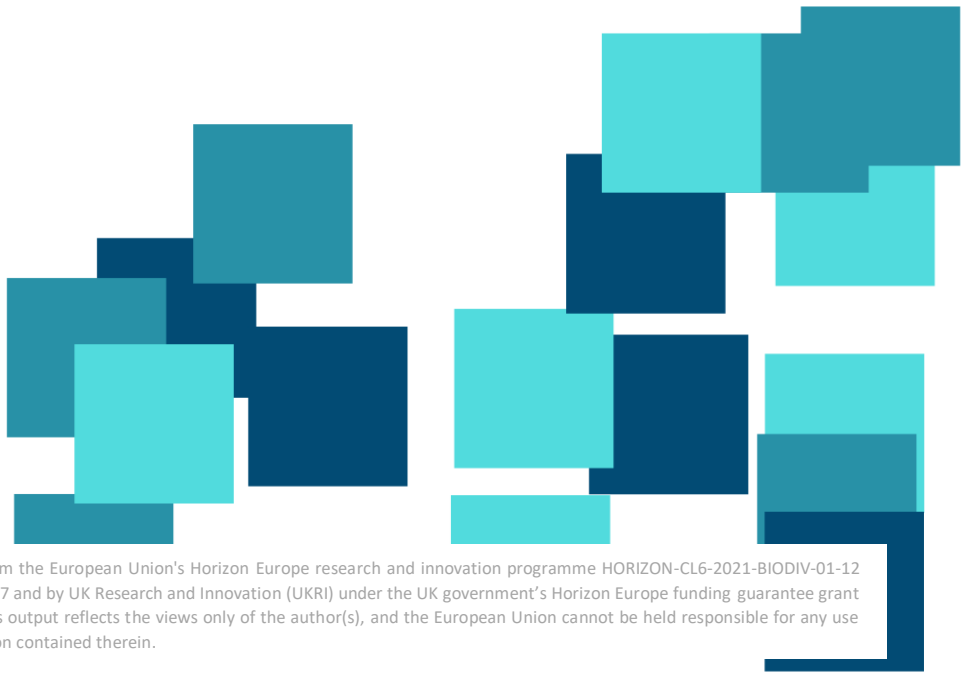
MarinePlan

IMPROVED TRANSDISCIPLINARY SCIENCE FOR EFFECTIVE ECOSYSTEM-BASED MARITIME SPATIAL PLANNING AND CONSERVATION IN EUROPEAN SEAS

# Deliverable D1.1

## Operational ecosystem-based maritime spatial planning (EB-MSP) framework and guidance for practical implementation



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# MARINEPLAN PROJECT SUMMARY

The diversity of terrestrial and marine life is dramatically affected by human interventions including climate change. Compelling and growing evidence shows that biodiversity underpins ecosystem functions and services, and consequently human benefits depending on them. Thus, the importance of ecosystems in a good state cannot be underestimated and calls for an effective management of marine activities and sustainable use of marine and coastal resources.

Maritime Spatial Planning (MSP) is the main governance process that ideally balances economic, ecological and socio-cultural goals through the regulation of human uses at sea. With the global and regional conservation and green energy targets ahead, there is an urgent need to define pathways for a better alignment of MSP and strategic conservation planning, as part of the operationalisation of an Ecosystem-Based approach to MSP (EB-MSP).

The EU-funded MarinePlan project supports the implementation of EB-MSP through the development of a Decision Support System (DSS). It will offer guidance for an improved alignment of MSP, spatial conservation, and restoration interventions during the challenging times of ever-increasing pressures on marine ecosystems.

This main goal will be achieved through four specific objectives for the European seas:

#1 Co-develop with stakeholders the conceptual elements of the DSS (guidelines and tools) and derive best practice guidance for EB-MSP implementation.

#2 Develop quantitative metrics to operationalise Ecologically or Biologically Significant marine Area (EBSA) criteria and their application at various spatio-temporal scales.

#3 Implement and apply the DSS based on objectives #1 and #2, its guidelines, metrics and tools at Planning Sites representing the diversity of European marine areas.

#4 Provide recommendations and improvements concerning the shortcomings, impediments to and opportunities of prevailing governance processes to enhance the implementation of EB-MSP.

MarinePlan develops and applies the EB-MSP DSS within seven Work Packages and eight European Planning Sites. The Planning Sites range from coastal ecosystems to open ocean and the deep sea and from local to transboundary scales. Applying and validating the DSS incorporates realistic planning scenarios, key action points to achieve the EU Biodiversity Strategy, and policy recommendations on how to enhance EB-MSP implementation in European Seas. MarinePlan will communicate results to decision-makers at horizontal (between sectors) and vertical (from local to European) levels and enable the transfer of knowledge to areas in differing socio-ecological settings. The improved natural and social science base will ensure effective policymaking to support a greater coherence in implementing environmental policies as well as to enable streamlined planning for marine industries.

# EXECUTIVE SUMMARY

EB-MSP is a holistic approach to MSP which manages sustainable human activities accounting for ecosystem processes, the biological and physical dynamics of marine and coastal systems, and the interconnectedness of marine and coastal ecosystems. However, despite the growing recognition of its benefits, as yet EB-MSP is not fully implemented in European countries. The Maritime Spatial Planning Directive (MSPD, (EC, 2014), provides a framework for MSP letting its implementation open to each Member State. The lack of a standardized framework for the implementation of an Ecosystem-Based Approach (EBA) to MSP, results in different forms with a mixed combination of principles. In addition, present national MSP processes differ greatly, as local conditions and governance frameworks tend to emphasize specific issues and planning objectives driving therefore context-specific approaches.

Taking all this into account, and aiming at facilitating the implementation of the EB-MSP for competent authorities and consultants, a review of the most relevant EB-MSP literature (i.e., 22 scientific publications and 14 technical reports) was conducted with the purpose of (i) identifying the main impediments to the implementation of EB-MSP reported in scientific publications and technical reports (see Section 3); (ii) defining the most frequently used terms in the framework of MSP and EBA or EBM (Ecosystem-Based Management), which are used interchangeably in the literature (see Section 4); (iii) defining the key operating principles for the operationalization of EBA to MSP (see Section 5); and (iv) selecting the most appropriate structure for the development of an operational EB-MSP implementation process template (see Section 6).

Future works as part of the MarinePlan project are described in Section 7, which encompasses the further development and improvement of the EB-MSP process template and the development of a comprehensive Decision Support System (DSS) which aligns each step of an EB-MSP implementation process to the required data, knowledge and tools. The DSS for EB-MSP will enable both strategic guidance and technical solutions based on best practices to deliver guidance for EB-MSP.

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# 1 AIM OF THE DELIVERABLE

EB-MSP is a holistic approach to MSP which manages human activities while accounting for ecosystem processes, the biological and physical dynamics of marine and coastal systems, and the interconnectedness of marine and coastal ecosystems while acