of NAS habitats is the **first reason justifying the protection of NAS marine ecosystems,** with 30% of the citizens surveyed defining it as priority; • Respondents to the survey are willing to pay on average **EUR 21 per household/year for biodiversity alone**, (Italy: EUR 21 per household/year; Slovenia: EUR 26 per household/year; Croatia: EUR 15 per household/year). Total aggregated **value for the NAS biodiversity is estimated at EUR 434 per year**.	There is uncertainty about the population size to use to extrapolate survey results to estimate the total value. With respondents from all regions and parts of the three countries, the total country population was used for this extrapolation.
Provisioning	Food/fisheries and aquaculture	**Fisheries** are a leading sector for Italy (the NAS represents 25% of the total national catch) and Croatia, including both small-scale and commercial fishing (small-scale fishery within 6-7 nm, bottom and pelagic trawling beyond 3 nm). It is a source of revenue for the local economy and for export from neighbouring landlocked countries (e.g. Austria) to Japan (tuna). The Slovenian fisheries sector is limited to small-scale fishing along the coast. The main species targeted in the three countries are anchovies, sardines, red mullet, hake and sea bream, with overfishing reported for anchovies, sardines, common sole, hake, red mullet and mantis shrimp. The most valuable species (in value/kg) are sole, sea bass, squid, sea bream and hake. The developing sector of **aquaculture** differs by country, with Italy specialising in shellfish farms (65% of national production), while Slovenia and Croatia (the only country with a positive trade balance for fish and seafood trade) have mainly developed fish farms. While Italy and Croatia's aquaculture is commercial, Slovenia has more small-scale family aquaculture farms. In 2017, **NAS employment** amounted to an estimated 2,983 FTE, 2,935 FTE and 2,180 FTE for the fisheries, aquaculture and seafood processing sectors, or slightly under **8 000 FTE** in total. Production value is **EUR 285 million/year** and **EUR 346 million/year** for the **fisheries** and **aquaculture** sectors, respectively.	With important nurseries and feeding habitats, and as a primary biomass production hotspot, it is likely that ecosystems from the NAS also contribute to fish populations beyond the NAS (and even NAS) limits. However, it was not possible to assess the benefits to fisheries elsewhere in the NAS as a whole, or beyond the NAS in the Mediterranean Sea.
	Sand extraction	Sand extraction (including from deep sea deposits) is used for **beach nourishment** in Italy, limited to port harbour dredging in Slovenia, and is marginal in Croatia. Sand extraction for the Italian part of the	Sand extraction is also used for construction purposes,

Service category	Service type	Socioeconomic importance of services at the scale of the NAS	Comments
		NAS is around 525,550 m^3/year (average for the period 1997-2017), versus around 80,000 m^3/year for Slovenia and 2,000 m^3/year for Croatia. Based on cost figures for beach nourishment from Italy (between EUR 10-20 million/m^3), the total value of sand extraction could range from **EUR 6-12 million/year for the NAS**.	especially in Croatia. Revenue from this activity can compensate for the costs of extraction.
	Water	Water is extracted from the sea to be treated by desalination plants for drinking water and other uses. In **Slovenia**, water abstraction is regulated, with 31 permits along the coast and a maximum level of annual extraction of **3,630,544 m^3**. In Croatia, desalination technologies are under development for water supply to **small islands**, in particular (current use: 54,000 m^3/year in Lastovo islands, for example). The value of water extracted from the NAS is estimated at **EUR 1.7 million/year** using an average unit cost for desalination costs.	It is unclear if the total maximum annual volume permitted is currently used. Thus, part of the total value estimated might represent potential rather than current service value.
	Salt	A **traditional sector** that is well developed in the NAS, salt extraction has significantly decreased in importance in recent decades. Today, it combines **production, cultural heritage and recreational roles**. There is one active saltwork within the Po Delta Park in Italy, two salt pans in Slovenia within natural protected areas, and two main salt extraction locations in Croatia. In Italy, no values or quantities are available. In Slovenia, salt production is estimated at 2,000-4,000 tonnes/year for a total production value of around EUR 12 million/year. In Croatia, 18,000 to 20,000 tonnes are produced annually. Using the Slovenian figures, the total value for the NAS is estimated at **EUR 84 million/year** minimum. Sale prices in shops to tourists vary between EUR 6 and EUR 10 for 100 g, leading to a value of tonne of salt (adequate packaging included) directly sold to tourists at EUR 60,000 to EUR 100,000. However, not all quantities are directly sold to tourists.	In Italy, there are no values or quantities for salt production relevant to the NAS. Thus, the total value for the NAS is likely to be underestimated.
	Ornamental products	There is fragmented (qualitative) evidence on quantities of coral or sponge produced in the NAS. Market prices for one gramme of red coral can be to up to USD 1,000. Red coral is mainly purchased by clientele from China.	Likely to be marginal for the NAS.
Regulating	Nutrient regulation and water quality	Key components of the ecosystem that plays a role in the nutrient regulation ecosystem service include the river delta hotspots, seagrass meadows, filter-feeders such as bivalve P. nobilis along with microbial components that are fundamental to the biogeochemical cycles and sequestration of potential toxic contaminants. The value of the service is estimated from the survey's results, with an average of EUR 23 per household/year (Italy: EUR 27 per household/year; Slovenia: EUR 21 per household/year; Croatia: EUR 20 per household/year. Aggregated at the scale of the NAS, the total value of the service is estimated at **EUR 475 million/year**. The presence of litter on the beach or in the sea (e.g. plastic, debris) and water pollution are the main factors affecting the experience of survey respondents in the NAS coast and marine area.	There is uncertainty about the population size to use to extrapolate survey results to estimate the total value. With respondents from all regions and parts of the three countries, the total country population was used for this extrapolation.

Service category	Service type	Socioeconomic importance of services at the scale of the NAS	Comments
	Coastal protection	Erosion strongly affects the Italian coastline of the NAS. Rock, hard substrata or biogenic reefs, as well as shallow sands, and seagrass beds, have a high capacity to reduce habitat and coastal degradation. In Italy, the high exposure to erosion risk is addressed through hard defences, beach nourishment, or a mixture of both. **Investment costs for addressing erosion risks in Italy are estimated at EUR 1.6 billion**. The potential value of Posidonia meadows for sediment retention that contribute to coastal protection has been estimated at **EUR 1.7 million/year for one hectare of meadows**, or a total of **EUR 54 billion/year** for an area of Posidonia meadows estimated at 31,446 hectares (99% in Croatia).	The total value estimated is likely to consider the retention capacity of Posidonia meadows beyond sediment retention. Thus, there is clear double counting, with values estimated for the retention of CO_2, nitrogen, phosphorous, etc. that are also relevant to water and climate regulation.
	Climate regulation	Seagrass meadows are recognised as long-term carbon sinks able to contribute to the abatement of atmospheric CO_2. The value of carbon sequestration provided by marine biological processes is estimated at around **EUR 3 million/year**.	Carbon sequestration from other components and habitats of the NAS coasts and seas are not considered here. This value is thus clearly underestimated.
Cultural	Tourism and recreation	Beaches and high biodiversity support beach and maritime tourism, with Italy and Croatia hosting 71% and 18%, respectively, of total tourists to the NAS. Diving, birdwatching activities connected to protected Natura 2000 and Ramsar sites, boating, yachting and nautical sports, as well as dolphin watching (in its infancy and mainly in Croatia) are all reported in the NAS. Key figures for the tourism sector in the NAS include: **50.5 million tourists/year**, with non-NAS tourists mainly from Germany and Austria; a total annual revenue of **EUR 48.2 billion** (2018), 90% of which was in Italy. However, only a small part of these economic indicators can be attributed to the coastal and marine ecosystems of the NAS, as many other (man-made) services and factors explain tourists' choices to visit NAS. The value of leisure and tourism services is estimated from the survey, with an average value of EUR 10 per household/year (Italy: EUR 12 per household/year; Slovenia: EUR 14 per household/year; Croatia: EUR 4 per household/year but not statistically significant), or a **total value of EUR 206 million/year for the NAS**. Only 6% of the survey respondents saw the delivery of recreational services as a priority justifying improvements in the state of NAS marine ecosystems. The low and non-significant value for Croatia might result from the mass tourism experienced by the country, which negatively impacts inhabitants (leading municipalities to set quotas for tourists in tourist hotspots like Dubrovnik).	There is uncertainty about the population size to use to extrapolate survey results to estimate the total value. With respondents from all regions and parts of the three countries, the total country population was used for this extrapolation.

Service category	Service type	Socioeconomic importance of services at the scale of the NAS	Comments
	Scientific knowledge research and education	The NAS receives considerable attention from the scientific community, evident in the existing monitoring and research infrastructure, research (including transboundary) projects implemented in the NAS, as well as the many EU-funded innovation and operational projects (e.g. financed by LIFE+ and Interreg). Many educational and ocean literacy activities are organised in the area.	It was not possible to assign a monetary value to this service.
	Aesthetic experience and landscape	The importance of the **scenery**, along with the **smells** and **sounds** of the sea, are seen as a priority for survey respondents (more than 50%).	It was not possible to assign a monetary value to this service.

FIGURE 13: ECOSYSTEM SERVICES DELIVERED BY THE NAS: DIVERSITY AND IMPORTANCE AT A GLANCE



6.2 Survey learnings on marine ecosystem protection and management

Having been to the sea for any activity makes individuals more willing to pay for its protection... Half of the respondents in Italy and Croatia, and 65% of respondents in Slovenia, have spent time at the sea or on the coast at least once during the last 12 months. By contrast, only 3% of respondents have never spent time on the coast or at sea in Slovenia and Croatia, and 13% for Italy. Respondents who have been (recently or not) to the coast or to the sea were either at the NAS (84% of Slovenian respondents and 82% of Croatian respondents, but only 34% of Italian respondents with easy access to other seas) or visited other sea locations (57% of Croatian respondents visited the sea locations along the southern Adriatic Sea, 48% of Italian respondents visited other areas of the Mediterranean Sea). For respondents who have visited many seas, the NAS was nevertheless their most-visited.

Having been to any sea in the last five years increases the likelihood of choosing the good health scenario in the WTP survey. Having gone to the NAS specifically has a positive influence on the choice of scenario, with more respondents choosing the good health option, compared to non-users of the NAS[135].

No matter where they were born or where they currently live... There is **no distance effect**, i.e. how far someone lives from the sea does not affect their WTP. Values reported by inhabitants living close (within 5km) or far (beyond 50km) from the sea are similar, which is quite common for this type of questionnaire[136].

... but it depends on their knowledge of the degradation affecting the sea. The majority of respondents in Italy and Slovenia have not heard or are only partly aware of the degradation of biodiversity in and around the NAS, and about the changes in NAS fish stocks. However, 46% and 54%, respectively, of Croatian respondents were aware of these two issues. The impact of tourism and related urban development on the ecosystem of the NAS and the physical impacts on the NAS caused by human activities proved to be the most widely known subject among respondents, in particular in Italy. Respondents' knowledge of the impacts of tourism and associated urban development on the NAS ecosystem is significant in the statistical models developed (Annex VII) with a negative coefficient: this means that the lower the knowledge about this impact, the less likely someone is to choose the more ambitious good health option.

Relevance for management and policy? Survey responses were extracted that are relevant to policy, management and maritime activities in the riparian countries of the NAS.

- In general, respondents reported a relatively low level of trust (in particular among Slovenian respondents) as to whether the funds collated would be allocated to marine ecosystem improvement. The Slovenian results may highlight the need to address governance, the balance between top-down and bottom-up approaches, and the role of citizens in policy-making.
- Croatian respondents are more aware than Slovenian and Italian citizens of the impact of (mass) tourism on marine ecosystems. This likely reflects the

[135] For the NAS in particular, the regression of the model represented in Annex VIII shows that the variable 'use_NAS' is significant and positive, which means that there is an effect.

[136] Nieminen et al. (2019) ; Tuhkanen et al. (2016).

significance of tourism in Croatia (20% of GDP), with 95% of tourism activities, revenue and turnover the coastal area of the Adriatic (ESA HR, 2019). It may also be related to ongoing public discussion of the negative impacts of mass tourism (over-tourism) on marine ecosystems, cultural heritage, and wider socioeconomic development, as illustrated by the plans to impose daily limits on the total number of tourists visiting Dubrovnik[137]. Similarly, it might explain the low WTP for recreational activities of Croatian inhabitants compared to the Italian and Slovenian respondents. Overall, the non-favourable view of the tourism sector and its impacts highlights the need to find new solutions to address the destinations' carrying capacity and over-tourism.

- Croatian respondents reported the highest awareness rate of changing fish stocks, followed by Slovenian and Italian respondents. Fishing and fish processing in Croatia is linked to traditional activities, and many communities are dependent on the sector for subsistence, particularly around the islands. This, in turn, contributes to tourism development (ESA HR, 2019).
- Finally, the survey highlights Italians' low level of knowledge and awareness of the impacts of human activities on the NAS marine ecosystems. This points to a need to raise awareness and increase ocean literacy if there is to be any real transition to sustainable practice.

6.3 The value of assessment and valuation of ecosystem services for MSP: recommendations

The results of the assessment and valuation of ecosystem services carried out for the NAS have yet to be used by MSP planners, as they have come at too late a stage in the current MSP process[138]. However, such results could help to:

- Make more explicit the importance of the NAS marine ecosystems as **shared transboundary resources** between the sectors and inhabitants from its riparian countries (Italy, Slovenia and Croatia) and beyond (in particular when considering the international character of tourism in the area);
- Strengthen the diagnosis of the **current state of marine space**, identifying marine areas that deliver significant ecosystem services and that need specific attention and management, including by reducing (maritime and land-based) pressures imposed on these marine areas;
- Contribute to the ***ex ante* assessment** of different options for managing and sharing marine space, highlighting ecosystem services potentially impacted (positively or negatively) by these different options in order to facilitate an informed decision on the best option;
- Contribute to **stakeholder processes**, stressing the many benefits, values and interests that relate to the management of marine ecosystems and that need to be linked to the MSP process. In some cases, this might help to build stronger support for the decisions emerging from this process;
- Justify a **broader focus for monitoring** the implementation of the MSP Directive[139]. Beyond its ecological component, monitoring needs to pay attention to changes in activities (including land-based) and related pressures on marine ecosystems, development of maritime activities, and changes in ecosystem services delivered to different groups that might justify adaptations to the plans adopted;

137 https://www.responsibletravel.com/copy/overtourism-in-dubrovnik

138 The deadline for Member States to adopt their Maritime Spatial Plans was 31 March 2021.

139 Building on the monitoring carried out for other policies, such as the MSFD, Water Framework Directive, the Common Fisheries Policy...

- **Communicate** to different target groups the societal importance of protecting, managing and sharing marine space, highlighting the diversity of benefits from marine ecosystems, and the importance of human actions in supporting their delivery (including by adapting individual and collective land-based and marine activities and practice to reduce pressures in areas that are essential to deliver ecosystem services). The differences between Italian, Slovenian and Croatian respondents make it clear that the communication focus needs to be adapted for the public in each country.

Assessment and valuation proved challenging because of the very fragmented nature of the information available (e.g. different assessment techniques, metrics, time periods and reporting scales), particularly in transboundary marine ecosystems such as the NAS. This challenge is not limited to monetary estimates, but is also evident in quantitative estimates of the importance of ecosystem services delivered (particularly in relation to regulation and cultural services). Fragmented information and the absence of data to quantify some ecosystem services highlights the importance of **combining qualitative, quantitative and monetary information to gain a broader understanding of the importance of ecosystem service flows and delivery**.

In cases, it was not possible to allocate quantitative and monetary information to **specific marine areas** within the NAS that play different roles in the delivery of ecosystem services. New approaches need to be found that facilitate the comparison of ecological and biophysical information with socioeconomic information at the scale of spatial (marine) units with ecological, socioeconomic and management relevance. In addition, more work is required to connect the functioning of the NAS to **ecosystem services delivered elsewhere in the Mediterranean Sea** (e.g. fish spawning grounds in the NAS that contribute to fish stocks and fishing activities elsewhere in the Mediterranean Sea). This will help to identify impacts and beneficiaries beyond the administrative boundaries of the NAS that can justify potentially specific management within the NAS MSPs.

This assessment provides a picture of the ecosystem services delivered today. It could be complemented by an assessment of **future potential for additional/new ecosystem services** that could support socioeconomic development, in particular for local coastal communities. Marine areas that could deliver future (new) ecosystem services could then receive particular attention in MSPs and in the management of long-term development and sustainability of marine ecosystems.

Finally, the challenges in quantifying and assessing the socioeconomic importance of services provided by the NAS ecosystems, and the limited evidence available for some services, highlights the limited research on marine ecosystem services. **More attention and resources** are required to strengthen the knowledge base on the importance of ecosystem services delivered by marine ecosystems in different European regional seas. Beyond supporting the implementation of the MSP and MSFD, that knowledge would contribute to strengthening the ocean/marine component of the European Mapping and Assessment of Ecosystems and their Services (MAES)[140].

[140] https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm

Annexes

Annex I - CICES reference for ecosystem services

BIOTIC ecosystem outputs		
Section	**Division**	**Group**
Provisioning (Biotic)	Biomass	Cultivated terrestrial plants for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Cultivated aquatic plants for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Reared animals for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Reared aquatic animals for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Wild plants (terrestrial and aquatic) for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Wild animals (terrestrial and aquatic) for nutrition, materials or energy
Provisioning (Biotic)	Genetic material from all biota (including seed, spore or gamete production)	Genetic material from plants, algae or fungi
Provisioning (Biotic)	Genetic material from all biota (including seed, spore or gamete production)	Genetic material from animals
Provisioning (Biotic)	Other types of provisioning service from biotic sources	Other
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Other aqueous ecosystem outputs
Regulation & Maintenance (Biotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of wastes or toxic substances of anthropogenic origin by living processes
Regulation & Maintenance (Biotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of nuisances of anthropogenic origin
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Regulation of baseline flows and extreme events
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Pest and disease control
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Regulation of soil quality
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Water conditions
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Atmospheric composition and conditions
Regulation & Maintenance (Biotic)	Other types of regulation and maintenance service by living processes	Other
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment
Cultural (Biotic)	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment
Cultural (Biotic)	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Other biotic characteristics that have a non-use value
Cultural (Biotic)	Other characteristics of living systems that have cultural significance	Other

ABIOTIC ecosystem outputs		
Section	**Division**	**Group**
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Other aqueous ecosystem outputs
Provisioning (Abiotic)	Non-aqueous natural abiotic ecosystem outputs	Mineral substances used for nutrition, materials or energy
Provisioning (Abiotic)	Non-aqueous natural abiotic ecosystem outputs	Non-mineral substances or ecosystem properties used for nutrition, materials or energy
Provisioning (Abiotic)	Non-aqueous natural abiotic ecosystem outputs	Other mineral or non-mineral substances or ecosystem properties used for nutrition, materials or energy
Regulation & Maintenance (Abiotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of waste, toxics and other nuisances by non-living processes
Regulation & Maintenance (Abiotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of nuisances of anthropogenic origin
Regulation & Maintenance (Abiotic)	Regulation of physical, chemical, biological conditions	Regulation of baseline flows and extreme events
Regulation & Maintenance (Abiotic)	Regulation of physical, chemical, biological conditions	Maintenance of physical, chemical, abiotic conditions
Regulation & Maintenance (Abiotic)	Other type of regulation and maintenance service by abiotic processes	Other
Cultural (Abiotic)	Direct, in-situ and outdoor interactions with natural physical systems that depend on presence in the environmental setting	Physical and experiential interactions with natural abiotic components of the environment
Cultural (Abiotic)	Direct, in-situ and outdoor interactions with natural physical systems that depend on presence in the environmental setting	Intellectual and representative interactions with abiotic components of the natural environment
Cultural (Abiotic)	Indirect, remote, often indoor interactions with physical systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with the abiotic components of the natural environment
Cultural (Abiotic)	Indirect, remote, often indoor interactions with physical systems that do not require presence in the environmental setting	Other abiotic characteristics that have a non-use value
Cultural (Abiotic)	Other abiotic characteristics of nature that have cultural significance	Other

Annex II: Sand dredged in Italy 1997-2017 (source: MATTM-Regioni, 2018, Annex 1, p. 304)

Situated off-shore of	Title	Depth (m)	Dredging technique	Entity/concession-holder	Year	Dredged volume (m3)	Destination
Tagliamento e Adige			Trailer/suction	Magistrato alle acque di Venezia	1997	1.921.604	Cavallino (VE)
Tagliamento e Adige			Trailer/suction	Magistrato alle acque di Venezia	1998	4.097.119	Litorale di Pellestrina (VE)
Tagliamento e Adige			Trailer/suction	Magistrato alle acque di Venezia	2000	565.362	Jesolo (VE)
Tagliamento e Adige			Trailer/suction	Magistrato alle acque di Venezia	2003	351.000	Jesolo - Cortellazzo (VE)
Tagliamento e Adige			Trailer/suction	Magistrato alle acque di Venezia	2004	296.485	Eraclea (VE)
Eraclea	JC	20-25	Trailer/suction	Regione del Veneto	2011	70.000	Eraclea (VE), Caorle (VE)
Eraclea	JC	20-25	Trailer/suction	Regione del Veneto	2012	70.000	Eraclea (VE), Caorle (VE)
Eraclea	JC	20-25	Trailer/suction	Regione del Veneto	2013	60.000	Eraclea (VE), Caorle (VE)
Tagliamento e Adige	JC	20-25	Trailer/suction	Magistrato alle acque di Venezia	2013	100.000	Jesolo (VE)
Tagliamento e Adige	JC	20-25	Trailer/suction	Magistrato alle acque di Venezia	2014	92.875	Jesolo (VE), Cavallino
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	165.300	Misano Adriatico (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	253.750	Riccione sud (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	65.200	Igea Marina
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	27.000	S. Mauro Pascoli - Savignano (FC)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	28.000	Gatteo a Mare (FC)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	43.500	Zadina (FC)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	176.100	Milano Marittima nord (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2002	41.000	Lido di Classe - Foce Bevano (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	149.000	Misano Adriatico (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	105.065	Riccione sud (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	105.787	Igea Marina - Rimini nord (RN)

Situated off-shore of	Title	Depth (m)	Dredging technique	Entity/concession-holder	Year	Dredged volume (m3)	Destination
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	68.391	Cesenatico nord (FC)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	90.108	Milano Marittima nord (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2007	107.128	Lido di Dante (RA)
Ravenna	A	35	Trailer/suction	Regione Emilia Romagna	2007	189.869	Punta Marina (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	219.000	Misano Adriatico (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	188.686	Riccione sud (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	171.047	Igea Marina, Rimini nord (RN)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	128.331	Cesenatico nord (FC)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	218.713	Milano Marittima nord (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	116.460	Lido di Dante (RA)
Ravenna	C1	40	Trailer/suction	Regione Emilia Romagna	2016	229.125	Punta Marina (RA)
Total						10.511.005	

ANNEX III: Census of submarine sand deposits (source: MATTM-Regioni, 2018, Annex 2 p. 307)

Region	Name	Name of sand deposit and general location	Depth m (max)	Depth m (max)	Potential Mm3				notes
					theoretical	accessible	supposed	verified	
Emilia Romagna	Area A0	43 km offshore	34	34	6.12	6.12	3.57	3.57	fine sand
Emilia Romagna	Area A1	43 km offshore	36	36	12.82	12.82	6.13	6.13	fine sand
Emilia Romagna	Area A2	44 km offshore	35	35	0.26	0.26	-	-	fine sand
Emilia Romagna	Area B	36 km offshore	34	35	2.82	2.82	1.8	1.8	fine sand
Emilia Romagna	Area C1	59 km offshore	39	41	55.1	55.1	39.53	39.53	fine sand
Emilia Romagna	Area C2	66 km offshore	40	39	16.21	16.21	10.56	10.56	fine sand
Emilia Romagna	Area C3	46 km offshore	40	42	104.39	104.39	58.84	58.84	fine sand
Emilia Romagna	Area H	65 km offshore	50	54	195.22	195.22	101.55	101.55	sandy silt
Veneto	RV_A	Laguna di Venezia	24	20	4.85	4.85	-	-	medium to fine sand
Veneto	RV_D	Caorle	21	24	18	18	-	-	medium to fine sand
Veneto	RV_G	Laguna di Venezia	30	31	2.6	2.6	2	2	sand from very fine to fine
Veneto	RV_C	Chioggia	26	32	6.1	3.9	3.9	3.9	medium to fine sand
Veneto	RV_H	Chioggia	29	31	60.53	51.86	51.86	51.86	medium to fine sand
Veneto	RV_B	Tagliamento	11	16	48.4	48.4	-	-	medium to fine sand
Friuli Venezia Giulia									No searches are carried out

ANNEX IV: Quantification of CES related to scientific knowledge and education provided by ecosystems in NA according to environmental spaces (EVS) and cultural practices (CP) delivering them, and related capabilities.

CES cat.	Title, Description, Capabilities	Country
EVS	**The Italian Long-Term Ecological Research Network (LTER-Italy).** The Italian Long-Term Ecological Research Network (LTER-Italy; www.lteritalia.it) includes terrestrial, freshwater and marine ecosystems distributed throughout our country, with a marked transecodomain approach. At the LTER-Italy sites ecological observations are carried out at the multidecadale scale, appropriate to support understanding and management of the environment. LTER represents one of the main tools for analysing how ecosystems change over time, and for describing and interpreting natural variability as opposed to 'man-made' variability. LTER-Italy is one of the twenty-five national networks that make up the LTER-Europe Network (LTER-Europe; www.lter-europe.net) and it pertains to the LTER International Network (ILTER; www.ilternet.edu/), globally distributed. LTER networks were created to share and integrate the ecological information, from local to global scale, becoming a scientific reference for policy makers. LTER-Italy is also one of the key nodes of the E-infrastructure for Biodiversity and Ecosystem Research LifeWatch (LifeWatch Italy; www.servicecentrelifewatch.eu/home). In the Northern Adriatic Sea there are three marine sites of LTER plus the Venice Lagoon. Source: http://www.ismar.cnr.it/infrastructures/observational-systems/lter-italy/index_html?set_language=en&cl=en In the NA, there are other LTER sites which are the site Gulf of Trieste, and the Emilia-Romagna and LTER monitoring program, managed by the Environmental Agency of Emilia Romagna Region (ARPAE). **Capabilities**: Scientific research, and education	IT
EVS	With respect to the **existing ecological monitoring observing systems**, the ECOSS project analyzed the current ecological observing systems in the area and the available level of knowledge with emphasis on the connections with the main Directives, the EUSAIR pillar and topics and the Maritime Spatial Planning (MSP) principles. ECOSS mentioned the following ecological monitoring observing in the Adriatic, including the NA (Vilibić et al., 2019): 3.1. Aqua Alta Tower 3.2. E1 Meteo oceanographic buoy 3.3. S1-GB dynamic pylon 3.4. Tele Senigallia dynamic pylon 3.5. Tide gauge network 3.6. High-frequency oceanographic radars 3.7. Meteotsunami research and warning network Here below some details from the research infrastructures in the NA ***About buoys, platforms, and other fixed sites***	IT, HR, SL

<table>
<tr><th>CES cat.</th><th>Title, Description, Capabilities</th><th>Country</th></tr>
<tr><td></td><td>The Italian National Research Council (CNR) operates several multi-parametric observational systems, most of them are located along the Italian coasts and transmit real-time data to the receiving stations along the coast. The complete real-time operation has not yet been reached by some of the systems, even if there is a development in this direction.
In the Northern Adriatic - Gulf of Trieste, there are:
3 inshore meteorological stations. Data: wind speed and direction, air temperature, relative humidity, precipitation (warmed rain gauge during winter time), solar radiation, air pressure. Data acquisition and elaboration every 10 minutes. Data Transmission in real time (hourly frequency).
1 meteo-marine station inside the harbour, water depth 6 m. Data: sea temperature (0.4 m, 2.0 m and 6.0 m below s.l.), air temperature, wind speed and direction. Data acquisition and elaboration every 10 minutes, Data Transmission in real time (hourly frequency).
1 tide gauge station. Parameters: sea level. Data acquisition every minute, Data transmission in real time (every 30 minutes).
PALOMA mast (45°37.097’N, 13°33.913’E), 12 km offshore, bottom depth 25 m. Data: sea temperatures (0.4, 2, 15, 25 m below s.l.), wind speed and direction, air temperature, relative humidity, precipitation, solar radiation, air pressure. Data acquisition and elaboration every 5 minutes. Data transmission in real time (every 3 hours). Paloma station (45°37.097’N, 13°33.913’E), 12 km offshore, bottom depth 25 m. Data: hydrological (CTD) and biogeochemical parameters (dissolved oxygen, inorganic nutrients, pHT, Total Alkalinity). Manual operations, monthly frequency.
The Gulf of Trieste meteo-marine network is part of the LTER Northern Adriatic Site.
In the Gulf of Venice there are:
“Acqua Alta” oceanographic platform (45° 18.83’ N, 12° 30.53’E), 15 km offshore, bottom depth 16 m. Meteorological data: wind speed and direction, air temperature, humidity, solar radiation, precipitation. Oceanographic data: sea temperature, sea level, ADCP currents, waves. Surface and scuba web cams Wide band intranet connection allowing real time data transmission.
Abate meteo-marine station, 20 nmiles offshore the Venice riviera. Meteorological dataand hydrological data are provided by the buoy owned by the Regional Agency for Environment Protection (ARPAV), hydrological data, current measurements and vertical fluxes. hydrological (CTD) and biogeochemical parameters (dissolved oxygen, inorganic nutrients, pHT, phyto and zooplankton,,chlorophyll are sampled with monthly frequency. The station is part of the LTER Northern Adriatic Site.
In the Venice Lagoon there is a network of 5 hydro-bio-chemical stations. Data: hydrological and chemical parameters, phyto- and zoo-plankton abundance, species composition. Monthly data and samples collection. The site joined the LTER network in 2008.
In the Po Delta there is the S1 Station (44.741042°N - 12.456111°E), bottom depth 22.5 m. Multi-parametric buoy. Oceanographic data: temperature, salinity, dissolved oxygen, pH, ADCP currents, waves. Meteorological data: air temperature, atmospheric pressure, relative humidity, net radiation, wind speed and direction. Real time data transmission. The station is part of the LTER Northern Adriatic Site.

OGS, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (National Institute of Oceanography and Applied Geophysics) has a monitoring network that, in a continuous and discontinuous way, collects basic information on the marine ecosystem, an essential prerequisite for understanding the ecosystem's sensitivity to climate changes and for accurate forecasting.
OGS deals with the continuation of marine ecological research, started by the University of Trieste in 1970, at the site called "C1 - Gulf</td><td></td></tr>
</table>

CES cat.	Title, Description, Capabilities	Country
	of Trieste" which, since 2006, has been formally included in the Italian network of long-term ecological research (LTER- Italy) as part of the LTER - Alto Adriatico macrosite. Since 1998, discontinuous monitoring has been accompanied by continuous monitoring thanks to the positioning of a meteo-oceanographic buoy called "MAMBO" (Operational Environmental Monitoring) dedicated to the continuous acquisition of meteorological and oceanographic data. The observing site thus implemented ("Gulf of Trieste" site) was endorsed by IMBER (Integrated Marine Biogeochemistry and Ecosystem Research). Also in the Gulf of Trieste OGS coordinates, on behalf of the Civil Protection, the system of MAMBO buoys positioned at the mouth of the Isonzo and Tagliamento rivers and at the mouths of the Grado and Marano Lagunare lagoons. A further observation site, E2-M3A, is located in the southern Adriatic basin at a depth of 1205 m and about 60 miles from the coast in an area of high scientific interest for the formation of dense water through convective processes in the open sea. Two anchorages are positioned on the site whose configuration allows to identify the formation of dense water by simultaneously measuring physical and chemical parameters. The site is integrated into the OceanSITES worldwide network. (source: https://www.inogs.it/it/content/reti-di-monitoraggio-marino) **Capabilities**: Scientific research	
EVS	**Existing ecological monitoring programs** The ECOSS project analyzed the current activities, the relevant observing programs carried out in the area and the available level of knowledge with emphasis on the connections with the main Directives, the EUSAIR pillar and topics and the Maritime Spatial Planning (MSP) principles. ECOSS mentioned the following monitoring programs in the Adriatic, including the NA (Vilibić et al., 2019): 1. Monitoring of parameters needed for evaluation of descriptors the state of according 2. to Adriatic Monitoring Plan enabling fulfillment of obligations of the Republic of 3. Croatia according to MSFD 4. Systematic research of water quality in transitional and coastal waters of the Republic 5. of Croatia 6. Adriatic Dolphin Project 7. Monitoring of sea turtles in the Adriatic 8. Regional Water Protection Plan - Monitoring of marine waters 9. Monitoring of water and shellfish quality in shellfish farming areas 10. Bathing water quality monitoring 11. Visual census of the seafloor by ROV 12. Seagrasses and macroalgae monitoring UNITS and FVG Region 13. Coralligenous monitoring UNITS; TRECORALA; PRIN ReefReseArcH Resistance and 14. resilience of Adriatic mesophotic biogenic habitats to human and climate change 15. threats Research project of national interest 16. Integrated monitoring programme of transitional water bodies in according to 17. legislative decree n. 152/2006 (aimed to chemical and ecological status classification 18. and to assessment of the quality of shellfish waters - specific destination waters) For details on each monitoring program refer to Vilibić et al. (2019)	IT, HR, SL

CES cat.	Title, Description, Capabilities	Country
	Capabilities: Scientific research	
CP	**Adriatic Fisheries and Oceanography Observing System** Since 2003, CNR-ISMAR runs a program aimed at using Italian fishing vessels as Vessels Of Opportunity (VOOs) for the collection of scientifically useful datasets. In the framework of the EU-FP5 project MFSTEP, 7 commercial vessels fishing for small pelagic species in the northern and central Adriatic Sea were equipped with an integrated system for the collection of data regarding catches, position of the fishing operation, depth and water temperature during the haul (Falco et al. 2007); this system was named "Fishery Observing System" (FOS) and until 2013 produced a great amount of data that could be helpful both for oceanographic and fishery biology purposes (Falco et al 2011; Martinelli et al. 2012; Carpi et al. 2015; Aydoğdu et a. 2016; Sparnocchia et al. 2016). Since 2014, CNR-ISMAR implemented in the Adriatic Sea the "AdriFOOS" observational system, by installing the FOOS on 10 commercial fishing boats. Since then the CNR-ISMAR datacenter in Ancona receives daily data sets on GPS tracks, water temperature/salinity/pressure (profiles and bottom), meteorology, catch amounts, species caught and target species sizes. Forecasts of sea height are sent daily on board thanks to the collaboration with the KASSANDRA Storm Surge Modelling System (http://kassandra.ve.ismar.cnr.it:8080/kassandra). Data of temperature and (in few cases) salinity measurements acquired by the FOOS, from January 2014 to March 2015, along the fishing tracks and at the various fishing depths were published within the JERICO project (http://www.jerico-ri.eu/previous-project/service-access/targeted-operation-phase/top-2-data-and-maps-from-sensors-on-board-fishing-vessels/adriatic-sea-fishery-and-oceanography-observing-system/). Source: http://www.ismar.cnr.it/infrastructures/observational-systems/adri-fishery-observing-system **Capabilities**: Scientific research, and life-long learning	IT
EVS	**The Miramare Biosphere Reserve (MBR)** infringe with the commercial and amateur fishing as well as other recreational activities. There is a significant conflict between mussel farming and fishing activities. The aim of this reserve is to maintain biological diversity through scientific research, monitoring activities and conserving its cultural value. The environmental education designed for students and the public is the major activity in the MBR (UNESCO- MAB, 2002). (source: http://www.riservamarinamiramare.it/) **Capabilities**: Scientific research, and education	IT
CP	**Blue flags** The foundation for environmental education in the beaches of Italy, Slovenia and Croatia coast under the Blue Flag beach certification program have educational events which have both cultural and scientific principles. The iconic Blue Flag is one of the world's most recognised voluntary awards for beaches, marinas, and sustainable boating tourism operators. In order to qualify for the Blue Flag, a series of stringent environmental, educational, safety, and accessibility criteria must be met and maintained. Central to the ideals of the Blue Flag programme is the aim of connecting the public with their surroundings and encouraging them to learn more about their environment. As such, environmental education activities must be offered and promoted in addition to a permanent display of information relevant to the site in terms of biodiversity, ecosystems and environmental phenomena.	IT, SL, HR

CES cat.	Title, Description, Capabilities	Country
	The Blue Flag has been awarded to 103 Italian Adriatic beaches and 29 marinas, 116 Croatian beaches and 19 marinas, 7 Slovenian beaches and 2 marinas under this program (data at year 2019, from https://www.blueflag.global/). Source: https://www.adriagate.com/Croatia-en/Blue-flag-beaches-Croatia **Capabilities**: education	
CP	**The Blue World Institute of Marine Research and Conservation (BWI)** Croatia has several educational programs structured by the marine education center, marine science museum, and also the sea turtle rescue center. The Blue World Institute of Marine Research and Conservation (BWI) works to protect the marine environment in the Adriatic Sea. To that purpose, the Blue World Institute operates three programmes – research, education, and conservation. BWI research focuses mainly on large marine vertebrates (dolphins and whales, sea turtles, sharks and giant devil rays) informing our education activities and conservation projects. BWI works from the Adriatic islands of Lošinj, Murter and Vis, with the local communities, and collaborate nationally, regionally and internationally to advance sustainable marine management and environmental sustainability in the Mediterranean Basin. (source: https://www.blue-world.org/) **Capabilities**: Scientific research, and education	HR
CP	**Rescue centers in the NA** In the Northern Adriatic, sea turtles spend parts of their life. The rescue centers have an opportunity to educate visitors about sea turtles and marine conservation. In addition, during the tourist season, workshops and special events for children are organized. Besides all the above mentioned activities, Adria-Watch, Fonda Fish Farm, and the Marine Educational Center, contribute to cultural services by their extensive educational programs that generate scientific knowledge on the marine environment. The **Marine educational centre Pula (MEC)** is a small non-government organisation established in 2005. Currently, it has 15 members which are heading the Sea Turtle Rescue Centre. The Centre is the only sea turtle recovery centre in Croatia and it is supported by the Ministry of culture, Republic of Croatia (5.000 € per year, since 2006). The current state of the infrastructure is suitable for a simultaneous recovery of 7 turtles (7 pools with a marine water flow system which is closed in the cold season and additionally heated). Three members (biologist, chemist and an aquarist) are in charge of the Centre's activity (cleaning of the equipment, turtle care, management, education etc.). Two members are veterinarians. Besides the rehabilitation of sea turtles, MEC Pula is involved in the conservation and protection of endangered species and non-institutional education of young people (preschool, school and student age) and citizens. For many years MEC Pula has been taking care of injured turtles, with little or no possibilities to improve the Centre. With NETCET we will increase the Centre capacity, technical support and set up a laboratory for better diagnosis. All improvements will be in order to obtain a fully equipped rescue centre for the acceptance, rehabilitation and release of marine turtles in the Eastern part of the Adriatic Sea, with the main aim of increasing the turtle recovery and consolidating the regional cooperation to the whole Adriatic. This will create the need for highly trained personnel who will be able to specialize within the project activities and continue through the established long lasting network. Through non-institutional education, permanent educational exhibits, release events, inauguration days and raising public awareness of stakeholders and others, MEC Pula will actively contribute to the conservation of sea turtles as a global goal of the project. All activities will be coordinated together with other beneficiaries to maintain a long lasting network. (source: http://www.netcet.eu/2013-01-04-21-36-00/marine-educational-centre-pula).	IT, HR, SL

CES cat.	Title, Description, Capabilities	Country
	Cetacea Foundation is a non-profit organization founded in 1988 with the commitment to protect the marine ecosystem especially Adriatic, through dissemination, education and conservation activities. Since 2008 it has undergone a radical transformation and has achieved total independence, taking the actual form of a non-profit organization. It makes use of the precious contribution of biologists, veterinarians, naturalists and volunteers. It is active in the rescue of animals in difficulty, especially sea turtles and cetaceans. The Foundation participate in numerous European projects including: Sharklife, NetCet, Tartalife. Adriatic +, Clean Sea Life. In addition, the Cetacea Foundation manages the reference center for the recovery of sea turtles for Emilia Romagna and Marche, one of the most important and active in the nation and for the Adriatic. In the Center over 500 sea turtles have been treated and returned to the sea, with a notable increase in recent years. The Foundation also intervenes on all beached turtles already dead to collect data on the health of our sea: in fact, turtles are a biological indicator of the health conditions of our sea. The Cetacea ONLUS Foundation is officially recognized by the Emilia-Romagna Region as an Environmental Education Center. He carries out research activities with Italian and foreign bodies. (source: http://fondazionecetacea.org/) In Slovenia, at the **Aquarium Piran**, veterinarians of the Wildlife Sanctuary "Zatočišče za živali prosto živečih vrst" take care of injured sea turtles. Aquarium Piran provides space for first aid treatment; it does not, however, have holding tanks for a longer rehabilitation phase (Ullmann and Stachowitsch, 2015). **Capabilities**: Scientific research, and education	
CP	**Morigenos – Slovenian Marine Mammal Society** is an independent, scientific, non-profit, non-governmental organisation that combines scientific research, monitoring, education, public awareness, capacity building and management, to achieve effective conservation of the marine environment and biodiversity. »Morigenos« means »sea-born« in ancient Celtic language. The organization was established in 2001 and is carrying out several projects in the field of scientific research, education, public awareness and conservation. Morigenos is officially recognized as "an organization working in public interest of nature conservation", by the Ministry of Republic of Slovenia of Environment and Spatial Planning. The central activity of Morigenos is the Slovenian Dolphin Project, a long-term research, monitoring and conservation programme, focusing on bottlenose dolphins (*Tursiops truncatus*) in Slovenian and adjacent waters in the northern Adriatic Sea. It is the first systematic and long-term study of any cetaceans (whales, dolphins and porpoises) in Slovenia. Morigenos has been studying and monitoring these animals since 2002 and has documented the presence of a resident population of bottlenose dolphins in the area. Before that, hardly anything was known about dolphins in Slovenia and few people knew that they are a regular occurrence in our waters. By using photo-identification techniques, we have been able to compile the first photographic identification catalogue of dolphins off the Slovenian coast. The catalogue now contains more than 150 dolphins that use Slovenian and neighbouring waters as their habitat. The team of Morigenos is composed of biologists, veterinarians, geographers, educators, chemists, etc. The work of Morigenos involves people from all over Europe and Morigenos team members are actively participating in several research projects and organisations all over the world, for example the European Cetacean Society. Through various activities, such as Dolphin Research Courses, Adopt a Dolphin programme and various lectures, we enable anyone to take part in our work. Morigenos is a partner to several Slovenian and international projects, organisations and expert groups and is the only Slovenian organization with the status of a partner organization	SL

CES cat.	Title, Description, Capabilities	Country
	to ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Neighbouring Atlantic Area), of which Slovenia is a contracting party. Source: https://www.morigenos.org/en/ **Capabilities**: Scientific research, and education	

ANNEX V: Distribution of the survey sample among the 3 countries according to their age, income, gender, etc.

Criteria		Italy	Croatia	Slovenia	Total
Sex	Male	161	159	170	**484**
	Female	173	174	163	**517**
	Other				**0**
	Prefer not to say				**0**
Age	18-24 years old	31	34	30	**95**
	25-34 years old	45	50	51	**146**
	35-44 years old	51	56	58	**165**
	45-54 years old	64	51	56	**171**
	55-64 years old	53	61	58	**172**
	More than 65 years old	91	81	80	**252**
CSP	Student, traineeship	31	30	23	**84**
	Employed full time	83	133	148	**364**
	Employed part-time	28	11	9	**48**
	Farmer	1	0	0	**1**
	Self Employed	45	12	8	**65**
	Retired	80	108	104	**292**
	Stay-at-home parent	22	0	7	**29**
	Unemployed	36	30	29	**95**
Revenue	Less than 500 €/month	10	16	20	**46**
	De 501 à 1000 €/month	26	52	90	**168**
	De 1001 à 1500 €/month	44	60	79	**183**
	De 1501 à 2000 €/month	62	51	42	**155**
	De 2001 à 2500 €/month	33	34	36	**103**
	De 2501 à 3000 €/month	40	33	16	**89**
	De 3001 à 3500 €/month	27	18	3	**48**
	De 3501 à 4000 €/month	23	10	2	**35**
	De 4001 à 4500 €/month	10	7	3	**20**
	De 4501 à 5000 €/month	2	1	0	**3**
	De 5001 à 5500 €/month	2	0	1	**3**
	De 5501 à 6000 €/month	4	4	2	**10**
	More than 6001 €/month	52	47	39	**138**
	No answer	10	16	20	**46**
Total		**335**	**333**	**333**	**1001**

Annex VI: Detail on the econometric analysis and regression table

First of all, a database clean-up was performed to remove "outliers", based on the following:

- Participants who responded in less than 8 minutes were removed assuming they did not carefully respond to the questionnaire.
- Participants who answered "no opinion" in questions related to their diploma, revenue and profession were also removed.

In total we obtained a data base of 5117 observations.

The Probit model was selected for the analysis as it is a statistical model in which the explained variable can only take one of two modalities (dichotomous variable), 1 or 0. Thus, to conduct the statistical and econometric analysis of the results, the data was firstly modelled as follows:

To the question "Would you be able to pay x€ for the program described? "the individuals answer :

- 1 if yes
- 0 otherwise.

The willingness to pay is defined by the following formula:

$$WTP_i(z_i u_i) = z_i\beta + u_i$$

Z is the vector of explanatory variables which are the variable influencing the choice of scenario or not, β the parameter vector (that is to say the coefficient associated with each variable) and U the error term.

To determine the willingness to pay it is necessary to first run a probit regression. In this regression, the explanatory variables correspond to the attributes and are equal to 1 if they are in good condition and 0 if not. The financial contribution is also part of the explanatory variables and its value is equal to the associated price: 0, 20, 50 or 100.

The dependent variable y (variable to be explained) represents the choice (binary choice: 1 or 0). Thus, the Probit model takes the following form:

$$Y = \beta_0 + \beta_1 Attr1 * \beta_2 Attr2 * \beta_3 Attr3 * \beta_4 Price * \beta_5 Sex * \beta_6 Diploma * \beta_7 Age + \varepsilon$$

Then, the model was performed on Stata software, and the results of the regression are presented in the following table:

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Interept.	0.494***	1.137***	0.266*		4.294*	4.475
WTP variables						
Biodiversity	0.257***	0.258***	0.258***	0.262**	0.257***	0.257***
Water quality	0.276***	0.279***	0.278***	0.284**	0.276***	0.276***
Recreation	0.124***	0.124***	0.124***	0.128**	0.125***	0.125***
Financial contribution	-0.12***	-0.12***	-0.01***	-0.01**	-0.01***	-0.01***
Socio economic variables						
Diploma	0.046**		0.041*			
Age	0.189		0.023			
Sexe	-0.408				-0.04	-0.04
year					-0.00	-0.00
revenu				0.028**		
Knowledge effect						
degradation-tourism		-0.11*				
degradation-human		-0.04				
degradation-fish		-0.00				
degradation-biodiv		-0.05				
Distance effect						
distance		-0.01				
coastline-region-born						-0.09
coastline-region-live					-0.05	
Sea User effect						
Sea-user			0.196*			
NAS-user				0.187**		
Country effect						
Country : Slovenia				-0.41**		
Country : Croatia				0.062		
Common value of NAS						
Q23-solidarity			0.132***			
Nb Observations	5117	5117	5117	5117	5117	5117
R^2	0.08	0.08	0.08	0.08	0.08	0.08

*"***" significant at 0.001; "**" 0.01 and "*" 0.05*

BOX 2: STATISTICAL SIGNIFICANCE

Significance refers to the point at which we can be sure that the **explanatory variable influences the dependent variable**. In our case when one of the attributes influences the choice of scenario. An insignificant variable means that if the explanatory variable changes it will not impact the dependent variable (e.g. if the weather changes, it won't impact my ability to play basketball in a gymnasium).

To test significance a test is carried out to assess if p(z) < a (with a=0.05).

When p(z) < 0.05 then the result is significant at a confidence level of at least 95% and we can interpret the sign (negative or positive) of the corresponding coefficient obtained and use its value for the calculation of the willingness to pay. On the contrary, if p(z) > 0.05 then the coefficient obtained is not significant and in other words we cannot rely on either the sign or the coefficient obtained.

For example, for biodiversity we obtained a coefficient of 0.257 and a p(z) of 0.000. We can thus say that we are 100% certain that the variable "biodiversity" influences the choice of scenario in a positive way.

Annex VII: WTP per countries

	Biodiversity	Water Quality	Recreation	Total
Italy	21	27	12	60
Slovenia	26	21	14	62
Croatia	15	20	Not significant[141]	34

	Biodiversity	Water Quality	Recreation	Total
Italy	398 107 309,45 €	511 852 255,00 €	227 489 891,11 €	1 137 449 455,56 €
Slovenia	28 590 951,81 €	23 092 691,84 €	15 395 127,90 €	67 078 771,55 €
Croatia	9 528 256,56 €	12 704 342,08 €	Not significant[142]	22 232 598,64 €

Annex VIII: Regression table for the 3 countries sub-sample

	Italy			Slovenia	Croatia	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Intercept	-4.40	0.539***	0.246	0.260*	0.686***	0.653***
WTP variables						
Biodiversity	0.281***	0.279***	0.281***	0.330***	0.175***	0.176***
Water quality	0.357***	0.358***	0.356***	0.273***	0.232***	0.233***
Recreation	0.156*	0.156*	0.155*	0.182***	0.044	0.045
Financial contribution	-0.13***	-0.01***	-0.01***	-0.01***	-0.11***	-0.01***
Socio-economic variables						
Diploma			0.133**			0.076*
Age					0.686***	
Sexe	-0.06					
Profession						
year	0.002					
revenu		0.053***		0.033**		
Knowledge effect						
degradation-tourism		-0.11*				
degradation-human		-0.04				
degradation-fish		-0.00				
degradation-biodiv		-0.05				
Distance effect						
coastline-region-born	0.171**					
Nb Observations	1477	1477	1477	1799	1841	1841
R^2	0.1	0.1	0.1	0.09	0.08	0.08

141 See Box 1 for explanation

142 See Box 1 for explanation

References

Supporting ecosystem services:

- Bonizzoni, S., Furey, N. B., & Bearzi, G. (2020) Bottlenose dolphins (Tursiops truncatus) in the north-western Adriatic Sea: Spatial distribution and effects of trawling. Aquatic Conservation: Marine and Freshwater Ecosystems.
- Claudet, J., Loiseau, C., Sostres, M., & Zupan, M. (2020). Underprotected Marine Protected Areas in a Global Biodiversity Hotspot. One Earth, 2(4), 380-384.
- Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., & Grasso, M., 2017. Twenty years of ecosystem services: How far have we come and how far do we still need to go?. Ecosystem Services, 28, 1-16.
- Falace, A., Kaleb, S., Curiel, D., Miotti, C., Galli, G., Querin, S., ... & Bandelj, V. (2015). Calcareous bio-concretions in the northern Adriatic Sea: habitat types, environmental factors that influence habitat distributions, and predictive modeling. PLoS One, 10(11), e0140931.
- Fonda Umani, S. (1996): Pelagic production and biomass in the Adriatic sea. Scientia Marina, 60 (2): 65-77.
- Jones, PJS., Qiu, W., De Santo EM. (2011): Governing Marine Protected Areas - Getting the Balance Right. Technical Report, United Nations Environment Programme.
- Manea, E., Di Carlo, D., Depellegrin, D., Agardy, T., & Gissi, E. (2019). Multidimensional assessment of supporting ecosystem services for marine spatial planning of the Adriatic Sea. Ecological Indicators, 101, 821-837.
- Manea, E., Bongiorni, L., Bergami, C., Pugnetti, A. (2020). Challenges for Marine Ecological Observatories to promote effective GMS of Natura 2000 network: The Case Study of ECOAdS in the Adriatic Sea. in "Governing Future Challenges in Protected Areas" Ruoss E., Alfaré L. In print.
- Millennium Ecosystem Assessment (MA), 2005 Biodiversity synthesis report. World Resources Institute, Washington, DC.
- Micheli F, Halpern BS, Walbridge S, Ciriaco S, Ferretti F, Fraschetti S, et al. (2013) Cumulative Human Impacts on Mediterranean and Black Sea Marine Ecosystems: Assessing Current Pressures and Opportunities. PLoS ONE 8(12): e79889.
- Nieminen et al, (2019) The economic benefits of achieving Good Environmental Status in the Finnish marine waters of the Baltic Sea, Marine Policy, V99-P181-189
- Tuhkanen et al (2016) Valuing the benefits of improved marine environmental quality under multiple stressors' , Science of the Total Environment. V551-552 , pp. 367-375

Provisioning ecosystem services (food):

- Bastardie, F., Angelini, S., Bolognini, L., Fuga, F., Manfredi, C., Martinelli, M., ... & Grati, F. (2017). Spatial planning for fisheries in the Northern Adriatic: working toward viable and sustainable fishing. *Ecosphere*, *8*(2), e01696.
- Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100
- FAO. 2019. General Fisheries Commission for the Mediterranean. Report of the twenty-first session of the Scientific Advisory Committee on Fisheries, Cairo, Egypt, 24–27 June 2019 / Commission générale des pêches pour la Méditerranée. Rapport de la vingt-et-unième session du Comité scientifique consultative des pêches. Le Caire, Égypte, 24-27 juin 2019. FAO Fisheries and Aquaculture Report/FAO Rapport sur les pêches et l'aquaculture No. 1290. Rome

- European Commission website (n.d.) Oceans and Fisheries – Facts and Figures – Facts and figures on the common fisheries policy – Employment. Available on: https://ec.europa.eu/oceans-and-fisheries/facts-and-figures/facts-and-figures-common-fisheries-policy/employment_en#f4
- Millennium Ecosystem Assessment (MA), 2005 Biodiversity synthesis report. World Resources Institute, Washington, DC.
- MIPAAF (2015) Piano strategico per l'acquacoltura in Italia 2014-2020
- MIPAAF (2016) Programma Nazionale Triennale della Pesca e dell'Acquacoltura 2017-2019
- North Adriatic Case Study SUPREME, 2018.
- Scientific, Technical and Economic Committee for Fisheries (STECF) – 2019 Stock Assessments part 2: European fisheries for demersal species in the Adriatic Sea (STECF-19- 16). Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-14558-5, doi:10.2760/95875, JRC119057
- SUPREME, 2018, Addressing MSP Implementation in the Case Studies, Slovenia Case Study, Deliverable C1.3.8, CORILA & MIT, p. 234. Available at: http://www.msp-supreme.eu/results www.eurofish.dk
- www.fao.org
- Soullard A. and Bencetic D. (2016), The Fish sector in Croatia, Flanders investment and Tradde Market Survey December 2016. Available at: https://www.flandersinvestmentandtrade.com/export/sites/trade/files/market_studies/2016-Croatia-Fish-Sector.pdf
- Scientific, Technical and Economic Committee for Fisheries (STECF) (2018), Economic Report of the EU Aquaculture Sector (STECF-18-19), Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-79402-5, doi:10.2760/45076, JRC114801. Available at: https://op.europa.eu/en/publication-detail/-/publication/7f9c98f0-0fe4-11e9-81b4-01aa75ed71a1/language-en/format-PDF/source-132387268
- Scientific, Technical and Economic Committee for Fisheries (STECF) (2019a), The 2019 Annual Economic Report on the EU Fishing Fleet (STECF-19-06), Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-79390-5, doi:10.2760/56158), JRC112940. Available at: https://op.europa.eu/en/publication-detail/-/publication/ca63ab82-c3bf-11e9-9d01-01aa75ed71a1/language-en/format-PDF/source-132387066
- Scientific, Technical and Economic Committee for Fisheries (STECF) (2019b), The EU Fish Processing Sector – Economic report (STECF-19-15), Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-14666-7, doi:10.2760/30373, JRC119498. Available at: https://op.europa.eu/en/publication-detail/-/publication/782537d7-36a5-11ea-ba6e-01aa75ed71a1

Provisioning ecosystem services (sand):

- Grottoli, E.; Cilli, S.; Ciavola, P., and Armaroli, C., 2020. Sedimentation at river mouths bounded by coastal structures: A case study along the Emilia-Romagna coastline, Italy. In: Malvárez, G. and Navas, F. (eds.), Global Coastal Issues of 2020. Journal of Coastal Research, Special Issue No. 95, pp. 505–510. Seville (Spain), ISSN 0749-0208
- MATTM-Regioni, 2018. Linee Guida per la Difesa della Costa dai fenomeni di Erosione e dagli effetti dei Cambiamenti climatici. Versione 2018 - Documento elaborato dal Tavolo Nazionale sull'Erosione Costiera MATTM-Regioni con il coordinamento tecnico di ISPRA, 305 pp
- Simonini, R., Ansaloni, I., Bonini, P., Grandi, V., Graziosi, F., Iotti, M., Massamba-N'Siala, G., Mauri, M., Montanari, G., Preti, M. and De Nigris, N., 2007. Recolonization and recovery dynamics of the macrozoobenthos after sand extraction in relict sand bottoms of the Northern Adriatic Sea. Marine Environmental Research, 64(5), pp.574-589.

- Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100SUPREME, 2018, Addressing MSP Implementation in the Case Studies, North Adriatic Case Study, Deliverable C1.3.8, CORILA & MIT, p. 234. Available at: http://www.msp-supreme.eu/results..
- United Nations Economic Commission for Europe, 2014, Environmental Performance Reviews, Second Review, ECE/CEP/172, UNITED NATIONS, pp. 234. Available at https://www.unece.org/fileadmin/DAM/env/epr/epr_studies/ECE_CEP_172_En.pdf

Provisioning ecosystem services (water):

- Borović, S., Terzić, J. and Pola, M., 2019. Groundwater quality on the adriatic karst Island of Mljet (croatia) and its implications on water supply. Geofluids, 2019.
- Capó, X., Tejada, S., Ferriol, P., Pinya, S., Mateu-Vicens, G., Montero-González, I., Box, A. and Sureda, A., 2020. Hypersaline water from desalinization plants causes oxidative damage in Posidonia oceanica meadows. Science of The Total Environment, p.139601.
- Geres, D., 2009. Water Management in Croatia: What is at Risk. In Decision Support for Natural Disasters and Intentional Threats to Water Security (pp. 159-171). Springer, Dordrecht.
- Palomar, P. and Losada, I.J., 2008. Desalinisation of seawater in Spain: aspects to be considered in the design of the drainage system to protect the marine environment. Revista de Obras Públicas, 3486, pp.37-52.
- Parihar, P., Singh, S., Singh, R., Singh, V. P., & Prasad, S. M., 2015, Effect of salinity stress on plants and its tolerance strategies: a review. Environmental Science and Pollution Research, 22(6), 4056-4075.
- Verdier, J. and Viollet, P.L., 2015. Les tensions sur l'eau en Europe et dans le bassin méditerranéen. Des crises de l'eau d'ici 2050. La Houille Blanche, (6), pp.102-107.
- Vlahović, T. and Munda, B., 2012. Karst aquifers on small islands—the island of Olib, Croatia. Environmental monitoring and assessment, 184(10), pp.6211-6228.

Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100

Provisioning ES (salt):

Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100Provisionning ES (Ornamental):

- Sidell M. (2015), Mediterranean Red Coral Jewelry Prices Soar Due to Chinese Demand, WWD, Noember 7 2018. Available at: https://wwd.com/accessories-news/jewelry/red-coral-jewelry-prices-china-demand-10274710/#!

Regulating ecosystem services:

- Basso, L., Vázquez-Luis, M., García-March, J. R., Deudero, S., Alvarez, E., Vicente, N., ... & Hendriks, I. E. (2015). The pen shell, Pinna nobilis: A review of population status and recommended research priorities in the Mediterranean Sea. *Advances in marine biology*, *71*, 109-160.
- Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100
- Canu, D.M., Ghermandi, A., Nunes, P.A., Lazzari, P., Cossarini, G. and Solidoro, C., 2015. Estimating the value of carbon sequestration ecosystem services in the Mediterranean Sea: An ecological economics approach. *Global Environmental Change*, 32, pp.87-95.
- Comici, C., & Bussani, A. (2007). Analysis of the River Isonzo discharge (1998–2005). *Bollettino di Geofisica Teorica ed Applicata*, *48*(4), 435-54.
- Cossarini, G., Querin, S., & Solidoro, C. (2015). The continental shelf carbon pump in the northern Adriatic Sea (Mediterranean Sea): Influence of wintertime variability. *Ecological Modelling*, *314*, 118-134.
- Cozzi, S., & Giani, M. (2011). River water and nutrient discharges in the Northern Adriatic Sea: current importance and long term changes. *Continental Shelf Research*, *31*(18), 1881-1893.
- d'Ortenzio, F., Antoine, D., Marullo, S., 2008. Satellite-driven modeling of the upper ocean mixed layer and air–sea CO2flux in the Mediterranean Sea. *Deep Sea Res.I* 55, 405–434.
- Drius, M., Jones, L., Marzialetti, F., de Francesco, M. C., Stanisci, A., & Carranza, M. L. (2019). Not just a sandy beach. The multi-service value of Mediterranean coastal dunes. *Science of the total environment*, *668*, 1139-1155.
- Duarte, C. M., & Krause-Jensen, D. (2017). Export from seagrass meadows contributes to marine carbon sequestration. *Frontiers in Marine Science*, *4*, 13.
- Frantar, P. (2007). Geographical overview of water balance of Slovenia 1971–2000 by main river basins. *Acta geographica Slovenica*, *47*(1), 25-45.
- Howard, J. L., Creed, J. C., Aguiar, M. V., & Fourqurean, J. W. (2018). CO2 released by carbonate sediment production in some coastal areas may offset the benefits of seagrass "Blue Carbon" storage. *Limnology and Oceanography*, *63*(1), 160-172.
- Knežević, R. (2003). Water flow conditions and stream flow regime in the catchment area of the Mirna River. *Hrvatski geografski glasnik*, *65*(2.), 81-97.
- Malone, T. C., & Newton, A. (2020). The globalization of cultural eutrophication in the coastal ocean: causes and consequences. *Frontiers in Marine Science*, *7*, 670.
- MATTM-Regioni, 2017. Linee Guida per la Difesa della Costa dai fenomeni di Erosione e dagli effetti dei Cambiamenti climatici. Documento elaborato dal Tavolo Nazionale sull'Erosione Costiera MATTM-Regioni con il coordinamento tecnico di ISPRA
- Millennium Ecosystem Assessment (MA), 2005 Biodiversity synthesis report. World Resources Institute, Washington, DC.
- Newton, A., Brito, A. C., Icely, J. D., Derolez, V., Clara, I., Angus, S., ... & Béjaoui, B. (2018). Assessing, quantifying and valuing the ecosystem services of coastal lagoons. *Journal for Nature Conservation*, 44, 50-65.
- Ondiviela, B., Losada, I. J., Lara, J. L., Maza, M., Galván, C., Bouma, T. J., & van Belzen, J. (2014). The role of seagrasses in coastal protection in a changing climate. *Coastal Engineering*, *87*, 158-168.
- Pettine, M., Patrolecco, L., Camusso, M., & Crescenzio, S. (1998). Transport of carbon and nitrogen to the northern Adriatic Sea by the Po River. *Estuarine, Coastal and Shelf Science*, *46*(1), 127-142.

- Rastelli, E., Petani, B., Corinaldesi, C., Dell'Anno, A., Martire, M. L., Cerrano, C., & Danovaro, R. (2020). A high biodiversity mitigates the impact of ocean acidification on hard-bottom ecosystems. *Scientific reports*, *10*(1), 1-13.
- Trombino, G., Pirrone, N., & Cinnirella, S. (2007). A business-as-usual scenario analysis for the Po Basin-North Adriatic continuum. *Water resources management*, *21*(12), 2063-2074.
- Zoppini, A., Ademollo, N., Bensi, M., Berto, D., Bongiorni, L., Campanelli, A., ... & Amalfitano, S. (2019). Impact of a river flood on marine water quality and planktonic microbial communities. *Estuarine, Coastal and Shelf Science*, *224*, 62-72.

Cultural ecosystem services (tourism & recreation):

- Alberini A., P. Rosato, A. Longo, V. Zanatta, 2020, Information and willingness to pay in a contingent valuation study: The value of S. Erasmo in the Lagoon of Venice Journal Of Environmental Planning and Management, 48 (2).
- Carranza, M.L., Drius, M., Marzialetti, F., Malavasi, M., de Francesco, M.C., Acosta, A.T. and Stanisci, A., 2020. Urban expansion depletes cultural ecosystem services: an insight into a Mediterranean coastline. Coastal Protection, Rendiconti Lincei. Scienze Fisiche e Naturali, 31, 103–111.
- Chung, M. G., Kang, H., & Choi, S. U., 2015. Assessment of coastal ecosystem services for conservation strategies in South Korea. PloS one, 10(7), e0133856.
- Drius, M., Bongiorni, L., Depellegrin, D., Menegon, S., Pugnetti, A. and Stifter, S., 2019a. Tackling challenges for Mediterranean sustainable coastal tourism: An ecosystem service perspective. Science of the Total Environment, 652, pp.1302-1317.
- Drius, M., Jones, L., Marzialetti, F., de Francesco, M. C., Stanisci, A., & Carranza, M. L., 2019b. Not just a sandy beach. The multi-service value of Mediterranean coastal dunes. Science of the total environment, 668, 1139-1155.
- Fetyukov A. (2015), Three facts you should know about the housing market in Slovenia, EE24, January 2nd 2015. Available at: an. 21, 2015
- Mazaris, A. D., Kallimanis, A., Gissi, E., Pipitone, C., Danovaro, R., Claudet, J., ... & Benedetti-Cecchi, L., 2019, Threats to marine biodiversity in European protected areas. Science of The Total Environment, 677, 418-426.
- Newton, A., Brito, A.C., Icely, J.D., Derolez, V., Clara, I., Angus, S., Schernewski, G., Inácio, M., Lillebø, A.I., Sousa, A.I. and Béjaoui, B., 2018. Assessing, quantifying and valuing the ecosystem services of coastal lagoons. Journal for Nature Conservation, 44, 50-65.
- Plan Bleu, 2016. Tourism and Sustainability in the Mediterranean: Key Facts and Trends. Plan Blue. Regional Activity Centre, Valbonne.
- Ruiz-Frau, A., Hinz, H., Edwards-Jones, G., & Kaiser, M. J. (2013). Spatially explicit economic assessment of cultural ecosystem services: Non-extractive recreational uses of the coastal environment related to marine biodiversity. Marine Policy, 38, 90-98.
- Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100SUPREME, 2018, Addressing MSP Implementation in the Case Studies, North Adriatic Case Study, Deliverable C1.3.8, CORILA & MIT, p. 234. Available at: http://www.msp-supreme.eu/results Zunino, S., Melaku Canu, D., Marangon, F. and Troiano, S., 2020. Cultural Ecosystem Services Provided by Coralligenous Assemblages and Posidonia oceanica in the Italian Seas. Frontiers in Marine Science, 6, p.823.

Cultural ecosystem services (research & scientific knowledge):

- Chan, K. M., Goldstein, J., Satterfield, T., Hannahs, N., Kikiloi, K., Naidoo, R., ... & Woodside, U. (2011). Cultural services and non-use values. In: P. Kareiva, H.

Tallis, T.H. Ricketts, G.C. Daily, S. Polasky (Eds.), *Natural Capital: Theory and Practice of Mapping Ecosystem Services*, Oxford University Press, Oxford (2011), pp. 206-228.

- Costanza, R., Kubiszewski, I., Ervin, D., Bluffstone, R., Boyd, J., Brown, D., ... & Shandas, V. (2011). Valuing ecological systems and services. F1000 biology reports, 3. p. 14, 10.3410/B3-14
- Fish, R., Church, A. and Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. Ecosystem Services, 21, pp.208-217.
- Campostrini, P., Manea, E., Bassan, N., Fabbri, F., Farella, G., Di Blasi, D., Morelli, M., Montanaro, O., Gomez-Ballesteros, M., Borg, M., Giret, O., Maragno, D., Innocenti, A., Cervera-Nuñez, C., Rosina, A., Venier, C., Sarretta, A., Barbanti, A., Braida, M., … Gissi, E. (2019). SIMWESTMED - Initial Assessment MSP oriented (R1). Zenodo. https://doi.org/10.5281/zenodo.2590100SUPREME, 2018, Addressing MSP Implementation in the Case Studies, North Adriatic Case Study, Deliverable C1.3.8, CORILA & MIT, p. 234. Available at: http://www.msp-supreme.eu/results.
- Ullmann, J., & Stachowitsch, M. (2015). A critical review of the Mediterranean sea turtle rescue network: a web looking for a weaver. Nature Conservation 10: 45-69. doi: 10.3897/natureconservation.10.4890
- Vilibić, I. et al. (2019), D3.1.1 Report on the assessment of existing ecological monitoring programs and observing systems, WP3 – Design of the Ecological Observing System in the Adriatic Sea (ECOAdS), A3.1 – Assessment of existing ecological monitoring programmes and observing systems, www.italy-croatia.eu/ecoss
- OECD, 2019 https://www.oecd.org/gov/gov-at-a-glance-2019-slovenia.pdf
- Web-site: https://www.reuters.com/article/us-croatia-dubrovnik-idUSKBN1KP0BF

Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning

V

The Massachusetts Ocean Management Plan: Revised Case Study Report

Written by Louise Lieberknecht, GRID-Arendal
July – 2021

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LIST OF ABBREVIATIONS

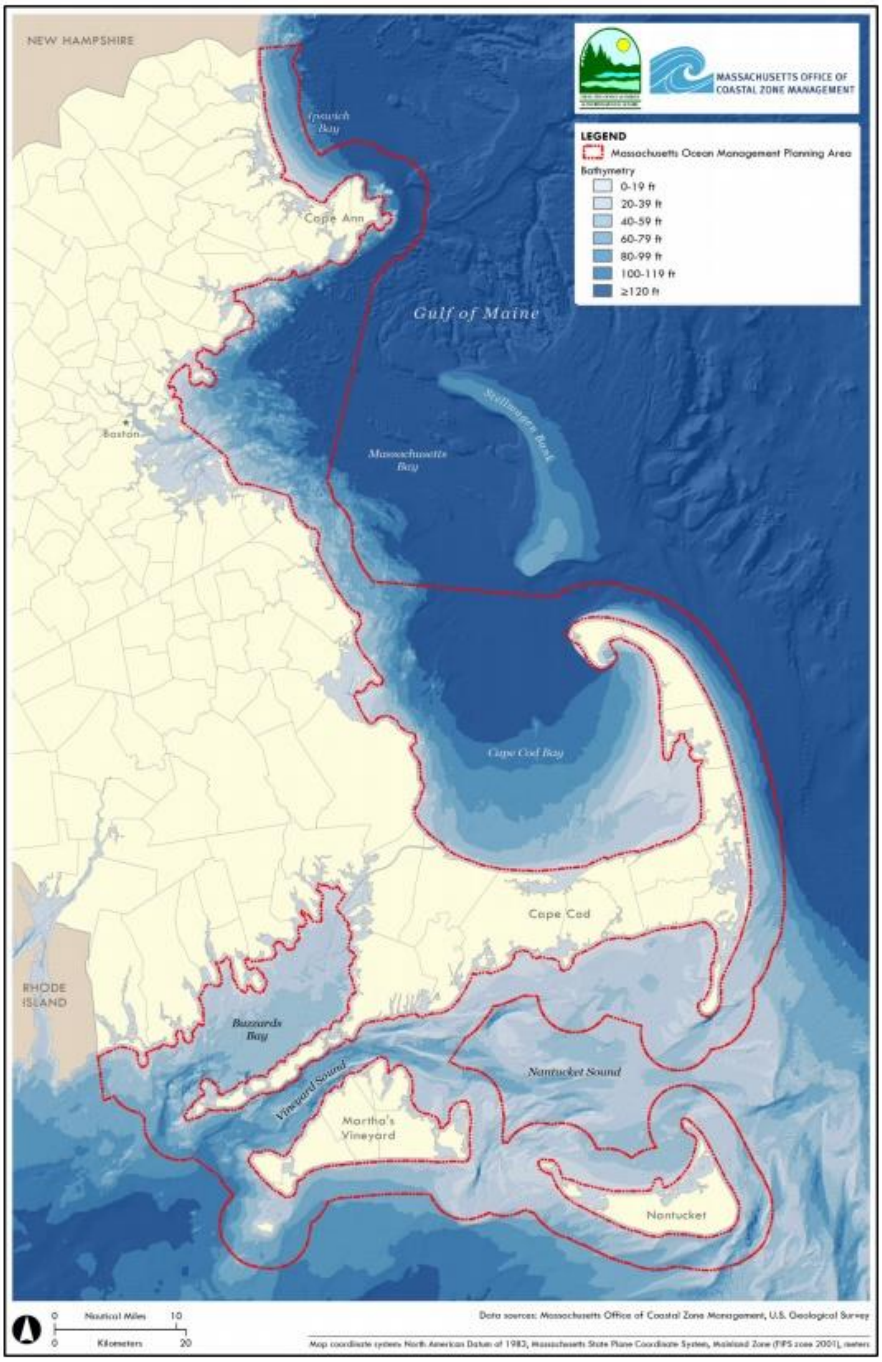
CZM	Massachusetts Office of Coastal Zone Management
DEP	Department of Environmental Protection
DMF	The Massachusetts Division of Marine Fisheries
EU	European Union
EA	Ecosystem Approach
EASME	Executive Agency for Small and Medium-sized Enterprises
EBA	Ecosystem-Based Approach to management
EBM	Ecosystem-Based Management (*the application of the Ecosystem Approach*)
EEA	Executive Office of Energy and Environmental Affairs (Massachusetts)
MOPF	Massachusetts Ocean Partnership Fund
MSP	Marine Spatial Planning
OAC	Ocean Advisory Commission
OMP	Massachusetts Ocean Management Plan
SAC	Science Advisory Council
SSU	Special, Sensitive or Unique Natural Resources
US	United States

1. SUMMARY

1.1 Location

This case study analysis focuses on the Massachusetts Ocean Management Plan (OMP) process under the Massachusetts Oceans Act 2008. The state of Massachusetts lies on the northeastern seaboard of the US, and the planning region defined by the legislation spans from 0.3nm from the coastline to the 3nm limit of state waters (internal bays are also covered). A map of the planning region covered by this case study is shown in Figure below.

FIGURE 1: PLANNING AREA FOR THE 2015 MASSACHUSETTS OCEAN MANAGEMENT PLAN



Note: The red line encompasses the planning area
Source: Commonwealth of Massachusetts, 2015

1.2 Overview

In 2004, a multisectoral oceans Task Force (established by the Massachusetts state government) published a report called *Waves of Change,* which set out a comprehensive vision for ecosystem-based, integrated management of the state's waters as well as a series of clear recommendations for achieving this vision. In the wake of this seminal publication, a public-private partnership (the Massachusetts Ocean Management Fund or MOPF) formed by relevant state agencies, industry and stakeholder bodies, and NGOs was established with a grant from a private foundation. Over the following years, this body carried out a comprehensive multidisciplinary process of data collection to build the knowledge foundation for an integrated ocean management process, and conducted a detailed and intensive process of stakeholder engagement to gather views and information from sea users around the state to help inform the plan.

The legislation underpinning the formal process that gave rise to the OMP - the Oceans Act - came into force in May 2008. It was the first ocean management act in the USA (and one of the first anywhere in the world) that aimed to create a multi-sectoral integrated regulatory system to balance current and future commercial and recreational uses of the sea with the protection of the marine environment. It encompassed a wide range of regulated human uses (including offshore energy developments, aquaculture, sand extraction, and cables and pipelines). These are regulated activities that, for projects or developments above a certain size threshold, must undergo environmental impact assessments (EIA) as part of the process of obtaining licenses or permits.

The first OMP was completed by 2009, identifying three management areas within state waters with specific siting and performance standards: mixed / multi-use (85% of the planning area, open to a wide range of activities including cables, pipelines, aggregate extraction), renewable energy (2% of the planning area – specific sites identified as having the most potential suitability for commercial wind farm developments), and protected areas (the remaining 13% of the planning areas). In addition, the OMP defined eleven special, sensitive and unique (SSU) features (species and habitats) and mapped the extent of their spatial distribution. Wherever SSU features occur, regulated activities must ensure their integrity, including in the multi-use area.

1.3 Cross-cutting issues and processes

This case study looks at two key cross-cutting issues relevant for operationalising EBA: adaptive management; and the integration of knowledge, perspectives and work from different sectors and sources.

The Oceans Act requires that the OMP must be reviewed at minimum once every five years. The first review cycle was complete in 2015, and at the time of completing this analysis, the second review cycle was still underway. This case study is thus a rare example of a multi-sectoral formal marine planning process that has undergone two complete planning cycles, constituting adaptive management in practice. The review processes to date have mainly focused on updating the science underpinning the OMP, in particular, the SSU distribution maps.

Integration has multiple facets that have played out in different ways at different stages of this process. The MOPF, consisted of a core group of experts responsible for the day-to-day operations of the stakeholder engagement and scientific information gathering processes, advised by a multidisciplinary scientific and technical body and a multi-sectoral strategic planning committee, and managed by a multi-agency steering group that included representation from public authorities with responsibilities for ocean and coastal management. As such, the MOPF formed a mechanism for the integration of knowledge from multiple academic disciplines (knowledge integration), for integrating the perspectives of multiple stakeholder sectors (stakeholder integration – both through the representatives on the strategic advisory committee and the steering group, and through outreach and facilitated engagement with the wider stakeholder communities across the state), and for integrating the work of multiple public authorities (governance integration). The wider stakeholder engagement process (public meetings and workshops) at the time took the form of a deliberative process.

However, the MOPF was established prior to the Oceans Act and its formal role was only ever advisory, playing a key supporting role to the formal process established for ocean management under the new legislation during the development of the initial plan, and in the early stages of the first review cycle. After 2014, the formal process took over, and the MOPF ceased to operate.

The Oceans Act created two new bodies to oversee and inform the OMP process, an ocean advisory commission (the OAC, consisting of representatives of all the relevant state authorities as well as major sectors of industry and NGOs) and a science advisory council or SAC. These bodies maintain some of the governance, knowledge and stakeholder integration, but to a much lesser extent than the MOPF did. The outward-facing stakeholder engagement (public involvement) in the formal process of the review cycles has also reduced in intensity, having changed to a consultative process with fewer public meetings and workshops, but in which sea users and other interested parties are still able to comment on the scope and content of reviews to the OMP, and to contribute their knowledge.

The MOPF considered all human activities taking place at sea, and spanned across the land-sea interface in that the strategic advisory group and steering committee included representatives of port authorities and coastal municipalities. The scope of the formal OMP process has a lower level of transboundary integration, as it excludes the first 0.3nm of state waters immediately adjacent to the coast, as these coastal waters are covered by integrated coastal zone management, a process in place before the OMP. (It appears that integration of coastal and ocean management planning occurs largely based on informal mechanisms, facilitated by the fact that there is strong overlap in the government authorities and expert advisers involved in both).

Fisheries management remains within the remit of existing fisheries management bodies and laws rather than being subsumed into the OMP. However, experts from the state fisheries authority are on the SAC, and fisheries are also represented on the OAC, to help ensure consistency of fisheries management measures with the measures put in place under the OMP.

1.4 Methods and tools

The MOPF undertook a series of strategic planning exercises and explored different potential future management scenarios that made use of a range of technical decision support tools, however, this work preceded the establishment of the formal planning process and had limited direct, tangible impact on the shaping of the initial OMP.

The MOPF also undertook a comprehensive scientific gap analysis that cut across multiple disciplines (natural and social sciences, economics, policy analysis), catalysing research and data collation efforts to fill the most significant information gaps, thereby ensuring that the 2009 OMP was based on a solid, systems-level understanding of the OMP area, based on the best possible evidence available. At the same time, the MOPF commissioned a comprehensive vulnerability assessment that gathered information (from scientific literature and experts familiar with the region) on the vulnerabilities of different ecosystem components to 58 anthropogenic stressors. This vulnerability assessment underpinned the selection of the official SSU list.

1.5 Concluding notes

The Massachusetts OMP represents a rare example of an integrated, multi-sectoral ocean planning process that integrated core principles of EBA from the very beginning, starting with *Waves of Change* and the recommendations therein in 2004, through the advisory and exploratory work of the MOPF to the formal process currently in place to review the OMP periodically. To some extent, the idealised vision of EBA in practice that formed the basis for the suite of recommendations in *Waves of Change* hit barriers when it came to translating it into real-world practice: The provisions in the Oceans Act are much less comprehensive and systems-oriented. Nevertheless, some EBA principles have permeated through the process of drafting the legislation and putting it into practice, particularly in relation to the different forms of integration mentioned above, and to adaptive management.

The central lesson that can be taken from this case study is that **intense stakeholder collaboration can serve as a highly effective vehicle for EBA**, **but it requires significant levels of resource** commitment if it is to be maintained over time.

The case study also illustrates that **the wording of legislation matters** for EBA to work in practice. The legislation underpinning this case study includes requirements to respect the interdependence of ecosystems, coordinate multiple uses, and to review the plan every 5 years, thereby ensuring some level of adaptive management. There is also an unambiguous requirement to identify and protect a list of priority ecosystem components (that are special, sensitive or unique), which scientists and stakeholders can select and review over time. The case study illustrates the importance of having a strong and specific enough set of environmental requirements in the legislation to prevent the watering down of the environmental provisions. However, the wording should also be flexible enough for management to be adaptive and for the implementation process to test different approaches and techniques that can adapt and evolve over time to produce the best possible outcomes.

Like in the EU, in Massachusetts open water **fisheries is treated differently** from every other type of human activity at sea, in that fishing is exempt from EIA requirements, even for operations carried out at significant scale. This disconnect between management approaches to different human activities creates an obstacle to integrated management, but this case study illustrates that it can be addressed by bringing the relevant management authorities together during planning and implementation, and by building trust and ongoing good relationships between them to facilitate the exchange of information and reduce potential conflicts.

Finally, this case study illustrates how **adaptive management can be implemented through an expert- and stakeholder-based approach, which can serve as a very effective complementary approach to metric-driven adaptive management cycles** in the EU context.

2. INTRODUCTION

2.1 About this report

This report is a deliverable written for the EU project EASME/2019/OP/0002: *Study on Integrating an Ecosystem-based Approach into Maritime Spatial Planning, in particular in the Context of the Implementation of the Directive 2014/89/EU* (EASME/EMFF/2018/1.3.1.1)[143].

It analyses a Maritime Spatial Planning (MSP) case study to assess ways in which elements of ecosystem-based management (EBM) were operationalized in the context of applied MSP. Specifically, the focus here is on the development and review of the Massachusetts Ocean Management Plan (hereafter "the OMP plan") under the state's Oceans Act of 2008 (Commonwealth of Massachusetts 2008). This was selected as a case study for inclusion in this project because it represents a rare example of a multi-sectoral MSP process that has already undergone several rounds of review, thus demonstrating adaptive management in practice.

The analysis presented here covers the time period from the mid-2000s (i.e. the years immediately preceding the enactment of the Oceans Act) through to the first quarter of 2020 (the document research and interviews for this analysis were conducted between March and June 2020). At the time that the draft of this report was being finalised, some brief additional notes were included relating to events occurring more recently (up until January 2021).

The report begins by presenting some brief case study context, a list of formal actors in the process along with their remits and roles, and a timeline of key events. This "telling of the story" provides readers unfamiliar with an easy entry point to the case study, and the contextual information they need to understand the second section of the case study report, which analyses specific EBM-related process elements in more depth. These include adaptive management, the integration of the ecological dimension into strategic goals and process implementation, and cross-cutting elements of integration (governance integration, transboundary integration, knowledge integration, and stakeholder engagement). The aim is to illuminate the processes by which elements of EBM have been operationalised.

2.2 Methods

2.2.1 Evidence gathering

The qualitative data underpinning this case study analysis are drawn from a review of relevant published documentation (legislation, grey literature and peer-reviewed articles), as well as interviews carried out with process participants. Unlike many real-world MSP processes, this is a richly documented case study, with comprehensive grey

[143] The project was contracted by the Executive Agency for Small and Medium-sized Enterprises (EASME), which in 2021 became The European Climate, Infrastructure and Environment Executive Agency (CINEA)

literature publically available on the website of the state government[144]. The documents available either on this website or easily accessible via links from this website include:

- Full text of relevant state legislation on the ocean environment, including the Massachusetts Oceans Act 2008 and the Massachusetts Ocean Sanctuaries Act 1970 and its 1989 amendment[145]
- The 2015 Ocean Management Plan and a long list of ancillary documents which outline the process by which the plan was developed (including the stakeholder process), the ways in which the plan is implemented and administered, as well as more technical documents outlining the findings of the baseline assessment and other scientific analyses conducted)
- The official data portal for ocean management in Massachusetts[146]
- The 2009 Ocean Management Plan and ancillary documents,
- Process documents published in between 2009 and 2015 relating to the evaluation, review and update of the original plan
- Membership and terms of reference of the Ocean Advisory Commission and the Ocean Science Advisory Council (see list of actors below)
- Documents funded by the Massachusetts Ocean Partnership (subsequently known as SeaPlan, now defunct - see list of actors below) that include reports outlining external observation and evaluation of the stakeholder engagement process, the use of scientific tools in the process, and technical documents created to support the process.

In addition, academic publications that make reference to the Massachusetts OMP or are otherwise relevant to its context are cited throughout this report.

The interviews were conducted from March to May 2020. As a first step, the individuals listed as members of the Ocean Advisory Commission and the Ocean Science Advisory Council were contacted as potential interviewees, and where the response was positive, they were asked for suggestions of additional suitable interviewees to reach out to in order to get a rounded view of the process. In total, seven interviews were conducted and recorded (after receiving explicit consent from interviewees to do so), providing almost eight hours of recorded material in total. On the basis of this recording, each interview was summed up in written form in an interview report. These reports (along with recordings and interview names) have been kept confidential, minimising constraints on interviewees to speak as freely as they wished about their experiences and perspectives. These seven interview reports provided a rich source of information that the present document has drawn from extensively, without attributing specific points to specific interviewees (to maintain anonymity).

Interviewees were selected to cover a wide range of experiences and perspectives on the plan development and review process, with the interviewees' collective experience spanning a time period of around 15 years (from the period during which the legislation was drafted and the initial planning process was being established in the mid-2000s to the present day). The group of interviewees included representatives from the Ocean Advisory Commission, the Ocean Science Advisory Council and the now defunct Massachusetts Ocean Partnership/SeaPlan (see list of actors in section

[144] https://www.mass.gov/service-details/massachusetts-ocean-management-plan (with a publications list at https://www.mass.gov/service-details/czm-ocean-management-publications)

[145] relevant federal legislation is listed here: https://www.epa.gov/beach-tech/laws-protect-our-oceans

[146] http://maps.massgis.state.ma.us/map_ol/mass_ocean_plan.php

2.2 below), providing perspectives from individuals with different roles and sectoral priorities and expertise from several scientific disciplines. The roles they covered included, *inter alia:*

- Process design and management
  - Early goal formulation, evidence collation, strategic process development and management, and stakeholder process management (run-up to the Oceans Act coming into force and, subsequently, the first plan being developed in 2009, including through the MOPF and Task Force)
  - Overseeing & delivering current review process (including shaping the stakeholder engagement process, the roles and responsibilities of participants)
  - Coordination with bodies and processes for planning across coastal / terrestrial planning, inter-state, and state-federal boundaries
- Stakeholder input into the ongoing review process
  - Providing input to plan development and review from sea users' perspectives
  - Providing input to plan development and review from conservationist perspective
- Providing expert scientific input into planning and review processes (including on ecosystem processes, fisheries management, and on specific habitats and / or species groups)
- Drafting of the Oceans Act

The interviews were semi-structured, using the subheadings in section 3 as an interview framework. Each interviewee was asked questions related to each of the subheadings, with the degree of depth and detail of the questions adjusted depending on the perspectives, opinions and expertise expressed in the answers. The phrasing of the questions was adjusted depending on the role and expertise of the interviewee, avoiding the use of abstract language that is used in some of the headings and content of this report. For example, when addressing governance integration, instead of asking "What is the degree of governance integration between public bodies involved in the state process?", a question might have been phrased as "Do you ever feel like you're being pulled in different directions by different state agencies, or are they consistent with each other?" Whenever possible, questions built on previous comments or statements, creating a natural flow to the conversation and assuring the interviewee that they were being listened to with interest (instead of them being hurried through a rigid "checklist" of perfunctory standard questions).

Open questions (e.g. "What do you wish someone had told you before you got involved in this planning process?") were used to elicit additional issues or themes that interviewees saw as important, and these were explored more deeply with follow-up questions. As such, the topics covered by each interview varied a lot, and the direction of the conversation was steered not only by the framework of section 3, but also by the interviewees themselves. Where appropriate, interviewees were encouraged to raise challenges they encountered with the process (as well as positive experiences), although they retained control over the level of detail they delved into at all times.

The interview summaries that were generated through this process differ markedly in terms of the perspectives they open up onto the OMP process, and in terms of the relative amount of information each individual interviewer brought to each of the subheading in section 3. Some interviewees contributed a lot of information relevant to stakeholder engagement, for example, while others contributed a lot of reflections on technical matters (e.g. the extent to which the OMP addresses & responds to ecosystem trends and functions, or the way in which priority conservation features were selected). Some interviewees brought a lot of historical knowledge, while others were actively involved in the current review process. In combination, the interview summaries have provided a rich source of information that forms the backbone of this report, helping to anchor and contextualise the content of published grey and academic literature, and place these published sources in relation to each other in a way that tells a coherent "story".

At this point, it is important to raise a disclaimer: There will be as many versions of this "story" as there are participants in the OMP process, and researchers / observers of it, each with their own values and perspectives that will shape their interpretation of why, when and how events unfolded, and of how events influenced each other or were influenced by the wider social, political, historical or economic context. The version of the "story" that is told and deconstructed in this report is told by a person entirely external to the events being analysed, based on evidence drawn entirely from the sources cited at the end of this report as well as the hours of interview recordings. This evidence is viewed through a very specific type of lens, reflecting the interest of the EU project that this report ultimately serves to inform: the operationalization of EBA in practical ocean management. As such, no claims are made regarding the comprehensiveness and authoritativeness of the "story" as it is presented here. It is merely one analysis, one very particular way of looking at the process, focused on a specific angle, drawing from the evidence sources that were accessible within the relatively short amount of time available to conduct the research for this case study.

2.2.2 Analysis and structure of this report

Section 2 of this report presents an overview of the case study, including a list of central actors and a timeline of some of the most relevant events. This section serves to familiarise the reader with the basic story of the process. Sections 3 and 4 then deconstruct and analyse the case study, with a view to establishing what elements of EBA have been put into practice, and what value they have added.

There is a lot overlap between the concepts of EBA and the concept of MSP (e.g. see Lieberknecht 2020), so it is not always easy to specify the difference between the two and to capture what EBA brings in addition to wider MSP. Furthermore, few (if any) published reports or references exist that specifically, systematically or explicitly address the impacts of EBA for this case study.

Lieberknecht (2020) provides an overview of the elements of integrated ocean management, which for the purpose of this case study analysis can be interpreted to mean ecosystem-based MSP. The headings in section 3 are drawn from this source, and they serve as a framework for deconstructing this case study into elements that reflect (to a greater or lesser extent) the elements of ecosystem-based MSP. This deconstruction is the first step of this case study analysis.

The second step of the analysis, presented in section 4, then casts a closer eye on the added value that EBA (as distinct from MSP) has brought to this case study. The headings in this section are based on work completed for other tasks in the EASME project referred to above, which has identified principles of EBA as distinct from wider MSP, with special emphasis on identifying its "added value", i.e. the positive impacts of applying EBA principles within the context of MSP. The questions of focus are how EBA helps to "do" and "decide" better, and as a result which likely potential social, economic and environmental benefits can be expected.

3. CASE STUDY OUTLINE

3.1 Key Legislation

The main piece of legislation underpinning this case study is the state's Oceans Act of 2008 (Chapter 114 of the Acts of 2008, see Commonwealth of Massachusetts 2008[147]), which came into force in May 2008. It was the first ocean management act in the USA (and one of the first anywhere in the world) that aimed to create a multi-sectoral integrated regulatory system to balance current and future commercial and recreational uses of the sea with the protection of the marine environment. It requires the relevant state bodies to develop an ocean management plan. Once this plan is adopted, the Oceans Act stipulates that all certificates, licenses, permits and approvals for any proposed structures, uses or activities within the waters of the commonwealth have to be consistent, to the maximum extent practicable, with the plan. Box 1 reproduces extracts from section 4C of the Oceans Act, which stipulate key environmental provisions as well as a requirement for a 5-yearly review of the OMP.

BOX 3: EXTRACTS FROM THE OCEANS ACT (COMMONWEALTH OF MASSACHUSETTS 2008) THAT STIPULATE ITS KEY ENVIRONMENTAL PROVISIONS AND A REQUIREMENT FOR A 5-YEAR REVIEW CYCLE.

Section 4C (a) The plan shall: (i) set forth the commonwealth's goals, siting priorities and standards for ensuring effective stewardship of its ocean waters held in trust for the benefit of the public; and (ii) adhere to sound management practices, taking into account the existing natural, social, cultural, historic and economic characteristics of the planning areas; (iii) preserve and protect the public trust; (iv) reflect the importance of the waters of the commonwealth to its citizens who derive livelihoods and recreational benefits from fishing; (v) value biodiversity and ecosystem health; (vi) identify and protect special, sensitive or unique estuarine and marine life and habitats; (vii) address climate change and sea-level rise; (viii) respect the interdependence of ecosystems; (ix) coordinate uses that include international, federal, state and local jurisdictions; (x) foster sustainable uses that capitalize on economic opportunity without significant detriment to the ecology or natural beauty of the ocean; (xi) preserve and enhance public access; (xii) support the infrastructure necessary to sustain the economy and quality of life for the citizens of the commonwealth; (xiii) encourage public participation in decision-making; (xiv) and adapt to evolving knowledge and understanding of the ocean environment; and (xv) shall identify appropriate locations and performance standards for activities, uses and facilities allowed under sections 15 and 16 of chapter 132A. The division of marine fisheries, pursuant to chapter 130 and any other applicable general or special law, shall have sole responsibility for developing and implementing any fisheries management plans or fisheries regulations.

[...]

Section 4C (h) The secretary shall promulgate regulations to implement, administer and enforce this section and shall interpret this section and any regulations adopted hereunder consistent with his power to enforce the laws. These regulations shall include provisions for the review of the ocean management plan, its baseline assessment and the enforceable provisions of relevant statutes and regulations at least once every 5 years.

(Note: "Chapter 132A" refers to another piece of legislation, and "Secretary" refers to the secretary of energy and environmental affairs.)

[147] Massachusetts is one of four US states called a "commonwealth" in their constitutions. This term is commonly used in official documentation related to this case study and is therefore also used in several places in this report, always in reference to the state of Massachusetts.

Key points to note about this piece of legislation for the purpose of this case study are as follows:

- It applies to the waters, seabed and subsoil of almost the entirety of sea area that falls within the jurisdiction of the Commonwealth of Massachusetts – specifically, from 0.3 to 3 nautical miles (0.56 to 5.56 km) from shore (also including internal bays, as showing in the figures in Section 3.3.2). The immediate waters of the shoreline (within 0.3nm) are excluded, although activities there are regulated through a variety of state and municipal measures. Beyond 3nm, federal jurisdiction applies.
- It was the first state legislation of its kind in the U.S., requiring the creation of a plan that addresses ocean uses and development that are incompatible with each other or with sustainable use of natural resources, aiming for an overall balance among use, protection, and development. As such, the legislation spans across social, economic and environmental dimensions.
- It sets out a clear timeline for implementation, requiring a comprehensive ocean management plan to be in place by the end of 2009, and requiring a review thereof every five years subsequently (see section 4C(h) in Box 1 above)
- The responsibility for developing the ocean management plan formally lies with the Secretary of the Executive Office of Energy and Environmental Affairs (EEA) (who, in practice, delegate much of the work to the Massachusetts Office of Coastal Zone Management or CZM): the EEA Secretary has formal oversight, coordination, and planning authority for the Commonwealth's ocean waters and ocean-based development.
- Through the provisions in section 4C of The Oceans Act (see Box 1), the EEA is required to develop an integrated ocean management plan that:
  - defines the Commonwealth's goals, siting priorities, and standards for ensuring effective stewardship of ocean waters and resources held in trust for the benefit of the public;
  - reflects the importance of these waters to the Commonwealth's citizens who derive livelihoods and recreational benefits from fishing;
  - values biodiversity and ecosystem health;
  - identifies and protects special, sensitive, or unique estuarine and marine life and habitats (SSU);
  - identifies appropriate locations and performance standards for activities, uses, and facilities allowed by the Ocean Sanctuaries Act
- The activities managed through the OMP include offshore renewables, cables and pipelines, sand extraction and aquaculture (the list of these activities can be amended). These are regulated activities that, for projects or developments above a certain size threshold, must undergo environmental impact assessments (EIA) as part of the process of obtaining licenses or permits. The licensing processes (implemented under Chapter 91, see below) provide a mechanism for imposing restrictions or conditions on these activities to reduce their environmental impacts and their impacts on potentially conflicting other human uses. Thus, the OMP provides an overarching mechanism for streamlining these processes and approaching them in a more strategic and integrated manner.
- Fisheries, however, is treated differently from all of these regulated activities. It is the only human activity explicitly mentioned as requiring protection in its own right in the Oceans Act (see Box 1), alongside ecosystem features and economic development more generally. More importantly, it can't be regulated through the OMP process – fisheries management and regulation remains the sole responsibility of existing authorities (including the DMF) and existing fisheries legislation.

Other important pieces of legislation are referred to in the timeline in section 3.3.1. Most notably, the state's Ocean Sanctuaries Act (initially passed in 1970, with subsequent amendments) provides the legal basis for the establishment of marine protected areas within state waters.

3.2 Key actors

This section sets out some of the key organisations involved in the process. It should not be seen as a comprehensive list of every actor that has ever been engaged with the process or played a role in it, but it lists the most prominent players (primarily based on those who were mentioned most frequently by interviewees) and provides an indication of the range, number and diversity of actors that the process has integrated since its beginning.

Two of the institutions listed here were created specifically for the implementation of the 2008 Ocean Act (these are the Science Advisory Council or SAC, and the Ocean Advisory Commission or OAC, both indicated with an asterisk). Most of the work for the process, however, has relied and continues to rely on capacities of pre-existing organisations and institutions. This includes state bodies with formal responsibilities in relation to the OMP, as well as federal bodies with responsibilities in the outer continental shelf area, i.e. the waters adjacent to state waters (which end at 3nm) out to the limits of national jurisdiction. Further actors with responsibilities in areas adjacent to the OMP area are mentioned in section 3.1.6. (on transboundary integration).

3.2.1 Federal actors

Bureau of Ocean Energy Management (BOEM): Part of the US Department of the Interior, the BOEM is the federal agency managing the development of activities related to exploitation of energy and mineral resources of the US Outer Continental Shelf (beyond the jurisdiction of state waters). This includes offshore oil and gas developments and renewable energy developments.

National Oceanic and Atmospheric Administration (NOAA): In relation to ocean management, NOAA are responsible for ocean observation and monitoring, scientific advice and resource management in US federal waters. During the late 2000s and early 2010s (at the time that the Massachusetts Oceans Act was being drafted and the first plan was being developed), NOAA was an active promoter of MSP and marine protected area planning in federal waters, reflecting political priorities under the Obama Administration.

3.2.2 State Actors

Executive Office of Energy and Environmental Affairs (EEA): The EEA is an office of the state government of Massachusetts, under a Cabinet secretary who is responsible for natural resource management and energy. The EEA acts as an executive agency in the Ocean Plan process, with responsibility for developing, implementing and reviewing the plan under the Oceans Act 2008. The EEA also sees itself as an important information provider to the public in relation to this process[148].

[148] https://www.mass.gov/orgs/executive-office-of-energy-and-environmental-affairs.

There are six environmental and energy agencies overseen by the EEA. The Oceans Act requires EEA to review and update the ocean plan at least once every five years – this is carried out by one of these six agencies, the Massachusetts Office of Coastal Zone Management (CZM).

The Massachusetts Office of Coastal Zone Management (CZM): one of the six agencies of the EEA. It is the lead policy, planning, and technical assistance agency on coastal and ocean issues within the EEA and implements the state's coastal program under the federal Coastal Zone Management Act[149].

The Massachusetts Division of Marine Fisheries (DMF): The state body responsible for regulating marine fisheries, both commercial and recreational[150].

Massachusetts Department of Environmental Protection (DEP): The state body responsible for enforcing environmental laws to protect air, land and water in the state, including in relation to environmental threats to public health and the economy, as well as in relation to protecting natural resources[151].

The Ocean Advisory Commission (OAC): A 17-member commission that includes legislators (members of the state Senate and House of Representatives), agency heads (CZM, DMF and DEP), and stakeholder representatives (MA Lobstermen's Association, an expert in offshore renewable energy, Cape Cod Commission, Martha's Vineyard Commission, Nantucket Planning & Economic Development Commission, Southeast Regional Planning and Economic Development Commission, Atlantic White Shark Conservancy, Merrimack Valley Planning Commission and Metropolitan Area Planning Council). The Oceans Act charged the OAC with assisting the EEA in developing the ocean management plan by holding public meetings and making recommendations for the proper management and development of the plan. The OAC provides advice and guidance on reviewing and amending the plan, ongoing implementation, and related ocean management issues[152].

Science Advisory Council (SAC): The SAC[153] is made up of nine scientists with expertise in the marine sciences and data management assembled to assist the Secretary of Energy and Environmental Affairs in the science and technical aspects of developing and implementing the Massachusetts Ocean Management Plan. SAC membership includes experts from NGOs, state bodies, and two universities, with every SAC member bringing relevant scientific expertise to the table. The SAC assists with: reviewing data sources and identifying other viable data, assisting in the development of the baseline assessment and characterization of the ocean planning area, identifying "big picture" questions to improve understanding of the natural systems and/or human uses and influences, and helping to formulate a long-term strategy for addressing information gaps.

Working Groups: The CZM has, at various stages of the process, convened thematic working groups to support the Ocean Plan development and review process. For the 2014 update of the plan, six working groups were created, focusing on

1. Habitat,
2. Fisheries,

[149] https://www.mass.gov/orgs/massachusetts-office-of-coastal-zone-management

[150] https://www.mass.gov/orgs/division-of-marine-fisheries

[151] https://www.mass.gov/orgs/massachusetts-department-of-environmental-protection

[152] https://www.mass.gov/service-details/ocean-advisory-commission

[153] https://www.mass.gov/service-details/ocean-science-advisory-council

3. Sediment resources,
4. Recreational and cultural services,
5. Transportation and navigation, and
6. Energy and infrastructure.

These working groups have been carried forward into the current review period. They carry out a lot of the research and information gathering work for the SAC, allowing the SAC to draw in knowledge and expertise that is wider than the SAC membership (as the Working Group membership is wider and more flexible, with membership managed by the CZM). The Working Groups respond to requests from SAC members to research particular questions in detail, though they have, on occasion, also raised issues or brought forward information under their own initiative. Given that these groups are convened and managed under the auspices of the CZM, their remit hasn't always been restricted exclusively to the Ocean Plan (e.g. they have also addressed coastal issues that fall outside the agreed boundary covered by the Ocean Plan).

3.2.3 Temporary Actors

Massachusetts Ocean Partnership Fund / SeaPlan (2006-2014)

MOPF, subsequently renamed as SeaPlan, was a multisectoral public/private collaborative that was initially established to support efforts in Massachusetts to move toward comprehensive ocean management through implementation of an ecosystem-based approach. In its original form, the MOPF was established several years prior to the passing of the Massachusetts Oceans Act in 2008. It was initially funded for 5 years through a grant from a private foundation (the Gordon and Betty Moore Foundation), allowing it to carry out extensive work to support integrated ocean management in Massachusetts state waters, although its formal role was always advisory.

The ambitions of the MOPF at the time of its establishment are set out in its Convening Report (Massachusetts Ocean Partnership Fund 2006) and include a science component (identifying gaps in scientific information about the state's ocean environment and addressing those gaps through data collation and commissioning new research) as well as a strategic planning component (developing ideas for improving and better integrating management of state waters), with a strong collaborative stakeholder approach cutting across both those components. The work was overseen by a Steering Committee, a Strategic Planning Group, and a Science and Technical Group. The Steering Committee acted as the management body, responsible for ensuring that the MOPF met its goals, while the Strategic Planning Forum was a multi-interest forum with broad stakeholder representation to support the strategic planning work, and the Science and Technical Group was a group of experts who were tasked with overseeing the scientific component of MOPF's remit. Members of the initial Strategic Planning Group and Steering Committee in 2006 are listed in Box 2 below.

The MOPF established a collaborative process that brought together members and volunteers from a wide range of sectors, organizations and companies with an interest in ocean management, bringing together expertise on the social and natural environment as well as different stakeholder interests to illuminate potential future pathways for improved ocean management in the state's waters. The MOPF was, inter alia, responsible for funding the first science gap analysis completed in advance of the 2009 plan (Mooney-Seus & Allen, 2007), which covered gaps in data as well as identifying challenges in governance and institutional barriers in the way of the ecosystem approach. The MOPF worked very extensively with stakeholders throughout the state, gathering data to support the mapping of environmental features, develop a proposed list of priority features for protection, and even conducting spatial management scenario planning using Marxan and other tools. An extensive list of outputs of this work has been archived on the OpenChannels archive[154]. The SeaPlan website[155] is no longer being maintained but was still accessible at the time of writing.

Although representatives of the relevant state bodies worked closely with the MOPF, the role of the MOPF remained advisory throughout. Its establishment predated the Oceans Act, and it never had a formal mandate to implement any part of this legislation (unlike the SAC and OAC). This meant that although the work carried out by the MOPF undeniably made a very significant contribution to the scientific evidence base underpinning the first OMP, the CZM (supported by the SAC and the OAC) retained control over the drafting of the plan itself, and over the subsequent public consultation process on that plan.

After the initial grant funding for the MOPF ended, the organisation reinvented itself as SeaPlan, as an expert body offering support to ocean planning processes in Massachusetts and more widely in the US. However, they were unable to secure enough funding to persist in the long term. SeaPlan played a much more limited role in supporting the 2015 OMP review, and are now no longer operational. The 2020 review[156] is being carried out entirely under the auspices of CZM (supported by the SAC, OAC and other actors listed in this section), with a very limited scope of stakeholder engagement compared to the scope of work carried out by MOPF between 2007 and 2014.

Box 4: Membership of the MOPF Steering Committee and Strategic Planning Group in 2006

At the time of the establishment of the MOPF, the Steering Committee included representatives from the MA Division of Marine Fisheries, the Massachusetts Environmental Trust, the UNH-Institute for Study of Earth, Oceans and Space, the CZM and the MA Technology Collaborative (Massachusetts Ocean Partnership Fund 2006). The Strategic Planning Group additionally included a range of representatives from a wide range of stakeholder groups, industry bodies, NGOs, public and private organisations:

- MA Lobstermen’s Association
- MA Fisheries Commission
- Conservation Law Foundation
- Sea Education Association
- Good Harbor Consulting
- Horsley Witten Group
- Recreational Fishing Alliance
- Massport
- MA Association of Conservation Commissions
- NOAA Coastal Services
- MA Division of Energy Resources
- Northeast Seafood Coalition

[154] https://www.openchannels.org/seaplan

[155] http://seaplan.org/

[156] this review was still underway at the time the research for this report was being carried out.

- Coalition for Buzzard's Bay
- New England Aquarium
- MA Marine Trades Association
- UNH-Institute for Study of Earth, Oceans and Space
- CZM
- The Analysis Group
- City of Gloucester
- Urban Harbors Institute

3.3 Case study overview

3.3.1 Timeline

The following sets out a timeline of events that are relevant for understanding this case study and its context. It is not an exhaustive timeline of all events related to ocean management or ocean protection in Massachusetts or adjacent waters, but provides enough detail to understand the analysis in later sections of this report. Section 2.3.2 then provides a commentary on key developments outlined here.

1641

- Chapter 91 statute passed - Morrison & Snow-Cotter (2008) highlight that Chapter 91, passed in the Colonial Ordinances of 1641, is the oldest statute in the US that codifies the public trust (i.e. held by government on behalf of the public) of the ocean. It provides for a comprehensive system of permitting and licensing for construction activities in intertidal and subtidal marine areas. All such regulated maritime activities must demonstrate that they serve a public purpose. Today, Chapter 91 (of course modified over the centuries) is still part of state legislation in Massachusetts and is implemented by the DEP.

1970

- Massachusetts Ocean Sanctuaries Act passed, largely with the intention of protecting the state's waters from impacts of offshore oil developments. Five state ocean sanctuaries were designated under this act, covering most of the state's waters, in which different specific restrictions apply to offshore developments, weighing up potential environmental and aesthetic impacts and the public good of the proposals (see Morrison & Snow-Cotter 2008 for a discussion of the links with the Chapter 91 statute). The five Ocean Sanctuaries unconditionally prohibit oil and gas drilling, commercial advertising, and the incineration of waste at sea, and they also place significant restrictions on dumping and discharge of waste, mining, and the construction of electricity generating stations and other physical infrastructure. There are no provisions in the legislation to significantly restrict commercial or recreational fishing.

1972

- Federal Coastal Zone Management Act passed. The CZMA was established to provide a federal framework for states to protect the coastal environment from growing pressures caused by residential, recreational, commercial, and industrial uses. The geographical scope of the legislation includes state waters (out to three nautical miles in most states) as well as a strip of coastal land "to the extent necessary to control shorelands and areas likely to be affected by sea level rise". The CZMA provisions help States develop coastal management programs to manage and balance competing uses of the coastal zone, and it requires that federal actions likely to affect the coastal zone should be consistent with each State's federally approved coastal management program

2003

- The Massachusetts governor appoints a Task Force to investigate ocean trends, ocean use and governance, and to recommend changes in governance (including in legislation and management) to improve it. The Task Force membership was broad, spanning relevant state and federal agencies, relevant state and local officials from public bodies, and a wide range of stakeholder representatives (including environmental NGOs, fishermen, port authorities, and scientific and legal experts). The specific remit of the Task Force was to
  - Define guiding principles for the use of state waters and ocean resources;
  - Examine Massachusetts coastal policies and the adequacy of the legal framework;
  - Determine data requirements for managing state waters; and
  - Examine the organization of governance over state waters to ensure that statewide interests are met
- Six Working Groups were established to support the Task Force: Frameworks; Policy; Use Characterization; Outreach, Principles; and Data Trends and Needs. The Task Force and its Working Groups met over thirty times between June 2003 and March 2004. All meetings were open to the public and all written materials were made available on a website (no longer online). In addition, the final report and recommendations of the Task Force underwent a public comment period before being finalized[157]. While the Task Force had no legal authority in itself, it did have an influence on the drafting of the Oceans Act and it contributed to the momentum that gave rise to the MOPF.

2004

- The Task Force publish their findings and recommendations in an over 200 page report called *Waves of Change* (Massachusetts Ocean Management Task Force 2004). From the perspective of EBA implementation, this constitutes a seminal milestone in the run-up to the creation of the Oceans Act that established the OMP process. The scope of the recommendations in *Waves of Change* was comprehensive, spanning from planning principles to governance, management, evidence gathering, ocean literacy and knowledge dissemination. These recommendations laid the foundation for the subsequent ocean planning process in state waters.

2006

- Massachusetts Ocean Partnership Fund (subsequently usually referred to as the Massachusetts Ocean Partnership or as MOPF) convened as a highly collaborative multi-stakeholder initiative to establish a public-private partnership "with the goal of improving the health, management and understanding of marine and coastal resources in order to ensure thriving ocean ecosystems and their continued capacity to serve vital ecological, economic, recreational and other needs" (Massachusetts Ocean Partnership Fund 2006).

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[157] The public comments on the report are archived online and can be accessed at https://www.mass.gov/service-details/massachusetts-ocean-management-task-force-reports-and-recommendations

2007

- MOPF five-year strategic action plan published, reflecting the five-year grant it had obtained from a private foundation (the Gordon and Betty Moore Foundation).

2008

- Massachusetts Oceans Act 2008 (Commonwealth of Massachusetts 2008), the key legislation underpinning this case study (referred to in this report as the Oceans Act), is passed.
- Initiation of the formal planning process for the first OMP, under the auspices of the EEA's CZM (the work of the MOPF continued in parallel, in close communication with relevant state bodies)

2009

- December: First Massachusetts Ocean Management Plan 2009 issued by the EEA (Commonwealth of Massachusetts 2009)
- All of the maps in the ocean plan are available on CZM's publicly accessible online data and mapping system, the Massachusetts Ocean Resource Information System (MORIS)[158]

2010

- At Federal level, Executive Order 13547 – Stewardship of the Ocean, Our Coasts, and the Great Lakes[159] – establishes the National Ocean Council and a policy mandate for the development of coastal and marine spatial plans

2013

- January: Initiation by the CZM of the first OMP review (for the update due by 2015)
- Public meetings and a formal 60-day consultation period in which the CZM gathered input on the scope of the update to the 2009 plan.
- CZM convened six technical work groups to review scientific data and information and identify and characterize important trends in ocean resources and uses, to support the OAC and SAC in the review process.
- May 22nd amendment process of first plan initiated with a notice published in *Environmental Monitor* (May 22nd)[160]
- the OAC and SAC held meetings to review draft technical work group reports throughout the autumn and winter, into early 2014

2014

- OAC, SAC and Working Group meetings continued
- CZM, with support from SeaPlan, held two public workshops to share information and solicit input and feedback on the findings and recommendations of the work groups. [161]
- Public comment period on the draft of the reviewed plan, released in September

[158] maps.massgis.state.ma.us/map_ol/mass_ocean_plan.php

[159] https://obamawhitehouse.archives.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes

[160] https://www.mass.gov/service-details/the-environmental-monitor

[161] https://www.mass.gov/files/documents/2016/08/xp/ma-ocean-plan-review.pdf

2015

- January 6th: The 2015 Massachusetts Ocean Management Plan comes into force (Commonwealth of Massachusetts 2015).

2016

- Northeast Canyons Marine National Monument designated in Federal waters off Massachusetts and Rhode Island, prohibiting commercial fishing in those areas

2020

- The 2020 Ocean Plan Review process, originally planned to be carried out by the end of the year, was delayed due to the COVID-19 pandemic, which interfered with the logistics of the meetings and public hearings that had been planned to take place through the year.[162]
- June: The Trump administration revoked the prohibition of fishing in the Northeast Canyons Marine National Monument (White House 2020)[163]
- November: CZM published a brief draft plan for the review process, opening up the document for a short public comment period. This document highlights that through 2020, CZM has reached out to the Working Groups, and that each of the Working Groups have raised the need to incorporate new data and updates to the maps of SSU (Special, Sensitive or Unique Natural Resources) and human uses in the plan. No substantive amendments to the plan itself have been completed at the time of writing, but the November 2020 draft document sets out a proposed series of steps to be taken for the review of the plan, which would run into 2021 (including further meetings of the SAC, OAC as well as public hearings and consultation).

3.3.2 Commentary: The history of the case study

Drivers for integrated ocean management

Based on the outline of the key piece of legislation underpinning this case study, and the timeline of important events in the previous section, the following paragraphs review the story of the case study, reflecting on what happened when and how, and on how different events influenced and linked to each other.

Massachusetts has a history of pioneering initiatives to improve coastal zone management and offshore management. Not all of this history is included in this report, which focuses mainly on the last 15-20 years, but it is summarized by Morrison & Snow-Cotter (2008).

Since the turn of the Millennium, there has been a growing and diverse range of pressures on the seas of the Commonwealth of Massachusetts. In addition to project applications for dredging and dredged material disposal, desalination facilities, and electric and telecommunication cables, and the re-licensing of existing power and

[162] At the time the interviews for this case study were carried out, from March –May 2020, the scale of the crisis was only just beginning to unfold, and interviewees were very uncertain about how it would impact on the timing of the review.

[163] During his first days in office in January 2021, President Biden instructed the Department of Interior to review this Executive Order, and to consider reinstating the prohibitions that were put in place in 2017, illustrating the extent to which the changing nature of politics can impact on long-term ocean management (see https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/)

wastewater treatment plants, the state has also been increasingly facing new proposals for major ocean-based developments such as liquefied natural gas (LNG) pipelines and terminals, port expansion, renewable wind and wave energy projects, and plans for the extraction of sand and gravel resources (Nutters & da Silva 2012 and sources therein). During this same period, there was deterioration of marine habitats and ocean resources, including loss of eelgrass beds, major declines in fish populations, increase in the frequency and duration of harmful algal blooms, expansion of marine invasive species, and rises in the number of beach closures from bacterial water quality standard violations.

Nutters & da Silva (2012) state that the offshore wind sector was a particularly strong driver for the development of integrated ocean management policy during the 2000s, because of strong industry interest and fears from other stakeholder groups that offshore energy installations would lead to conflicts around the use of ocean space (this was echoed in several interviews as well).

Waves of Change

In response to these drivers, Massachusetts was an early adopter of a multi-sectoral marine planning and spatial management approach for its state waters. The first key milestone was *Waves of Change*, which was written and signed off in 2004 by a body (the Task Force) representing state bodies, federal bodies, relevant expertise and stakeholder interests. The recommendations of *Waves of Change* were comprehensive (see Box 3 below), addressing social, economic and environmental dimensions, and reflecting a genuine systems approach that incorporated all the forms of integration referred to in section 3 (governance, knowledge, transboundary, stakeholder, and systems integration). These recommendations laid the foundation for the subsequent ocean planning process in state waters. As such, Waves of Change can be regarded as a pioneering effort of operationalizing EBA in ocean management, and Massachusetts was therefore regarded as a trailblazer in MSP at the time.

The Task Force was purely advisory in nature, however, which meant that the recommendations in *Waves of Change* weren't comprehensively implemented. The fact that they had been discussed and endorsed by such a wide range of individuals and interests, and subjected to such a degree of public scrutiny, however, gave them more weight than a purely expert-authored, technocratic report may have done, and the report was consistently mentioned in interviews a key catalyst for subsequent efforts – most importantly, the establishment of the MOPF, and the drafting of the Oceans Act.

BOX 5: SUMMARY OF KEY RECOMMENDATIONS RELATED TO EBA IN *WAVES OF CHANGE* (NUMBERS SHOWN INDICATE THE ORIGINAL NUMBERING OF THE RECOMMENDATIONS IN THE SOURCE).

Principles

- The principles for managing ocean uses should embody an ethic of ocean stewardship that: (1) protects the public trust; (2) values biodiversity; (3) respects the interdependence of ecosystems; (4) fosters sustainable uses; (5) makes use of the best available information; and (6) encourages public participation in decision-making.

Governance Recommendations

- #1: a comprehensive Ocean Resources Management Act should be established that would require the development of a management plan with management objectives and strategies specific areas and activities, retaining and strengthening existing environmental protections and streamlining existing statutes governing the use of state waters (including the Ocean Sanctuaries Act), and the responsibilities of all state government bodies with an ocean management remit

- #2: Massachusetts should pursue ecosystem management of offshore waters through federal, regional, and state coordination and cooperation, including cooperative ocean management plans for state adjacent offshore waters with federal agencies such as NOAA, support for regional and international ocean management councils, such as the Gulf of Maine Council on the Marine Environment; and the development and/or expansion of existing cooperative agreements with adjacent states
- #3: Amendments to the state's Climate Change Plan that address effects of climate change on coasts and oceans, and the impacts thereof (e.g., sea level rise, ocean and coastal storm frequency, ocean salinity, …) as well as policies to reduce greenhouse gas emissions.

Management Tools Recommendations

- #1: Updated fee structures (in place under existing legislation that requires potential developers to pay fees to the state as part of permit application processes) and the establishment of a dedicated account where the revenues generated can be retained to support environmental and ocean management costs, (e.g. for state activities to increase public access to the ocean; conduct scientific research, monitoring, and data collection; enforce compliance with regulatory requirements; …).
- #2: the creation of a Marine Protected Areas working group to develop a formal process, criteria and information standards for designating Marine Protected Areas, which could include areas for the protection of special, sensitive, and/or unique estuarine and marine habitat and/or life (such as marine mammals, birds, reptiles, soft corals, and other bottom dwelling plants and animals), physical or submerged cultural resources, the protection of important fisheries and fishing activities from other uses, and/or the protection and study of marine biodiversity and ecosystems. The working group should consider ways to ensure a clear and inclusive public process, with appropriate role(s) for key state agencies (e.g., DMF and CZM), in coordination with federal agencies, and addressing management planning, monitoring and research, and enforcement measures.
- #3: Strengthen coordination for the mitigation of unavoidable impacts of regulated activities, clarifying between compensation to the Commonwealth for occupation or use of public trust resources, and mitigation for environmental impacts. Mitigation should be considered from the earliest planning stages for any new proposed activity and be fully integrated into the EIA process (for developments requiring an EIA). The state should develop a priority list of marine restoration and remediation projects that could be considered as appropriate mitigation in situations where a project may have impacts that are difficult to otherwise mitigate.
- #4: Enforcement of coastal laws and regulations should be a high priority of the Commonwealth, and relevant state bodies should ensure that sufficient enforcement personnel are provided to resource management and law enforcement agencies. Where appropriate, the Commonwealth should require implementation of supplemental environmental projects in lieu of monetary penalties assessed for environmental violations.
- #5: Relevant state agencies should develop and implement common methodologies and standards for the analysis of visual, cultural, and aesthetic impacts of proposed projects in state waters. Where possible, the agencies should develop common standards and criteria for mitigation of said impacts.
- #6: To support fully informed and inclusive decision-making, ocean management planning should be supported by the development and maintenance of inventories of the uses and resources of the state's marine waters. These should be kept up-to-date to indicate existing uses as well as trends in new or changing types and patterns of use. This data should be GIS-based and organized on maps and databases to illustrate uses and resources on the seafloor, in the water column, and/or at the ocean surface, as well as uses in the airspace over these areas, and when activities (human and natural) occur in time. Additionally, to the extent feasible, they should include upstream and coastal areas that affect the ocean resources.

Scientific Understanding Recommendations

- #1: An advisory group of state, federal, academic and other marine and fishery scientists and other experts should be appointed to evaluate and estimate baseline marine species population levels, habitat conditions, and contaminant levels so that changes in ocean resources through time can be tracked, emerging threats to ocean resources identified, and appropriate management goals to address changes and threats then determined.
- #2: As a basis for sound management of ocean resources a comprehensive ocean resources monitoring and research plan should be developed. This should comprehensively encompass living and non-living estuarine and marine resources, as well as studies of the economic and other uses of these resources. The plan could serve as an important "roadmap" for work to be carried out by state resource agencies and others (e.g., academic institutions, permit applicants, public agencies), and should be periodically reviewed and updated.
- #3: The Commonwealth should acquire remotely sensed high-resolution seafloor habitat maps.
- #4: Environmental monitoring should use more standardised protocols for data collection. These should be designed to aid managers in assessing environmental suitability and impacts of proposed and permitted activities and gain understanding of individual and cumulative impact of projects and uses.

Outreach Recommendations

- #1: The state should make a formal commitment to developing a new ocean literacy and stewardship ethic among all citizens of Massachusetts. The initiative should target a multigenerational audience, and include the private and public sectors, academic institutions, politicians, advocates, the media, and the general public.
- #2: There should be increased public dissemination of data collected on the Commonwealth's resources, including an index of all state-funded ocean resource and use data; data collected in support of permit applications or as part of permit requirements; and data collected with state-issued scientific permits. Such data should be made available to interested parties for a nominal fee, accompanied by documentation to set the context for their proper use.

The Massachusetts Oceans Partnership Fund (MOPF)

The work of the MOPF (which spanned across the time period during which the Oceans Act was being drafted, and subsequently played a significant role in supporting the first planning round) was highlighted by Heimes (2012) as one of the central reasons why the Massachusetts ocean planning model should serve as a model for better and more integrated ocean planning in other parts of the US, a point echoed by Brown & Wehner (2007), and by several interviewees.

The following extracts from the MOPF five-year plan (see the box below) illustrate the ambition and scope of the work to be carried out, the way in which the relationship with the formal OMP process was intended (the process wasn't yet underway, because the Oceans Act was only to be passed the following year, but which was very much on the horizon at the time), and the overarching EBA-based vision of ocean management.

BOX 4: KEY EXTRACTS FROM THE MOPF FIVE-YEAR PLAN: MEMBERSHIP OF THE MOPF STEERING COMMITTEE AND STRATEGIC PLANNING GROUP IN 2006

At the time of the establishment of the MOPF, the Steering Committee included representatives from the MA Division of Marine Fisheries, the Massachusetts Environmental Trust, the UNH-Institute for Study of Earth, Oceans and Space, the CZM and the MA Technology Collaborative (Massachusetts Ocean Partnership Fund 2006). The Strategic

Planning Group additionally included a range of representatives from a wide range of stakeholder groups, industry bodies, NGOs, public and private organisations:

- *"The Massachusetts Ocean Partnership Fund (MOPF) is a broadly representative public-private partnership created to support and advance ecosystem-based integrated multi-use management of the Commonwealth's coastal ocean resources. By collaborating with others, MOPF will work toward the goals of improving the health, management and understanding of marine and coastal resources to ensure thriving ocean ecosystems and their continued capacity to serve vital ecological, economic, recreational and other needs. MOPF's primary near-term goal is to support the development and implementation of an integrated multi-use ocean management plan for MA waters as soon as possible. Responsible state, local and federal agencies will develop, implement and enforce the integrated multi-use ocean management plan; MOPF will provide support and coordination for this complex undertaking."*
- *"MOPF's vision for an integrated, multi-use ocean management plan is one that will:*
    - *integrate management across sectors and interests (user groups, conservation groups, etc.) ecosystem resources, and agencies;*
    - *be based on scientific principles of ecosystem-based management that incorporate human activities and reflect compatible spatial and temporal scales;*
    - *reflect public input and gain the support of major affected groups and organizations;*
    - *establish a process for adapting the plan to respond to changing conditions; and*
    - *support sustainable marine industries and ecosystem stewardship more effectively than current management systems do."*
- *"This Five Year Strategic Plan […] is organized into three main strategies critical to the accomplishment of MOPF's goal. They are:*

    1. Become a leading-edge and visionary public-private institution with a strong and enduring presence driving the development and implementation of effective integrated multi-use ocean management in Massachusetts.

    2. Develop and improve the natural and social scientific understanding necessary to do effective integrated multi-use ocean management, and advance the integration of that science and management decision making processes.

    3. Expand stakeholder understanding of integrated multi-use ocean management issues to increase effectiveness and durability of a plan.."

Source: Massachusetts, Ocean Partnership Fund 2007

The Oceans Act and the first Ocean Management Plan

The next key milestone was the passage of the Oceans Act of 2008 (Commonwealth of Massachusetts 2008), which requires the Massachusetts EEA to implement ocean management measures that address a list of legally specified goals that span the social, environmental and economic dimensions of sustainable development. The legislation, although more limited in scope than what had been recommended in *Waves of Change,* was hailed as a progressive trailblazer in improving disjointed, mismatched ocean management practices in the US at the time (Crowder et al. 2006). As summarized in section 2.1, it stipulated a one-year timetable for the issuing of the first plan, and for its subsequent periodic review (to happen at least once every five years).

The Massachusetts Oceans Act of 2008 required the creation of a comprehensive ocean management plan by December 2009. The planning process was formally initiated by CZM in 2008, after the legislation was passed, but it drew heavily from the momentum, evidence base and advice that was already being generated at the time through the work of the MOPF described above. In parallel to (and to a large extent supported by) the MOPF initiative, the formal planning process focused on collating the best available data and science (communicated and coordinated through the SAC).

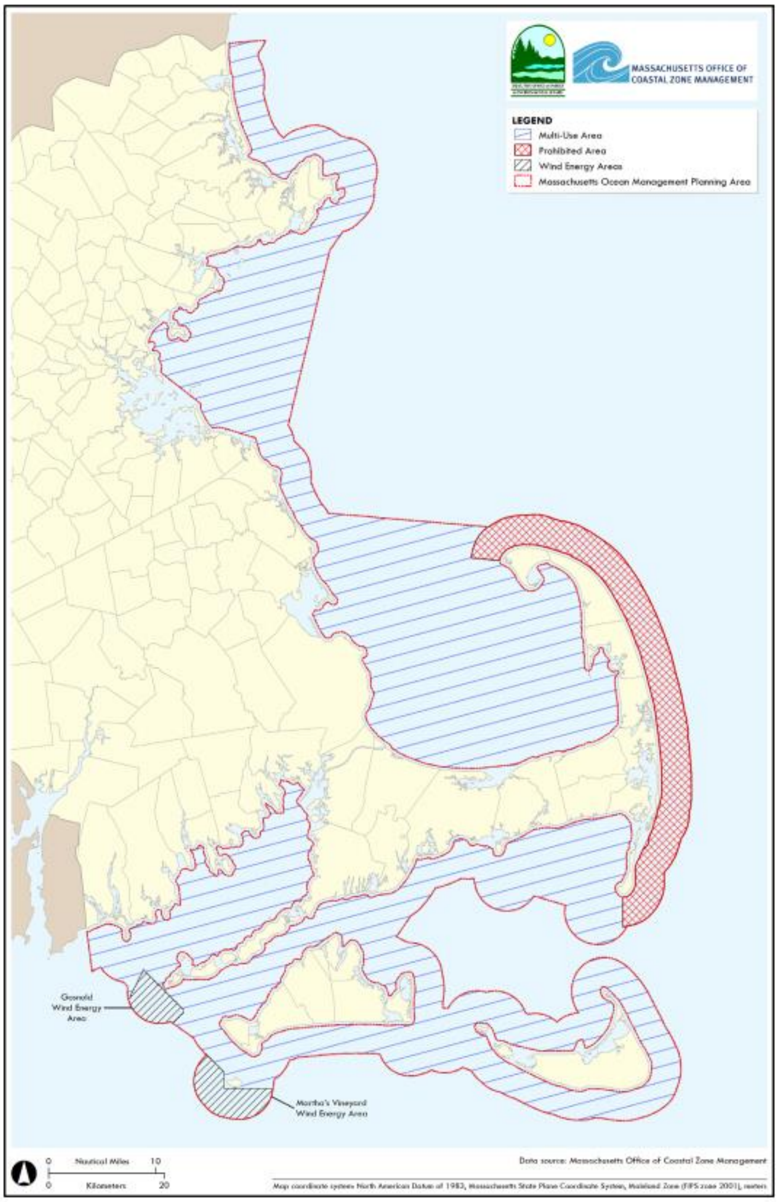
The legislation stipulated that the plan should specify and map the location of Special, Sensitive, or Unique (SSU) natural resources, i.e. of marine features (species or habitats) deemed to be of conservation priority because of their ecological value, their rarity/uniqueness, or their particular sensitivity to impacts of human activities. However, it didn't stipulate a specific list of SSU that must be protected, nor did it define any legal criteria on the basis of which SSU should be defined or selected. Thus, a key task at the outset of the first planning process was to specify a list of SSU (species, habitat types and other types of natural feature) deserving of protection. The MOPF outputs recommended a list of 15 SSU, 11 of which were carried over into the formal planning process and mapped for the 2009 Plan using the best data available at that time (the SSU list was amended in the 2015 plan, with an additional feature added).

The first OMP was issued in 2009. This plan identified three management areas within state waters with specific siting and performance standards established to protect existing natural resources as well as commercial and recreational uses (published in Commonwealth of Massachusetts 2009, and also summarized in Nutters & da Silva 2012, and in Commonwealth of Massachusetts 2015 and 2020): mixed / multi-use (85% of the planning area, open to a wide range of activities including cables, pipelines, aggregate extraction), renewable energy (2% of the planning area – specific sites identified as having the most potential suitability for commercial wind farm developments), and protected areas (the remaining 13% of the planning areas, designated under the Ocean Sanctuaries Act, as amended by the Oceans Act). The OMP set out requirements for licensing, fees, permits and impact assessments that any new offshore activities must undergo in state waters, streamlining this process across multiple sectors for the first time. The specific requirements for a proposed development in any specific location depend in part on the mapped distribution of the SSU. Commercial fishing, as a pre-existing activity, was considered a "protected use" of the ocean in the initial OMP process, part of the purpose of the OMP being to safeguard the continuation of this activity alongside potential new types of ocean use.

Figure 2 shows the planning area for the Massachusetts OMP and the three management areas in the 2015 plan, while Figure 3 shows the distribution of some of the SSU features and areas used by commercial fishermen mapped for the 2015 plan. Figure 2b was created to highlight SSU and human uses (in this case, commercial fisheries) that might be negatively impacted by sand extraction, and as such serves as a tool for actors planning to carry out this activity to better understand the licence conditions and EIA requirements that they would need to follow if they were to apply for a permit to extract sand in different areas of state waters. Figure 3 specifically shows areas for sand extraction to avoid undue impacts on the environment or conflicts between human uses:

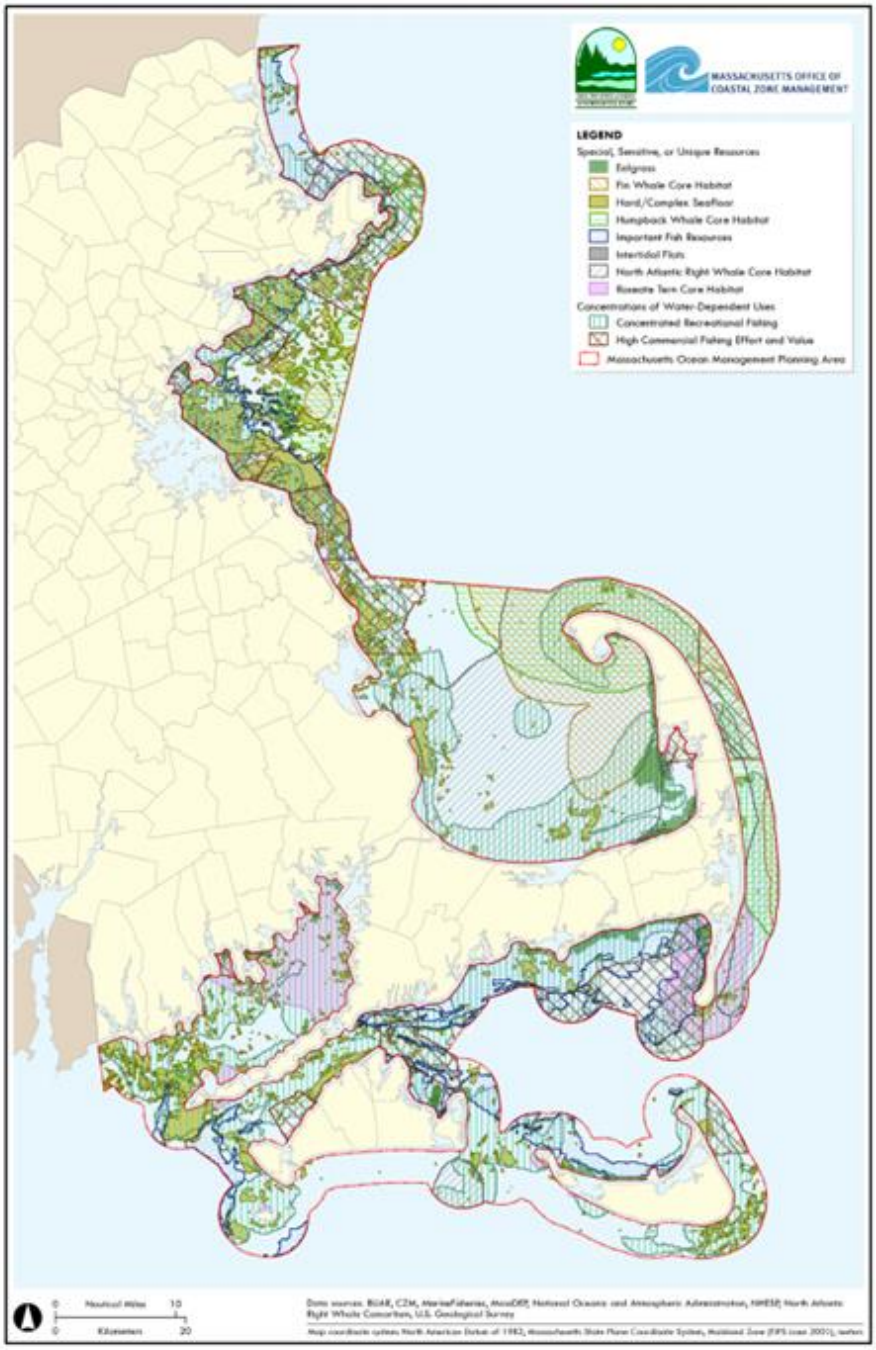
due to Climate Change impacts, there has been an increase in beach erosion along the coastline, driving a need for sand to be extracted from the seabed for use in beach nourishment.

FIGURE 2: MAP OF THE THREE MANAGEMENT AREAS REFERRED TO IN THE TEXT.



Source: Commonwealth of Massachusetts 2015

FIGURE 3: MAP OF SSU AND HUMAN USES THAT NEED TO BE ADDRESSED IN ANY APPLICATION FOR SAND EXTRACTION



Source: Commonwealth of Massachusetts 2015

The plan includes equivalent maps for other human uses managed through the OMP. As such, the known distribution of environmental features (the SSU) has an automatic impact on the management of maritime activities through the OMP – if an SSU distribution map is updated during the 5-yearly review process, this will have direct consequences on where different licence conditions apply to different activities.

Reviewing and revising the plan

Under the Oceans Act the OMP is intended to be an evolving document to be revised at minimum every 5 years to adapt as better information and science are developed, policy goals evolve, and experience in applying the management and administrative framework is gained. In practice, what this has meant is a review of the best available information on the spatial location of the SSU, resulting in updated distribution maps (but no review of the list of the SSU themselves). The reviews have also been taken as an opportunity for the specialist working groups to review trends in the environment and in the usage of the ocean, in order to highlight any emerging issues that the plan may need to adjust to. There is no formal system of indicators that are systematically monitored, nor any formalized system of predefined criteria for evaluating the performance of the plan during the review process – the issues that are raised depend a lot on the interests and priorities of the working group members, and on directions from CZM staff (who might task a working group to look into a specific topic if they perceive a need to do so).

The first reviewed OMP was released in 2015, with comparatively minor substantive changes to the 2009 plan – the main changes that impacted on sea users were updates to the SSU maps. The list of SSU remained almost identical, with the only change the addition of one feature (Storm Petrel core habitat). One important point to note is that the strong interest in wind farm development (which, to a great extent, had catalysed the creation of the Ocean Act as a way of integrating planning across multiple ocean uses) never translated into any actual developments going forward. This situation may change with the Biden administration's drive towards a green energy transition, which may revitalise industry interest and drive towards offshore renewable developments. A commercial offshore wind farm (Vineyard Wind) in federal waters immediately adjacent to the OMP received approval from the relevant federal authorities in 2020 (with the OMP having facilitated the planning of cable routes through Massachusetts state waters to connect it to the grid onshore).

A third update was due to be completed in 2020, but the review and consultation process was delayed due to the COVID-19 pandemic. A draft review of the OMP was published in November 2020 and opened for a brief consultation period until December 2020 (Commonwealth of Massachusetts 2020). In addition to a stated requirement to review and update the SSU distribution maps again, some potential new emerging user pressures and user-user conflicts have been flagged, as has the need to better understand and adapt to environmental trends, most notably those linked to climate change. It is not clear, at the time of writing, how substantive the changes might be once the next review of the plan is finalized in 2021.

This case thus represents a rare example of *adaptive management* in practice, where the process has not only already completed a full adaptive management cycle (from goal formulation in the legislation and subsequent policy to assessment of the status quo in a detailed environmental assessment process, the development of a new plan, the adoption and implementation of new measures, and monitoring and evaluation of their effectiveness) but is currently in the final stages of a second completion. It serves to illustrate some of the pragmatic decisions that have to be taken under real-world process constraints (political priorities, commercial driving forces, limited capacity, time and financial resources to support ocean planning, etc.) that lead to discrepancies between the idealized representations of adaptive management frameworks that abound in the environmental management literature, and real-world planning in action. Some of these issues are deconstructed further in section 3 (section 3.1.1 moreover provides an overview of adaptive management) and in section 4.

The same is true for stakeholder engagement, for which there is also a balance to be struck between pragmatism and idealized frameworks presented in the specialist literature (this topic is illuminated in detail in section 3.1.8.). The intensity of stakeholder engagement has reduced since MOPF / SeaPlan ceased to exist, but nevertheless there is a clear formal mechanism for ensuring the integration of good scientific knowledge (through the SAC) and a clear structure for achieving cross-sectoral integration at the strategic decision-making level (through the OAC, bringing together state legislators, state agencies and key stakeholder representatives). These elements build on processes, structures and institutions that, in some cases, predate the 2008 legislation, as is evident in the list of key actors in the previous section – the only bodies that were newly created for this specific process are the OAC and the SAC.

As such, this case study can help illuminate how core elements ecosystem-based MSP have been implemented in practice: Stakeholder engagement, multisectoral integration, strategic integration of multiple objectives with clear environmental goals included, the integration of scientific knowledge, and adaptive management, in particular. These elements are deconstructed in more detail in the next section, and the added value of EBA is discussed in section 4.

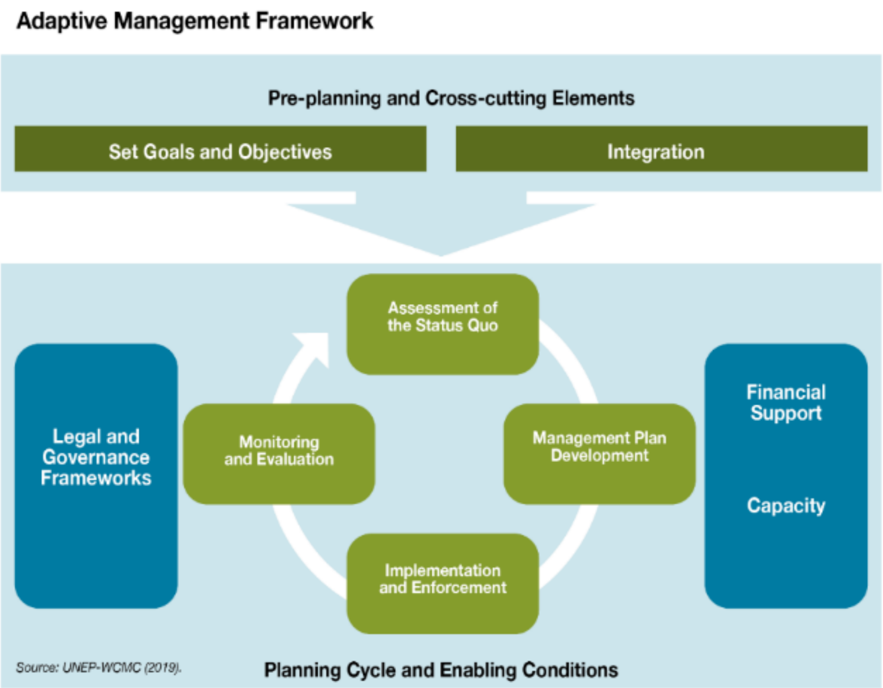
4. ELEMENTS OF EBA IN THE CASE STUDY

4.1 Adaptive management

4.1.1 Extent of adaptive management implemented in this case study

Adaptive management is commonly seen as an integral part of both MSP and EBA. Figure 3 illustrates an idealised vision of the four main phases of adaptive management as commonly described in the environmental management literature.

FIGURE 4: ADAPTIVE MANAGEMENT FRAMEWORK FOR ECOSYSTEM-BASED INTEGRATED OCEAN MANAGEMENT.



Note: The core of the figure is formed by a representation of a continuous improvement cycle as is commonly described in business management.

Source: prepared by the author (see Lieberknecht, 2020), based on UNEP-WCMC (2019)

Referring back to the timeline of events in the previous section, it is clear that adaptive management has been taking place in this case study. The Oceans Act sets out a legal requirement for a review every 5 years, during which the SAC and OAC review the plan, and members of the public / wider stakeholder constituencies have the opportunity to comment on drafts of the review during public meetings and a formal public consultation period (the most recent one having taken place in November and December 2020).

However, the interviews conducted for this analysis highlighted that the review cycles of the OMP do not follow the four phases of the adaptive management cycle in the exact way that they are envisaged in Figure 3. The idea of the continuous improvement cycle (as represented in the figure) is that a specific objective (or set of objectives) is defined at the top, and that the monitoring and evaluation efforts measure indicators linked to those objectives in order to assess whether they are being achieved. Any shortfall identified in relation to these objectives should trigger a revision to the plan (or its objectives), thus driving the cycle onward.

The way in which the review process plays out in this case study is different. The review process is driven by the Oceans Act, which requires that the OMP (including its baseline scientific assessment) has to be reviewed at minimum once every five years (see section 4C(h) of the Oceans Act in Box 1). Every five years, the review process is initiated by the CZM (on behalf of the EEA), and the SAC is tasked with reviewing the plan from a technical / scientific perspective. SAC members can raise issues of concern based on their own expertise and judgement, and based on input received from Working Groups. The CZM has a strong degree of influence on what issues are deemed important for consideration, although they work in close collaboration with other organisations represented on the SAC.

The review process also involves stakeholder outreach and consultation with wider stakeholder communities (this is another requirement set out in the Oceans Act). During the revision of the 2009 plan (which resulted in the 2015 plan), stakeholders were engaged at the start of the review process, allowing them to bring issues to the attention of the SAC, the Working Groups or the public sector agencies involved in the process. This was done with support from SeaPlan, who were still in existence at the time. During the ongoing revision at the time of this analysis, a stakeholder consultation on the scope and content of the planned revisions was conducted in late 2020/early 2021, but as this was still ongoing at the time of writing, this stakeholder process falls beyond the timeframe for the analysis presented in this report.

Thus, the revisions that are made during the review process aren't triggered by a failure to meet specific, predefined objectives. In fact, there is no formal monitoring and evaluation process that gathers data on specific metrics or indicators either on process performance (e.g. level of adherence to rules) or on environmental status and impacts, nor are there formally defined trigger points for action to be taken (e.g. a particular environmental status trigger) that are specific to the OMP. Instead, the review process is triggered every 5 years by the agencies responsible for the process, with the overall scope set out in the underpinning legislation, though the wording of this leaves a lot of room for interpretation (Box 1).

In practice, the results of the review process are strongly driven by the expertise, knowledge and concerns of the individual persons involved, and it is reactive to whatever issues are raised by them involved (and, to a lesser extent, by members of the public during consultation periods), rather than being driven by specific, overarching strategic objectives. The extent to which an ecosystem perspective is taken is therefore not set in stone through any dedicated process elements, but the advantage of this approach is that the review process is relatively light touch and flexible, compared to what would be required for a more detailed, technocratic, objective-driven review cycle as envisaged in Figure 3.

While the OMP review cycle can't be described as following a continuous improvement cycle in the strictest sense, the four "phases" depicted in the cycle in Figure 3 are nevertheless present in the OMP process. The first plan was preceded by an in-depth assessment of the status quo (largely through the work of the MOPF), and the scientific baseline assessment is reviewed by experts in every cycle. Amendments are made to the plan, both by updating the SSU distribution maps and reviewing the SSU list as well as by reviewing the provisions made for licence conditions linked to each of the SSU. And while there is no monitoring and evaluation process for indicators linked specifically to the OMP, the updates to the plan are of course informed by knowledge derived from a range of environmental monitoring programmes that are in place for the state's waters, run by the CZM and other agencies, environmental NGOs, and academic institutions.

4.1.2 EBA elements implemented in pre-planning (goal setting)

To operationalise EBA in the context of strategic goal setting, there are several considerations to address. Firstly, EBA requires a recognition of the fact that functioning societies and economies depend on functioning ecosystems, and that there are ecosystem boundaries that can't be overshot without jeopardising the very foundation of sustainable development. Strategic goals for an EBA-based MSP process should therefore reflect a prioritisation of the ecological dimension, at absolute minimum, to the extent that cumulative impacts from human activities don't push the natural system over ecosystem boundaries, and that actions to reduce existing overshoots must be prioritized. In relation to spatial measures, space must be provided for nature to recover and thrive.

Secondly, EBA requires systems thinking. For goal setting during the pre-planning stage, this means that there should be strategic integration of goals across ecosystem boundaries, and across a diverse range of human needs. Ecosystems should be recognised in their entirety, as systems that are dynamic and linked. Furthermore, human economies and the activities undertaken to sustain those economies need to be recognised as intrinsically linked to those ecosystems. In the context of setting goals for MSP, this means setting strategic goals that are conducive to the different forms of integration deconstructed later in this section.

The overarching strategic direction of the OMP process is framed by the Oceans Act, which sets out a range of strategic objectives that cut across the three dimensions of sustainability. Specifically, the Oceans Act requires the EEA to develop an integrated ocean management plan that:

- defines the Commonwealth's goals, siting priorities, and standards for ensuring effective stewardship of ocean waters and resources held in trust for the benefit of the public;
- reflects the importance of these waters to the Commonwealth's citizens who derive livelihoods and recreational benefits from fishing;
- values biodiversity and ecosystem health;
- identifies and protects special, sensitive, or unique estuarine and marine life and habitats (SSU);

- identifies appropriate locations and performance standards for activities, uses, and facilities allowed by the Ocean Sanctuaries Act

These overarching requirements are consistent with EBA in that they articulate the importance of biodiversity and ecosystem health, and the idea of the oceans being "held in trust", which implies intergenerational thinking and responsibilities of managing the ecosystem for long-term health and sustainability. It also sets a frame for streamlining the management (including spatial management) of multiple sectors, another aspect that is consistent with and conducive to EBA. However, these legal requirements fall significantly short of the much more comprehensive, ecologically grounded and detailed principles and strategic recommendations in *Waves of Change*, suggesting that the intense, collaborative (but merely advisory) work of the Task Force was able to make a lot more progress on advancing EBA than the formal (and much more consequential) process of drafting the legislation itself. One of the interviewees was involved in this drafting process and highlighted that there was a degree of negotiation ("horse-trading") going on behind the scenes, with representatives of different interest groups trying to ensure their interests were adequately safeguarded within the legislation.

The ways in which the strategic framing of the Oceans Act falls short of *Waves of Change* are multiple (when viewed from the EBA perspective). Firstly, the greatly reduced level of detail leaves the legal provisions made open to a lot of interpretation. No definitions are provided for crucial terms like "protect" or "ecosystem health", no criteria are defined for how to identify and select SSU, nor are any specifications included for how to "value" biodiversity or how that "valuation" should impact on practical decisions for what ultimately matters: who will be able to do what, where, when, and how in state waters. Secondly, it doesn't include any explicit requirements for creating space for nature through new protected areas, or through more stringent management of existing protected areas (e.g. through zoning the extensive state ocean sanctuaries). *Waves of Change* had already identified this as a controversial topic and made a strong recommendation for MPAs to be progressed in state waters. Thirdly, and perhaps most significantly, fisheries management is explicitly treated as a special case, effectively creating a deliberate strategic *dis*joint between fisheries management and the management of other human activities at sea – this is a point that has also been raised in the literature (e.g. Heimes 2012), and is discussed further at the conclusion of this report.

Despite these shortcomings, however, the Ocean Act provides a legal basis that can be interpreted in ways that would fully support EBA, i.e. it opens doors for EBA to be applied in practice. Ocean management researchers widely regarded it as progressive at its time, and deserves recognition for being one of the first pieces of legislation worldwide that set the scene for multisectoral, strategic ocean management (including MSP).

4.1.3 EBA elements implemented through the planning cycle

When considering the degree to which EBA is operationalized throughout the planning, implementation and review cycles of the OMP, it helps to distinguish between three linear phases: 1. The collaborative efforts of the Task Force and MOPF that took place in the immediate run-up to the passing of the Oceans Act, 2. The first round of formal planning under the auspices of this new piece of legislation (which culminated in the first plan, published in 2009), and 3. The two subsequent review rounds (the second of which was still ongoing at the time of writing, having been delayed due to the COVID-19 pandemic).

This is because the degree of tangible operationalization of EBA principles was arguably at its strongest in the earliest phase. As stated above, and illustrated by the set of recommendations summarized in section 2.3.1., *Waves of Change* embodied the principles of EBA and provided clear, practical recommendations for translating those principles into actions within the governance, science, management and socio-economic context of Massachusetts at the time. The Task Force in itself can be seen as an operationalization of EBA, in that it was a collaborative and participative effort to set a strategic framework and objectives for ocean management, which brought together technical experts with public bodies and relevant stakeholders as partners, each of whom helped shape the outputs. The Task Force also went through an intensive and highly participatory stakeholder engagement process, with a series of public meetings and public comment periods, at which wider constituents were able to view, comment on and help shape the strategy, as well as provide their own expertise to the evidence base that was being created to support ocean planning.

The transition to the second phase is marked by the drafting of the Oceans Act, including the "horse trading" it triggered behind the scenes. This transition was crucial, because at this time, the strategic planning changed from being advisory in nature to becoming legally binding and therefore much more consequential, arguably putting some brakes on the full operationalization of EBA principles where these collided with particular stakeholder interests, or were perceived as a threat to such interests. During the second phase, the operationalization of EBA profited from the momentum that had been triggered by the Task Force and carried forward through the MOPF. The latter was a body that

- through its membership, continued to bring together key experts from different disciplines, public bodies with different ocean related remits, and stakeholder representatives from different sectors,
- continued to build and improve the evidence base for ocean planning (collating data on the ocean environment and on ocean uses), including information on ecosystem processes and trends,
- developed and tested a highly collaborative and participative stakeholder process, organizing and facilitating meetings for wider stakeholder representatives who not only had the opportunity to comment on draft plans or ideas that had been developed by experts (as would happen in a purely consultative exercise), but could also contribute their knowledge and information to the evidence base, and participate in the development of potential future planning scenarios
- applied a number of decision support tools and technical methods to identify priority conservation features and areas, assess the vulnerability of different ecosystem receptors, and develop spatial planning scenarios balancing human uses with space for nature (through using Marxan).

An interesting tension emerged during this second phase. The MOPF was never given a planning or decision-making mandate, neither formally (e.g. a legal mandate through the Oceans Act) or less formally (e.g. through the EEA's CZM delegating some of its responsibilities to the MOPF, e.g. through an MOU or similar). This means that the outputs from the MOPF were always advisory in nature, and there was never any guarantee that their work (especially in relation to management scenario planning) would ultimately be carried through and implemented through the formal OMP. In practice, however, the work of the MOPF was closely intertwined with the first round of OMP development, and to participating stakeholders they may have seemed indistinguishable, thereby raising expectations about the significance and impact of the MOPF work:

- the public agencies and other bodies represented on the OAC and SAC overlapped a lot with MOPF membership,
- The MOPF was (and still is, in virtually all the grey literature that refers to this time period that is cited throughout this report) consistently framed and presented as "supporting" and "facilitating" the OMP process,
- the evidence collected through the MOPF was combined with information collected through the Working Groups of the SAC as well as with data collected by public bodies in their own right (for instance, CMZ invested in seabed mapping), thereby making a significant contribution to the evidence base that ultimately supported the OMP process
- all outputs of the MOPF were communicated to the formal OMP process, not only through publications but also through members of the SAC and the Working Groups.

Ultimately, a lot of the work carried out through the MOPF permeated into the OMP (e.g. the list of SSU developed with support by the MOPF was carried over into the plan), but this happened in an organic way that doesn't seem to be clearly documented, nor did interviewees differentiate clearly between these two intertwined strands of work that seemed to be part of the same process, but actually had very different roles and mandates.

In terms of operationalizing EBA, this tension translated into increasing number and height of barriers in the formal OMP process (because the plan would carry legal weight and impact on stakeholder interests), compared to the advisory process. Box 1 (section 2.1) shows an extract of section 4C of the Oceans Act, including the wording relating to the environmental provisions embedded in the legislation. While the law requires the OMP to "value biodiversity and ecosystem health" and "respect the interdependence of ecosystems", it doesn't provide any detail on mechanisms by which this should be achieved or measured. Arguably the most specific environmental stipulation in the Oceans Act is that the OMP must "identify and protect special, sensitive or unique estuarine and marine life and habitats" – this is the requirement that gave rise to the SSU referred to earlier in this report.

The list of SSU features is of key importance to the environmental impacts of the OMP, as the known distribution of this limited set of features has direct consequences for how human activities are managed where they are present, including in the multi-use zone of the OMP (which makes up the largest proportion of the state's waters by far). The process by which the list of SSU was decided upon is described in Kappel et al. (2012), who were commissioned by the MOPF to conduct a survey of New England experts in each of 15 marine ecosystem types to carry out a vulnerability assessment of different ecosystems to 58 anthropogenic stressors. This work resulted in a vulnerability matrix that subsequently informed the identification of the 11 SSU features that were included in the 2009 plan. During the review of the 2009 plan, another SSU was added to the list, and the SSU list now consists of the following features:

- North Atlantic Right Whale Core Habitat
- Humpback Whale Core Habitat
- Fin Whale Core Habitat Yes
- Roseate Tern Core Habitat
- Special Concern (Arctic, Least, and Common) Tern Core Habitat
- Sea Duck Core Habitat (formerly mapped as Longtailed Duck Core Habitat in 2009 plan)
- Leach's Storm-Petrel Important Nesting Habitat (added during the review of the 2009 plan)
- Colonial Waterbirds Important Nesting Habitat

- Hard/Complex Seafloor
- Eelgrass
- Intertidal Flats
- Important Fish Resources

Kappel et al. (2012) stress that expert knowledge was critical for filling gaps in the scientific literature to comprehensively evaluate the 870 stressor-ecosystem combinations in the matrix of this vulnerability assessment, which had to be completed in about 1.5 years during the development of the initial plan.

The preceding paragraphs illustrate that some of the initial emphasis on EBA was lost in each step of the process from *Waves of Change* through to the drafting of the Oceans Act and the interpretation / implementation of the Act. Although the Oceans Act makes reference to the interdependence of ecosystems, it merely states that these must be "respected", without any explicit minimum requirements for safeguarding this systems perspective. Ultimately, in practice, a lot of the "environmental" weight in in the OMP is carried by the limited number of SSU, which are dominated by "charismatic megafauna" (cetaceans and birds). Thus, the ecosystem is deconstructed into component parts and only a narrow subset are targeted for protection.

A related point is that the birds and cetaceans included on the SSU list are mobile species, which move in and out of their core habitats (i.e. the areas mapped for the OMP which define management measures), and indeed in an out of the OMP planning area itself – many of the seabirds listed nest along the coastline, so their breeding habitats fall outside the OMP plan area, and many of these species move beyond the relatively narrow 3nm strip of state waters. This is, to some extent, addressed through transboundary integration (see below).

Nevertheless, the OMP has delivered tangible benefits both for ecosystem protection and for sea users. The protected areas and distribution maps of the SSU features have already had a direct influence on economic activity. Blau & Green (2015) highlight that the 2009 plan effectively extended protection to over 70% of the state's waters through defining them as SSU extending protection beyond the formal protected area of the Cape Cod National Seashore across much of the multiple use areas in the OMP (although it should be noted that the only MPA in Massachusetts that falls within the IUCN categories of protected areas is the Cape Cod National Seashore, which falls into IUCN Category II). As a result of the SSU maps in the 2009 OMP, Comcast were able to design a cable plan to avoid sensitive seafloor habitats from the outset, whereas previous cable projects had run directly through these sensitive areas. The authors also highlight that the 2009 plan explicitly included new regulations that limited short-term profits to sand and gravel extraction industries in the interest of conservation and long-term sustainability – to protect spawning grounds, the plan closed areas in which developers had previously expressed interest. The plan also constrained areas where developers could build large infrastructure projects. The cost to developers was balanced out, however, by lowered uncertainty and risk associated with EIA processes, as they were able to avoid the most environmentally sensitive areas from the outset (as in the Comcast example). This point was echoed by many of the interviewees.

One of the biggest shortcomings of the OMP process in terms of operationalisation of EBA is the disconnect between fisheries management and the management of regulated activities that was highlighted in section 2.1. Unlike other human activities, commercial and recreational fisheries are explicitly highlighted in the Oceans Act as values that the OMP must protect, while the legislation doesn't provide for restrictions or regulation of fishing activities to protect the environment. Where fishing is restricted, this is done by fisheries management bodies (e.g. the DMF) through fisheries regulations that are separate from the OMP, and such regulations generally target the safeguarding of fisheries resources (rather than environmental benefit). Notwithstanding this shortcoming, the interviews highlighted that there is good collaboration between the DMF and CMZ in this process, which means that opportunities for synergies are actively being sought for, and there are instances where there is good overlap between wider environmental protection and the protection of habitats that are important for replenishing fish stocks, e.g. in protecting eelgrass beds from the impacts of physical infrastructure or sand extraction.

Another way in which EBA operationalisation could be strengthened in this process might be through more proactive incentivisation of activities that inherently bring environmental benefits (possible examples could include offshore renewable energy developments, which help decarbonise energy production and thereby can be seen as beneficial for the global environment, or kelp farms, which would lock up carbon and might have local biodiversity benefits for the marine ecosystems in Massachusetts). Regarding offshore renewables, despite the OMP explicitly setting aside areas for community wind farm developments, no such community-based developments have materialized in these areas to date, and it might be worth exploring what kind of incentives would make them more viable.

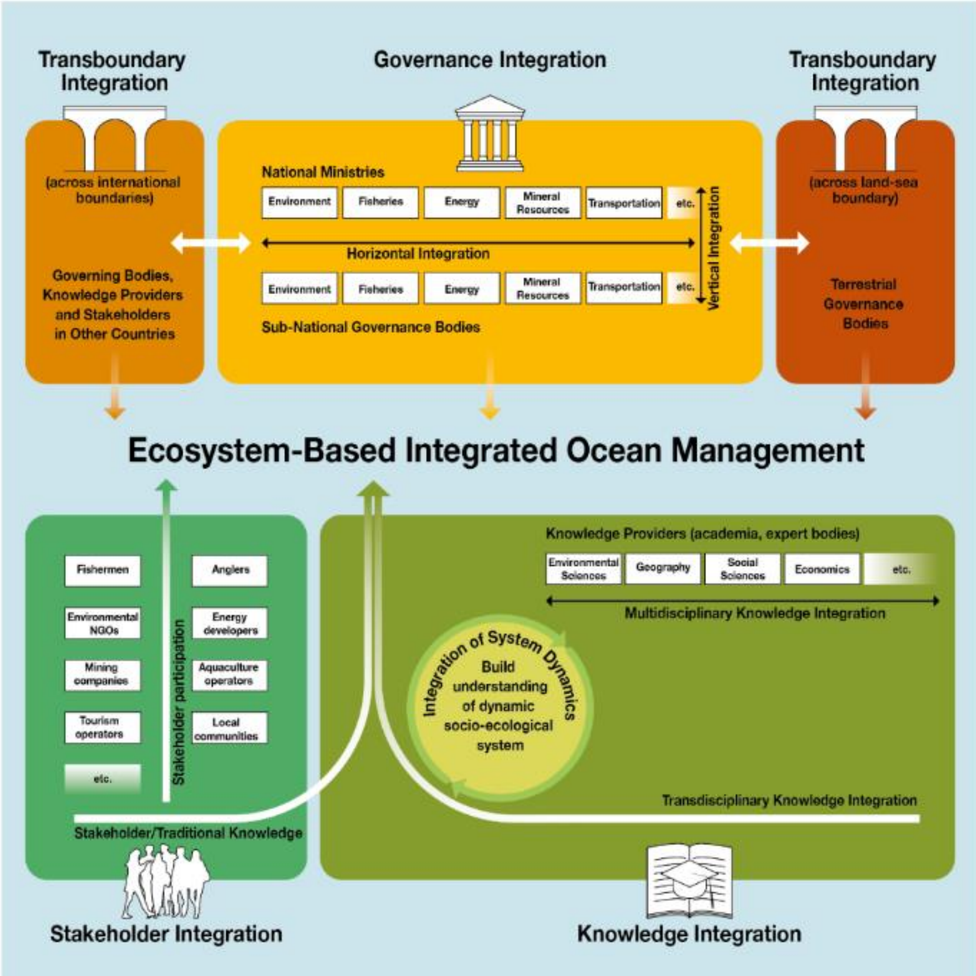
4.2 EBA implemented in cross-cutting elements (Integration)

4.2.1 General notes on integration

Figure illustrates the different forms of integration that are relevant in ecosystem-based integrated ocean management, and for operationalizing EBM in MSP.

Governance integration refers to mechanisms of communication, information exchange, coordination or collaboration between public sector organisations that have a remit to plan and manage activities taking place at sea. At the national level, different ministries often have responsibility for different maritime sectors. Similarly, there are often different sectoral management bodies that operate at a sub-national (e.g. province, state or municipal) level. Integration mechanisms are therefore needed both horizontally (to integrate management across sectors) and vertically (to integrate across scales of governance).

FIGURE 5: DIFFERENT FORMS OF INTEGRATION IN ECOSYSTEM-BASED INTEGRATED OCEAN MANAGEMENT



Source: Lieberknecht 2020

Transboundary integration is needed to coordinate governance and information exchange across international boundaries (represented in the top right), and across the land-sea boundary (represented in the top left). When it involves integration of governance mechanisms across jurisdictional boundaries, transboundary integration overlaps with governance integration, but transboundary integration can also refer to knowledge exchange mechanisms across boundaries (overlapping with knowledge integration), or to mechanisms for engaging key stakeholders from across boundaries (overlapping with stakeholder integration).

Stakeholder integration refers to mechanisms that engage stakeholders in planning, decision-making, implementation, monitoring and evaluation of management measures. Stakeholder integration can take many forms (see the "ladder of participation" below), and serve a wide range of different purposes, including *inter alia* to ensure stakeholders are kept informed of developments, to ensure their views are integrated into the planning process and their interests are understood and addressed by planners, or as a vehicle for knowledge integration.

Knowledge integration refers to the need to draw knowledge from multiple fields of academic expertise (through multidisciplinary and interdisciplinary approaches) and from stakeholders who often hold valuable local or traditional knowledge of relevance. This means that stakeholder integration and knowledge integration mechanisms may need to be linked. The purpose of knowledge integration is to build a comprehensive understanding of the socio-ecological system of the planning region in question, creating the information base needed to underpin sound management measures. This requires integration of system dynamics to create an information base that reflects the natural dynamics of the systems that are being managed. This systems perspective is an important aspect of EBA.

Each of these forms of integration can be supported by a range of tools, methods and approaches. Because integration cuts across all stages of the management cycle, different mechanisms, tools and methods for integration may be appropriate for different phases.

If carried out well, each form of integration can bring added value: improved effectiveness of measures, improved stakeholder understanding and buy-in (resulting in easier implementation), reduced conflicts, improved efficiencies, social capital, generation of new knowledge, etc. Not all of this added value necessarily translates into improved environmental outcomes or a more holistic ecosystem-based perspective, however. To help operationalize EBA, integration should deliver added value for ecosystem-scale protection (e.g. transboundary integration should help adjust management measures to the known scales of ecosystem processes, knowledge integration should generate a good understanding of ecosystem linkages, dynamics and boundaries, stakeholder integration should give a voice to stakeholders who represent biodiversity and ecosystem protection, and governance integration should ensure that administrative bodies with environmental remits are sufficiently powerful & connected to other administrative functions, etc.).

The following sections outline the structures and processes within the Massachusetts OMP case study for each of these forms of integration (bearing in mind the overlap between them, e.g. stakeholder integration sometimes serving as a vehicle for knowledge integration, as was indeed the case in this case study). Each section briefly reflects on the mechanisms in place, and discusses how well they functioned in general, before commenting on the added value they have been bringing to the ecological dimension of sustainability and ecosystem-level focus needed for effective EBA. The text in the following sections builds on the case study outline in section 2, but adds further information (largely drawn from interviews) where relevant.

4.2.2 Governance integration

This section focuses on integration among public bodies at state level. Vertical integration between the federal and state public bodies is covered in the next section.

The CZM does not operate in isolation, but has established cross-sectoral engagement mechanisms that bring in advice and information relating to policy decisions and priorities, e.g. from legislators and elected officials as well as representatives of other relevant state agencies (including those responsible for fisheries management and infrastructure development). This allows for coordination, information exchange and review mechanisms to take place across different government offices.

Integration across agencies at the state level happens through a number of interagency groups and meetings, which aren't specifically related to the OMP, but at which matters relating to the OMP can be tabled and discussed formally, or that provide networking opportunities for such matters to be raised informally between relevant individuals. In addition, the key state bodies are represented on the OAC and SAC, providing formal integration mechanisms focused on knowledge integration (see below) and decision making that are specific for the OMP process, albeit with a membership that extends beyond governing bodies and public agencies.

None of the interviewees raised any concerns about lack of horizontal governance integration across different state bodies with different marine remits, though lack of integration across land and sea planning was raised (see the next section). Nonetheless, Heimes (2012) argues that there is a fundamental detraction "from Massachusetts's otherwise model efforts to rapidly and decisively prepare a comprehensive, ecosystem-based marine spatial plan", which is that the Oceans Act leaves jurisdiction over commercial and recreational marine fisheries in the hands of the DMF, and requires that any component of the OMP that has an impact on fishing should aim to minimize negative economic impacts on commercial and recreational fishing. Arguably, this is a form of horizontal governance disconnection that has deliberately been written into the Oceans Act, instead of treating and regulating fisheries like any other of the activities covered by the legislation. Realistically, such an ambition would be unlikely to be realized, given the cultural and historical factors that contribute to fisheries being treated in a very different way from other offshore uses (the same disconnect applies in many parts of the world, including in the EU). There are thus cultural and historical barriers which, in turn, create legal barriers that prevent operationalization of an idealized EBA process with fully integrated management of all human activities in the ocean, centred on managing the cumulative impacts of human activities in order to maintain ecosystem functions and restore / recover damaged ecosystems.

4.2.3 Transboundary integration

The focus here will be on the extent to which the scales of planning have taken account of natural ecosystem boundaries and ecological connections across these boundaries. In an idealized application of the EBA, the scale of planning should match ecosystem scales both in time and space. However, in reality, the bodies and institutions responsible for ocean governance – i.e. those bodies who have power to substantively impact who can do what, where, when and how at sea (or within adjacent watersheds) - have jurisdictions with fixed spatial boundaries that make this idealized vision of multi-scalar EBA very difficult to operationalize in practice. In the case of the Massachusetts OMP, there are three such boundaries to consider: 1. The state-federal boundary at 3nm from the shore, 2. The state-state boundaries between Massachusetts and adjacent state waters of Rhode Island, New Hampshire and other surrounding states in the region, and 3. The land-sea boundary (in this case, at 0.3 nm from the shoreline, as the immediate coastal waters don't fall under the Oceans Act).

To a lesser extent, the international boundary with Canada is also relevant, as the Gulf of Maine spans across the border between New England and the maritime provinces of Canada.

The Gulf of Maine Council on the Marine Environment[164] provides a mechanism for international transboundary integration for the Gulf of Maine. This body was created in 1989 by the state and province governments of Maine, Massachusetts, New Brunswick, New Hampshire and Nova Scotia to foster environmental health and community well-being throughout the Gulf watershed. It essentially provides a forum for knowledge integration through exchange of relevant scientific information to inform management decisions.

[164] http://www.gulfofmaine.org

Regarding the state-federal boundary, the state of Massachusetts has a history of active engagement in national and regional organisations (Morrison & Snow-Cotter 2008), including in relation to coastal management, where the CZMA has long provided a legal underpinning for state-federal communication. Nevertheless, Crowder et al. (2006) and Heimes (2010) highlighted the general mismatch between state and federal ocean governance in the US at the time that the Oceans Act was being developed and starting to be implemented, and the opportunity to use the momentum generated by this process as leverage to improve integration between state and federal authorities and agencies. This echoes some of the recommendations in Waves of Change, summarized in section 2.3.1. of this report.

There are no formalized mechanisms, structures or institutions for state-federal, interstate or land-sea integration that have been put in place specifically for the planning and implementation process for the Oceans Act. However, interviewees repeatedly highlighted that there is a lot of interaction between state officials at all the state agencies listed in section 2.2. and federal agencies with an ocean management remit, through a variety of other processes, meetings and forums. This state-federal network of relationships was generally considered to work well for the purposes of the OMP process, at least as far as communication between public agencies is concerned.

Another point that came up in an interview is that Jane Lubchenco was the NOAA Under Secretary of Commerce for Oceans and Atmosphere from 2009 to 2013, a crucial time period for the first ocean plan implementation. She was the first marine ecologist to occupy this post, and her expertise helped drive forward advice and progress on ocean planning and marine protected area planning in US federal waters, including waters adjacent to Massachusetts state waters. Although NOAA has no formal remit in the OMP process, the energy, thinking and expertise at the federal level helped galvanise progress at the state level, with informal knowledge sharing happening through a variety of meetings and forums that brought together state and federal experts. As such, while no formal mechanisms were established for state-federal transboundary integration in the state ocean planning process, such integration did take place, both in terms of knowledge exchange (which could also be badged as a form of knowledge integration, see next section), and in terms of ocean planning policy and processes, at this crucial time period during which the OMP process was establishing itself.

Since the release of the first OMP, Massachusetts has been actively working with the Northeast Regional Ocean Council, comprised of state and federal agencies in the region in a planning initiative pursuant to the Obama Administration's National Ocean Policy. This provides opportunities for state-state integration if needed – again, these are informal and not related specifically to the OMP.

The same was highlighted in two interviews for the landward boundary of the planning region: Although no formal land-sea integration mechanisms exist specifically for the OMS process, there is strong overlap between the state government organisations and people within them who are involved both in the OMS process and in the management and regulation of water-based activities and constructions within 3nm. However, the lack of integration between terrestrial environmental management and marine environmental management was raised as a problem, especially in relation to the effective protection of seabirds that are listed as SSU in the OMP process, but spend a crucial part of their life cycle nesting on coastal cliffs.

It is also notable that the integration that people spoke about in the interviews relates to public bodies, but not to stakeholders, or to effective integration mechanisms for knowledge across boundaries (see next section).

4.2.4 Knowledge integration (including integration of systems thinking)

At the start of the timeframe covered by this analysis (the mid-2000s), there was a comprehensive knowledge gathering exercise that was initiated by the Task Force, and which directly led to focused research and survey efforts to fill the most important information gaps: Through the 2000s, CZM invested heavily in seafloor mapping and in characterizing sea uses in state waters, in part carried out in response to the recommendations in Waves of Change (Morrison & Snow-Cotter, 2008).

The MOPF conducted an even more thorough science gap analysis that was framed entirely around identifying gaps in ecosystem-level understanding (Mooney-Seus & Allen 2007). This gap analysis focused research efforts on areas where the biggest knowledge gaps existed at the time, in order to build a scientific baseline report centred explicitly on implementing EBM. This gap analysis was informed by a literature review, the research priorities identified by key organisations, and interviews with experts from a wide range of disciplines, including (but not limited to) economics, social science, physical oceanography, geology, marine biology, ocean and coastal management and user groups, as well as a smaller subset of federal agencies and national organisations working in the Gulf of Maine.

The gap analysis highlighted a wide range of research gaps in Massachusetts at the time (ranging from a lack of baseline assessments on the status of species and habitats to a lack of understanding of ecosystem linkages and dynamics, a lack of a comprehensive understanding of human impacts on the marine ecosystem, and a lack of ability to predict the impacts of climate change within state waters). The analysis produced a series of recommendations for specific research projects and research outputs that would fill these gaps, giving each a priority rating depending on the level of relevant research that was already underway.

As such, this gap analysis exercise represents an excellent example of transdisciplinary knowledge integration, and the findings of the analysis highlighted the benefits of this cross-disciplinary approach: Not only were important information gaps identified in multiple relevant fields and disciplines, but the process of interviewing experts from across such different backgrounds also revealed that different individuals and organisations had very different perceptions of the importance and relevance of different aspects of science and scientific data collection. While natural scientists repeatedly stressed the importance of long- and short-term field survey data as crucial for underpinning models as well as for long-term management of resources, continuous monitoring was also identified as very challenging to fund, because non-scientists didn't see routine data collection as a priority.

During the run-up to the 2009 plan, Heimes (2012) states that the partnership between the EEA and the MOPF proved effective, highlighting the ongoing role of the MOPF in engaging with stakeholders and bringing their knowledge and perspectives to the table, as well as their role in funding not just natural science research, but also important policy analyses (allowing the process to learn from ocean management processes in other parts of the world) and the mapping of recreational activities in Massachusetts waters.

At present, as the second review phase is unfolding, the knowledge brought into the process is less comprehensive in scope, as the purpose of the review cycles is to update and maintain the scientific knowledge base underpinning the plan, rather than having to recreate it. A lot of emphasis is placed on updating the maps of SSU distribution, and a significant portion of the efforts of the SAC and Working Groups are focused on this task.

Having a dedicated scientific advisory body (the SAC) in the process potentially allows for a differentiation of roles between wider stakeholder participation in decision-making, so that different interests can be addressed (through the consultative mechanisms, i.e. public meetings and public comment periods) and the role of providing scientific or other expert knowledge to underpin the process as a whole (through the SAC and Working Groups). However, interviews reveal that this differentiation isn't always clear in the minds of participants, in particular in relation to the role of the Working Groups. These six groups (1. Habitat, 2. Fisheries, 3. Sediment resources, 4. Recreational and cultural services, 5. Transportation and navigation, and 6. Energy and infrastructure) are ostensibly responsible for supplying knowledge (data, information and expertise) to the SAC, while the SAC then updates the plan purely on the basis of newly emerged information. On the face of it, this is an entirely data / evidence-driven process with a good level of knowledge integration, given the breadth and variety of topics that the six working groups focus on.

However, the interviews revealed that Working Group members are free to raise issues of concern to the SAC, and that the interests of the working group members can have a strong influence on what issues are raised – there seems to be no clear distinction, therefore, between the role of defending the interests of a particular sector, and the role of ensuring that the review process draws on the most comprehensive, accurate and detailed information that is available. From the interviews conducted, it wasn't clear to what extent the knowledge that is integrated into the review process is driven by the needs and interests of the CZM, or the wider SAC, or based on the initiative of Working Group members. There was also a lack of clarity over the criteria based on which Working Group members are identified and selected.

The Working Groups cover a wide range of topics, but this does not guarantee that a whole-ecosystem perspective is taken during the review process: Whether or not this happens depends on the interests and drive of members of the SAC and the Working Groups. Evidence gathered during the interview process highlights that, while some ecosystem processes have been illuminated and discussed during last two review cycles, the overwhelming majority of EBA-relevant focus is on the SSU, both on the list of SSU itself (which was amended by adding a bird species in the 2015 update of the plan), and on updating the distribution maps for the SSU features.

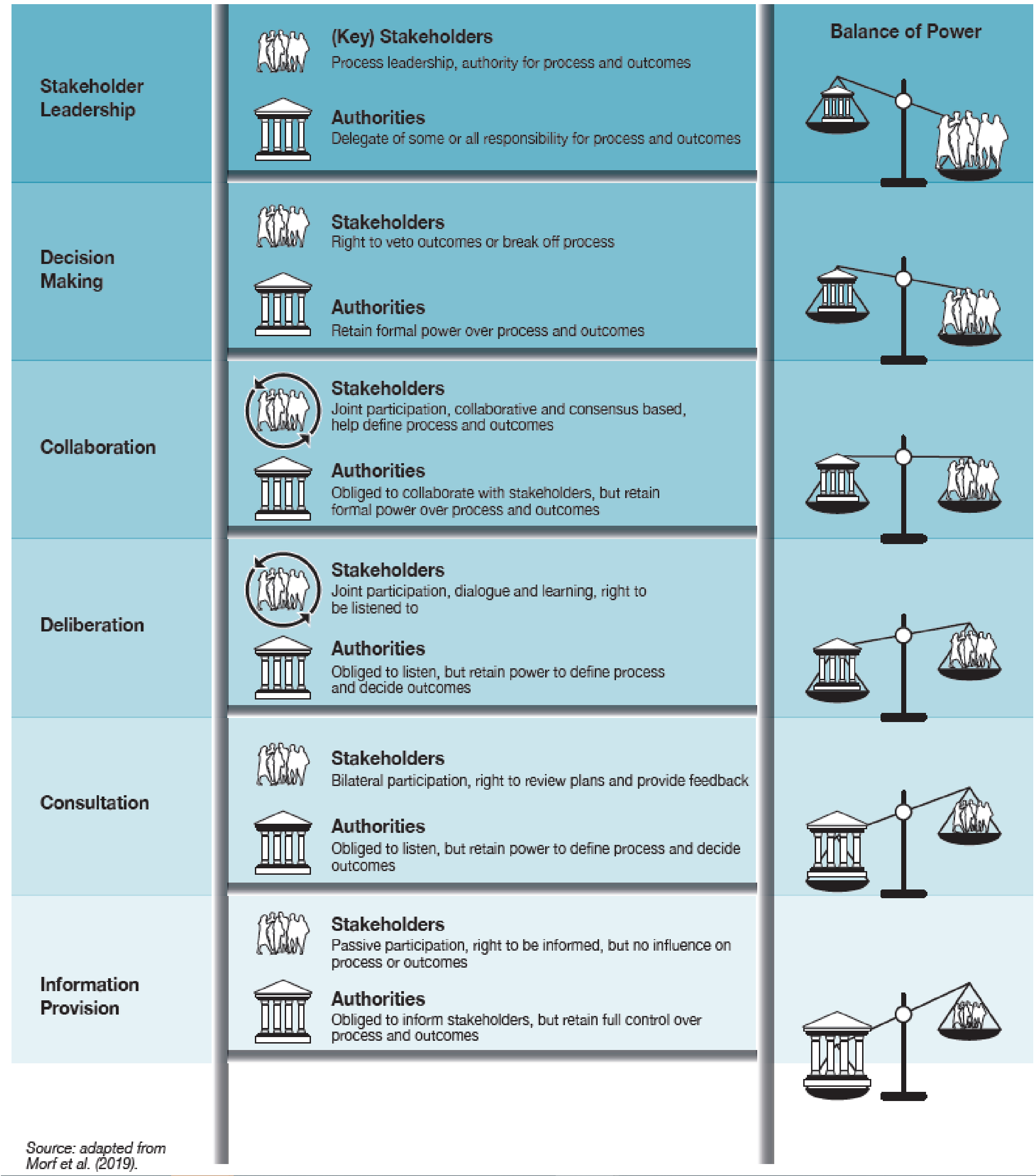
The documents published for stakeholder consultation in late 2020 (for the second review cycle) highlight the need to increase and improve the understanding of changes and trends at the ecosystem scale, especially for trends related to Climate Change. This point was also highlighted by several interviewees, who saw this as a key priority for updating and improving the plan in future, although there was no clear statement of how an improved understanding of trends over time would translate into management actions.

4.2.5 Stakeholder engagement

Stakeholder engagement can take many different forms and serve many different purposes in the context of ecosystem-based integrated ocean management and MSP. This is illustrated by the "ladder of participation" in Figure 5. As stated in Lieberknecht (2020) in relation to this specific figure, which was drawn based on a review of MSP case studies in the EU (Morf et al. 2009):

"The ladder represents different levels of power delegation from authorities to stakeholders. Higher levels of power delegation can ease burdens on authorities and improve management effectiveness, if the power delegation is genuine. Two levels represented in this figure, deliberation and collaboration, require different stakeholders to engage with each other and work together across sectoral divides (indicated by the black circular arrows around the stakeholder group icon). This cross-sectoral element is absent in the two highest levels on this particular version of the ladder, which is based on a geographically limited sample of MSP case studies (all in Europe). However, in [ecosystem-based integrated ocean management] it is also possible to maintain the cross-sectoral collaborative aspect while fully delegating power to stakeholders (for example, there are successful examples of collaborative, community-based co-management of coastal fisheries and MPAs in other parts of the world). Cross-sectoral engagement can bring significant benefits, if there is sufficient capacity to support mechanisms that bring stakeholders together and facilitate their joint work. The most appropriate and effective form of engagement depends on a wide range of case-specific considerations (including the cultural, political, and legislative context, established engagement practices, and the resources and capacities available). There is no single type of engagement that is inherently superior: every type of engagement represented here can be an effective element of [ecosystem-based integrated ocean management] in the right circumstances, and different types of engagement might be needed at different stages of the same process."

FIGURE 6: THE LADDER OF PARTICIPATION



Source: Figure copied from Lieberknecht (2020), adapted from Morf et al. (2019)

Stakeholder engagement is consistently cited as an absolutely crucial factor for success in specialist literature on MSP, but often without articulating clearly what is meant by "stakeholder engagement" and how to make the engagement process itself successful (from both the perspective of process managers as well as participants). This section illuminates how stakeholder engagement was carried out in this case, the levels of participation implemented and the purposes it served, how the nature of the process has changed over time, and how the process has been perceived by those involved (inasmuch as it is possible to say, based on the evidence collected for this report). The discussion here mainly views participation through the EBA lens, i.e. attempting to highlight to what extent (if any) the engagement process has been a vehicle for operationalizing EBA.

The Massachusetts OMP process has had a strong component of stakeholder engagement running through it from the beginning, but there have been significant shifts and changes to the way in which that engagement has happened in practice. In the run-up to the legislation being enacted and the first plan being developed, stakeholder engagement was strongly supported by the MOPF, who (in the absence of a legal mandate to start with) started shaping an intensive, collaborative process of knowledge gathering and planning with a wide range of stakeholders. This phase of the process can be described as "deliberation" as defined in Figure 5.

The formal planning process that was (carried out under the auspices of the bodies that were provided with a legal mandate through the Oceans Act in 2008) has followed its own stakeholder engagement process, which has been largely consultative and much more light-touch, with interests being represented through OAC members and several opportunities for public comment and consultation on drafts of the reviewed plans. The stakeholder engagement for the formal process can be described as "consultation" as defined in Figure 5.

During the first planning process, and for part of the first review, the two happened in parallel and supported each other in many ways. However, since the demise of the MOPF/SeaPlan, there has been a much less intensive public-facing (i.e. open to members of the public / wider stakeholder communities) stakeholder engagement process, which is now purely consultative, i.e. the review process is driven by the CZM, the SAC, and the Working Groups, and wider stakeholders and members of the public have a right to comment on draft plans.

The OAC and SAC, in themselves, also include representatives from different stakeholder sectors, including offshore energy developers and fishermen. In addition, as highlighted in the previous section, sector-based interests are to some extent reflected and integrated more substantively into the reviews through the six Working Groups, for whom this analysis wasn't able to determine any clear dividing line between their role as expert knowledge provider and their (potential) role in defending stakeholder interests. To some extent, this lack of clear role definition also applies to the SAC itself. The OAC, meanwhile, represents a wide range of stakeholder interests, and provides a formal structure through which those interests can impact on the plan and its reviews. However, the OAC meetings are relatively short and infrequent (the Oceans Act requires the OAC to meet quarterly at minimum), and primarily serve to review and approve the work put forward through the SAC. Their members face a considerable task simply in assimilating the volume of information that is published through the SAC. One interviewee highlighted the "information overload" during the two OMP review processes, with technical reports issued to the SAC and OAC from working groups often numbering hundreds of pages, and little or no support for members of the OAC to process this information and understand potential implications for the sector whose interests they represent.

The wide range of stakeholder engagement mechanisms that were in place during the first OMP process, while the MOPF was carrying out a lot of the public-facing engagement, are summarised by Nutters & da Silva (2012). The formal OMP process in 2008 / 2009 included preliminary semi-structured interviews with stakeholders to collect information on major concerns and issues among different groups, as well as subsequent stakeholder meetings and workshops. Once the draft OMP was developed, public listening sessions were held to gather public feedback on it, alongside a public comment period.

Nutters & da Silva (2012) conducted a series of interviews with stakeholders who had been involved in this first OMP process, and examined commercial fishermen's perceptions of the engagement process, comparing the role they sought with the one they actually played. They highlight that the fishing sector is in itself very diverse, with interests that can be disparate depending on the type of fishing undertaken by different fishermen. The authors state that there was significant input from commercial fishermen into the drafting of the legislation, but that engagement in the subsequent planning process was less active (with fishing representatives observing and watching out for impacts on their sector, rather than actively helping to shape the plan), despite significant outreach to fishing organsiations by the MOPF (who supported the stakeholder outreach efforts of the first planning round) and the formal OMP process itself. This may have been because fishermen felt their input into the legislation was more important, or because of insufficient outreach to the wider fishing community. Engagement was mainly with leaders of fishing organisations, who were expected to act as representatives of the community – the OMP process managers relied on them to communicate with the wider community, without providing support for them to do so, and despite some of the individuals concerned being heavily engaged in other fishery management issues, usually unpaid, and often on top of their "day jobs" as fishermen.

The same authors further highlighted that there was a mismatch between the kind of participation that fishermen were seeking (shared decision-making) and what the managers of the process were seeking (consultation and information provision by stakeholders to help build the information base for decisions). They criticise "mixed messages" from the process managers about the purpose of engagement, raising expectations among fishermen beyond what their role ultimately shaped up to become.

Several of the points highlighted in the paper by Nutters & da Silva (2012) resonate with information provided by interviewees for the present case study analysis, who were interviewed between March and May 2020, including that the expectations of stakeholders had been raised early on, but these expectations weren't fully met in the formal planning process. As stated earlier, during the first planning process, and for part of the first review, the MOPF operated a stakeholder engagement process in parallel to the formal OMP process being initiated under the auspices of the CZM, SAC and OAC. This created two "strands" to the process that were intertwined and supported each other in many ways, but that also created some interesting tensions.

One interviewee who had been particularly heavily involved in the early stages of planning (through MOPF) voiced considerable frustration over the loss of the benefits that the collaborative, intensive stakeholder process brought into the OMP, and a perceived lack of recognition of the value provided by staff working to support it (citing skills related to process design, communication and facilitation). The same interviewee also stated that a lot of technical work ultimately was sidelined, especially related to scenario planning. This highlights that the frustrations expressed by the fishermen interviewed by Nutters & da Silva (2012) may have extended to other participants in those early, intensive planning meeting – not only by stakeholders who attended the meetings, but also by the staff that organized and facilitated these meetings, and by technical specialists who contributed their skills and expertise.

On the basis of the evidence that was collected for this report, the main issue that seems to have led to the demise of MOPF / SeaPlan was a lack of resources to continue to support their work. Once the initial grant money that had helped MOPF get established ran out after 5 years, the experts that had been supporting the day-to-day operations of the MOPF reinvented themselves as SeaPlan, offering expert support to ocean management initiatives more widely across the US, based on the experiences gathered in Massachusetts (particularly in relation to the organisation and facilitation of stakeholder engagement, and in terms of expert knowledge integration to support planning and scenario development). However, they were unable to maintain themselves in this form, and ultimately disbanded. Interestingly, the work of the MOPF in its original form was very explicitly framed through EBM (which, for the purpose of this analysis, can be regarded as the same as EBA), while the language on the subsequent SeaPlan website was more generic and mentioned "economic growth" and "conservation" as parallel goals, with no explicit reference to EBM. This analysis was unable to establish why this was the case – it may have been an attempt to achieve a wider appeal to those seeking support for their own ocean planning processes beyond Massachusetts.

In terms of whether or not the stakeholder engagement process in this case study has served as an effective vehicle for EBA, it is clear that the intensive engagement process that the Task Force and MOPF conducted went hand in hand with outputs and recommendations that certainly embodied EBA at their core. However, it is not clear what drove this – stakeholder input, the particular way in which the stakeholder meetings were organized and framed, political priorities, particular personalities of key individuals, or expert-driven elements (from academics and/or experts at the relevant state bodies) may all have played their roles, which are impossible to untangle 15 years later by an external analyst conducting a relatively short analysis of the process.

What is also clear is that the less intensive public-facing consultative process that is currently included in the review process has gone hand in hand with a less intensive focus on EBA, although a causal relationship can't be established from the evidence gathered on this particular case study. Depending on how a process is framed and what questions stakeholders are asked to address, "collaborative" does not automatically mean "more EBA" than "consultative", but there are those who argue that collaboration between multiple stakeholders in deliberative processes is key to operationalizing systems thinking in sustainability transitions in other contexts such as city planning (e.g. see Thriving Cities Initiative 2020). There are logical reasons to believe that the variety and diversity of knowledge, perspectives, and expertise held by different stakeholders is a vital for gaining a good understanding of socio-ecological systems linkages, and that collaborative approaches to integrating that knowledge are more likely for those linkages to be identified than bilateral consultative approaches. This is in addition to considerations regarding the potential for social capital to be created by bringing people together and supporting them through joint problem solving processes, and how that social capital might benefit implementation and adherence to plans.

However, there are also risks to collaborative processes, one of which has been identified in this case study: If the collaborative process has no mandate beyond providing advice, expectations may be raised and subsequently dashed when joint recommendations aren't implemented in practice. The interviews (along with the archived documentation of the MOPF work on OpenChannels) also highlight the intensity of support that a collaborative process requires – in the case of Massachusetts, this level of support was only possible through a grant from a private foundation, and couldn't be sustained in the long run. In that sense, the following extract from the introduction to *Waves of Change* – although not focused on stakeholder engagement processes *per se* - proved to be prophetic:

> *"In the course of its deliberations, the Task Force became very much aware of the extraordinary extent to which state agencies are stretched in managing coastal resources: from the review of ocean-based projects to assessing fisheries stocks or habitat, from planning activities in ocean sanctuaries to seafloor mapping, and from permitting to enforcement of resource protection laws, many environmental agencies have lost significant staff in recent years. These staff reductions lessen the state's ability to adequately manage ocean resources at precisely the time when it is needed most. The Task Force*

recognizes the need to assess current staff levels and program needs and supports investments in personnel, research, and equipment for Massachusetts' coastal and ocean resource management and planning programs."

5. DISCUSSION: ADDED VALUE OF EBA IN THIS CASE STUDY

5.1 Has EBA contributed to better knowledge, planning or implementation?

While section 3 deconstructed the process into elements related to EBA, and provided an insight into the degree to which EBA was operationalized through these process elements, this section frames the question the other way around: What added value has EBA brought to the Massachusetts OMP process? Specifically, what has EBA done to contribute to better knowledge, planning or implementation in the process?

Of course, EBA is a normative concept, i.e. based on its common definitions it is seen as inherently desirable, and its implementation becomes a goal in its own right. In that sense, there is a risk of the question asked in this section turning in on itself and the answer becoming tautological ("the added value of operationalizing EBA is the operationalization of EBA"). However, it is possible to argue that EBA has brought ancillary benefits in that it contributed to better knowledge (creating a shared information base to underpin MSP), as well as improving the process (better planning and better implementation).

In terms of improving knowledge, the intensive, EBA-focused work carried out by the Task Force and MOPF included a very comprehensive information gathering endeavour, guided by the priority recommendations from the gap analysis published in 2007 (Mooney-Seus & Allen 2007). The result was an improvement in data management and accessibility on the one hand, and targeted new research and survey work to fill data gaps on the other hand. For example, remote sensing surveys were carried out to create comprehensive seafloor habitat maps for the entirety of the state's seafloor for the first time, and existing information was collated and made available via central repositories, portals and technical reports (as highlighted in the introduction, this is a very richly documented case study, and much of the information that was collected is easy to find through links on the websites referred to).

As a result of this work, stakeholders - including the public agencies, but also academics and interested parties from sea user communities - have much easier access to information about the nature of the marine environment and of the human uses that take place there than they did before the OMP process began. By virtue of the participative elements in the process, especially during the more intense and collaborative early stages, this knowledge has to some extent been assimilated by a wide range of people, generating a better *shared* understanding of the state's ocean environment and its human users.

While the more recent stages have been less intensive and collaborative in terms of public-facing stakeholder engagement, the Working Groups span a wide range of topics, which means that the knowledge base created earlier on is still being added to, updated, and built upon as the review cycles continue. The legal codification of adaptive management (the requirement for 5-yearly reviews written into the Oceans Act) can be seen as the power behind the engine that keeps the process "spinning", by requiring that the Working Groups, at minimum, review and update the information base underpinning the OMP every five years.

In terms of better planning, it is possible to argue that the EBA elements of the process have benefitted governance integration by providing multiple public bodies with different remits with a shared task to solve together. This will have strengthened ties and networks between different public sector agencies, which can only benefit wider governance of the environment.

From the evidence that was gathered for this report, it is hard to gauge the exact extent to which the EBA related aspects of the OMP process have improved the effective implementation of rules and measures or increased ownership/acceptance by stakeholders. It is evident, however, that the integration mechanisms in the process, and the streamlining of the licensing and consenting procedures under Chapter 91 that was facilitated through them, has had some added value. This was a point highlighted by some of the interviewees with stakeholders' perspectives on the process, and has also been highlighted in the literature. Blau & Green (2015) highlight the multi-sectoral, multi-use character of this case study compared to many others. They cite sources stating that commercial stakeholders have seen a clear benefit as a result of the ocean plan, specifically, telecommunications companies who, following the 2009 plan, found a more streamlined consenting process which allowed them to gain permission for a new cable between Martha's Vineyard and the mainland in much faster timeframe than expected (12 – 24 months faster than expected), and at a much lower cost because of a lack of need to hire outside counsel. They also cite sources stating that fishermen benefitted from having their views represented better, and from an integrated governance framework that had jurisdiction across a wider range of human uses. Specifically, where fisheries closures of important spawning areas had previously only applied to fishing, under the 2009 plan these closures were easily able to be applied to sand and gravel extraction in areas which the plan defined as Important Fish Resource Areas, protecting fish resources from damaging impacts of mining.

5.2 Conclusions

5.2.1 Concluding remarks on EBA in the case study

EBA can't be turned on or off - it is more like a dimmer switch: The more you turn it up, the brighter it gets and the better (more sustainable) the outcomes. This case study illustrated a process which started with the light turned up very brightly, but it has arguably been dimmed somewhat over time. The benefits of the early stages of the process still permeate the process, however, not least because of the strength of the first plan that was generated in 2009. There are also indications that the growing concern over climate change impacts is going to lead to the switch being turned up a bit more brightly again, with Working Groups raising the need to better illuminate trends in the marine ecosystem as a whole, and in how these will impact on humans at sea and along the coastline.

What is difficult to determine is what, exactly, caused the reduction in EBA in the first place, given that *Waves of Change* was such a collaborative effort that took into account so many different perspectives. Why was there not enough momentum for this level of EBA to become self-sustaining for the long term? It clearly wasn't because of a lack of technical capacity, people willing and interested to carry out the necessary science and technical work, lack of knowledge, lack of available tools and methods, lack of sufficient data or expertise. That much is clear from the detail and volume of information produced by the Task Force and the MOPF.

Political will is often cited as a major stumbling block for operationalizing any form of environmental protection measures – however, the political will for some degree of EBA in ocean management (at least in terms of improving environmental protections and streamlining / integrating across sectors) was certainly there in the 2000s and 2010s at the state level. This was partly driven by strong interest from potential renewable energy developers for the establishment of offshore wind farms and thereby galvanizing a sense of urgency about streamlining ocean management (Morrison & Snow-Cotter 2008), but the creation and remit of the Task Force by the state governor in 2013 demonstrates that the political will went beyond addressing the need of commercial developers and extended to a genuine desire to improve ecosystem management at the same time. This time period coincided with a strong level of political will to invest in MSP and ocean protection at the federal level under the Obama administration. In 2016, that federal commitment to ocean protection undeniably fell off a cliff edge, culminating in the removal of existing protections in National Marine Monuments in 2020 by executive order. While this was obliquely referred to in some interviews as having taken some of the energy out of ocean planning more generally (resulting from less opportunities for mutual exchange of knowledge, expertise and ideas across federal and state bodies), none of the interviewees explicitly highlighted a lack of political will as a major stumbling block at the state level. Nobody raised concerns that the state government wasn't sufficiently committed to improving the state of the marine environment (although some interviewees referred to a degree of "horse trading" between stakeholder interest groups that played out in the nitty-gritty of the drafting of the law and the implementation of the legislation). In summary, there is little indication in the evidence reviewed for this report that a lack of political will within Massachusetts was a significant barrier to operationalizing EBA.

Returning to the dimmer switch analogy, perhaps the main barrier in this instance is the financial outlay that has to be borne by *someone* - everyone in the house might want the brighter light and everyone stands to benefit from it in their own way, including the substance of the house itself (because the light will make it more visible when areas need attention and maintenance) – but someone in the house has to pay the bill. In pure monetary terms, operationalizing EBA is costly, and the experience of the MOPF / SeaPlan demonstrates that it can be very difficult to find a sustained source of financing to keep it going for the long term. Thus, a key enabling factor for EBA that is perhaps not sufficiently considered in the MSP literature is putting in place financing mechanisms that can support EBA in practice.

Management Tools Recommendation #1 in *Waves of Change* (see Box 3 in section 2.3.2) recognised this point, recommending an update to existing state licence fee structures – these are in place under existing wider environmental legislation that requires potential developers to pay fees as part of permit application processes – so that revenues generated from such fees can be used to support ocean management processes.

5.2.2 Take-home lessons

5.2.2.1 Stakeholder collaboration

The central lesson that can be taken from this case study is that intense stakeholder collaboration can serve as a highly effective vehicle for EBA, but it requires significant levels of resource commitment if it is to be maintained over time.

In addition to this central lesson, which has been discussed at length throughout this report, there are further insights to be gleaned from this case study analysis that may prove to be of relevance and interest to MSP actors in the EU context. These are set out below.

Wording of legislation

The wording of legislation matters in relation to implementing EBA in practice. The Oceans Act includes wording that codify some of the basic tenets of EBA, including requirements for the OMP to value biodiversity and ecosystem health, respect the interdependence of ecosystems, identify and protect SSU, and coordinate multiple uses across multiple scales (as highlighted in Box 1 in section 3.1). Crucially, the Oceans Act also requires the OMP to be reviewed every 5 years at minimum, thereby ensuring some level of adaptive management. Regarding the environmental stipulations in the legislation, some of the wording is ambitious but not specific enough to have translated into tangible actions (e.g. "respect the interdependence of ecosystems"). Arguably the most impactful portion of the environmental stipulations is that related to the SSU, as it is unambiguous: The OMP must identify and protect a list of priority ecosystem components (that are special, sensitive or unique). The legislation doesn't, however, contain any annexes that predefine a list of species and habitats to protect (unlike the EU Habitats and Birds Directives, for example). This means that the scientists, public agencies and other stakeholders involved in the process have flexibility to define and select SSU, and to review and change this list over time as ecosystem knowledge improves and as the ecosystem changes, with immediate impacts on EIA and licensing requirements for offshore operations and developments.

A lesson that can be taken away is that it matters to get the right combination of ambition, specificity and flexibility into the wording of legislation for it to serve as a genuine catalyst for EBA. It should include a strong and specific enough set of environmental requirements to prevent the watering down of the environmental provisions at the time of their implementation. It should also be worded to ensure a basic level of integration, at minimum ensuring coordination across multiple types of ocean uses. However, the wording should also be flexible enough for management to be adaptive and for the implementation process to test different approaches and techniques that can adapt and evolve over time to produce the best possible outcomes.

The Oceans Act achieves this to an extent, but it misses an element that is arguably fundamental to the integration of EBA and MSP, which is a clear requirement for highly protected areas and/or a systematically planned network of MPAs. From an environmental perspective this can be seen as a missed opportunity to build on and strengthen the provisions of the Ocean Sanctuaries Act, and to follow up on one of the management tools recommendations in *Waves of Change*. On this aspect, the EU Marine Strategy Framework Directive can be seen as stronger, as it requires the establishment of "coherent and representative MPA networks that cover the diversity of the constituent ecosystems".

Integrating fisheries with other uses

Ocean management in Massachusetts shares one important characteristic with the EU, which is that **fisheries is treated differently** from every other type of human activity at sea. Like in the EU, fisheries operations[165] are exempt from EIA requirements, even for operations carried out at significant scale. The Oceans Act even includes a specific wording (cited in Box 1) that emphasizes that fisheries (unlike other human uses) require protection in their own right, effectively placing it alongside SSU as "special" features of the oceanscape. Furthermore, the act emphasises that fisheries management and regulation remain the sole responsibility of the state's existing fisheries management bodies under existing fisheries legislation, as opposed to being regulated through the OMP process. This is in contrast to other forms of human use, for which the act emphasises the importance and value of cross-sectoral coordination which the OMP should help achieve.

From an EBA perspective, this codified separation of fisheries management from the management of other forms of offshore activities is unhelpful, as it creates barriers to integration across sectors, as well as barriers to the application of one of the most important instruments of environmental protection (EIAs) to significant fisheries operations. In the case of the Massachusetts OMP, these barriers are reduced by having the fisheries management bodies at the table during the planning and review process (through the SAC), and through the existence of strong and cooperative working relationships between key officials at CMZ and DMF. This highlights the value of building integration mechanisms between governance bodies, both formal and informal, as a pragmatic way of reducing the codified disjoint between fisheries and other human activities at sea.

Adaptive management doesn't have to be driven by metrics

The different stages of an MSP process are commonly represented as a continuous improvement cycle, which starts by defining objectives, then assesses the status quo, plans scenarios and pathways to get from the status quo to the goals and objectives, decides on a scenario / pathway to implement, puts the relevant measures in place, and monitors indicators linked to the objectives to evaluate progress. The cycle then returns to the planning phase, during which management interventions are modified (or alternatives devised, or objectives revised) if there has been insufficient progress towards the objectives. This continuous improvement cycle is one form of adaptive management (the latter being a central tenet of EBA).

The continuous improvement cycle originated as a concept in business management, where managers have a lot of control over the system being managed, and where it is comparatively simple to pre-determine specific and measurable targets that are cheap to monitor and are meaningful to the business. The approach has since been adopted in environmental management to ensure that interventions have a genuine impact (and that environmental projects are accountable to donors), while remaining adaptable to changing circumstances. Environmental managers deal with highly complex socio-ecological systems in which they have limited control over outcomes, and they have dedicated a lot of effort to developing metrics and indicator systems that measure ecosystem health and integrity (complementing social indicators, equally relevant for sustainability). These can function as "alarm signals" for issues that

[165] "Fisheries operations" here refers to open water fishing, not aquaculture, which is included in an annex to the EU's EIA Directive.

managers need to address and serve as metrics to drive adaptive management processes akin to the continuous improvement cycle.

However, ecosystems and socio-ecological systems are so complex that even the most comprehensive indicator systems are unlikely to be able to fully describe or "measure" them. Furthermore, the more comprehensive an indicator system is used, the more expensive the monitoring and evaluation process becomes (especially in the marine environment), and the more administrative burden is created, which might exceed the resources of a given management process.

The Massachusetts OMP case study provides a complete counterpoint to this metric-driven approach, by having a review cycle that relies on a much more reactive, flexible, expert- and stakeholder-based approach to identify and flag issues that need to be addressed every 5 years. There are no specific, measurable targets set for the OMP, nor does the OMP have a dedicated monitoring and evaluation programme in place that feeds its results into the 5-year reviews. Instead, relevant experts and stakeholders convene during every cycle (through the SAC, the Working Groups and the OAC) and table issues (environmental issues, problems, emerging conflicts) that they consider important for the OMP review to address. In doing so, they draw from their own knowledge and experience of the environment, based on direct experiences of working in the marine environment (or of dealing with wider stakeholder communities that work there), and based on new scientific information they are aware of (including from monitoring and survey work carried out in state waters for a variety of projects and purposes that aren't part of the formal OMP process).

This expert- and stakeholder-based approach to adaptive management may serve as a very effective complementary approach to metric-driven adaptive management cycles in the EU context. It offers the potential advantages of being a lot more flexible and therefore better able to rapidly identify and respond to unpredicted emerging issues and system changes than a more rigid system that relies entirely on monitoring predefined metrics (which may miss the parameters that would flag unpredicted system changes or emerging trends). Of course, this relies on having the right people at the table to ensure that the most important environmental (and social) issues are flagged and addressed (and, as highlighted in section 5.2.2.1, a well-supported stakeholder process can be costly in its own right). This opens up a whole range of interesting questions that go beyond the scope of this analysis, but which deserve at least the same level of attention in the context of EBA as the development of robust indicator systems. For example: Is stakeholder representation in the process comprehensive, balanced and fair? Is the full range of relevant expertise represented, including from academics as well as from people who operate within the marine and coastal environment being managed? Is the process inclusive in terms of diversity? Are marginalised voices and communities provided with fair access and support?

REFERENCES

- Blau, J. and Green, L., 2015. *Assessing the impact of a new approach to ocean management: Evidence to date from five ocean plans*. Marine Policy, 56, pp.1-8. https://doi.org/10.1016/j.marpol.2015.02.004
- Brown, A. and Wehner, N., (2007). (No. 54xnc). Center for Open Science. (Report accessed at https://www.openchannels.org/literature/13661, May 2020)
- Commonwealth of Massachusetts (2008) An Act Relative to Oceans. https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter114

- Commonwealth of Massachusetts (2009) *2009 Massachusetts Ocean Management Plan* https://www.mass.gov/service-details/2009-massachusetts-ocean-management-plan-superseded-by-the-2015-plan
- Commonwealth of Massachusetts (2015) *2015 Massachusetts Ocean Management Plan* https://www.mass.gov/service-details/2015-massachusetts-ocean-management-plan
- Commonwealth of Massachusetts (2020) *Review of the Massachusetts Ocean Management Plan. Draft Document.* https://www.mass.gov/files/documents/2020/11/10/draft-2015-ocean-plan-review-november-2020.pdf
- Crowder, Larry B., Gail Osherenko, Oran R. Young, Satie Airamé, Elliot A. Norse, Nancy Baron, John C. Day et al. (2006) Resolving mismatches in US ocean governance. Science 313, 617-618.
- Heimes, R.S. (2010). *Ocean Management and Planning in the United States: From Competition to Cooperation*. Annuaire de Droit Maritime et Océanique, 1, 1-19
- Kappel, C.V., Halpern, B.S., Selkoe, K.A. and Cooke, R.M., 2012. *Eliciting expert knowledge of ecosystem vulnerability to human stressors to support comprehensive ocean management*. In Expert knowledge and its application in landscape ecology (pp. 253-277). Springer, New York, NY.
- Lieberknecht, L.M. (2020) *Ecosystem-Based Integrated Ocean Management: A Framework for Sustainable Ocean Economy Development*. A report for WWF-Norway by GRID-Arendal https://www.grida.no/publications/477
- Massachusetts Ocean Management Task Force (2004) *Waves of Change.* Massachusetts Ocean Management Task Force Report and Recommendations. https://www.mass.gov/files/documents/2016/08/ql/waves-of-change.pdf
- Massachusetts Ocean Partnership Fund (2006) *Convening Report* *https://www.openchannels.org/sites/default/files/literature/Massachusetts%20Ocean%20Partnership%20Fund%20-%20Convening%20Report.pdf*
- Massachusetts Ocean Partnership Fund (2007) *Five Year Strategic Plan To Advance Integrated Multi-use Ocean Management for Massachusetts' Coastal Ocean Waters. https://www.openchannels.org/sites/default/files/literature/Five%20Year%20Strategic%20Plan%20To%20Advance%20Integrated%20Multi-use%20Ocean%20Management%20for%20Massachusetts%20Coastal%20Ocean%20Waters.pdf*
- Mooney-Seus & Allen (2007) *Ecosystem-Based Coastal and Ocean Management in Massachusetts: Science Gap Analysis.* Prepared by Fort Hill Associates LLC on behalf of Massachusetts Ocean Partnership Fund https://www.openchannels.org/literature/13660
- Morf, A., Kull, M., Piwowarczyk, J. and Gee, K. 2019. *Towards a ladder of marine/maritime spatial planning participation*. In Maritime Spatial Planning. Zaucha J. and Gee K. (eds). Cham: Palgrave Macmillan.
- Morrison, K.K. and Snow-Cotter, S., 2008. Toward More Integrated Ocean Governance in Massachusetts: A Progress Report. Coastal Management, 36(4), pp.412-430.
- Nutters, H.M. and da Silva, P.P., 2012. *Fishery stakeholder engagement and marine spatial planning: Lessons from the Rhode Island Ocean SAMP and the Massachusetts Ocean Management Plan*. Ocean & coastal management, 67, pp.9-18.
- Thriving Cities Initiative (2020) *Creating City Portraits* https://bit.ly/3gN3djy
- UNEP-WCMC (United Nations Environment Programme World Conservation Monitoring Centre). 2019. A marine spatial planning framework for areas beyond national jurisdiction. Technical document produced as part of the GEF ABNJ Deep Seas Project. Cambridge (UK): UN Environment Programme World Conservation Monitoring Centre. 45pp, United Kingdom.
- White House (2020) *Proclamation on Modifying The Northeast Canyons And Seamounts Marine National Monument* https://www.whitehouse.gov/presidential-actions/proclamation-modifying-northeast-canyons-seamounts-marine-national-monument/

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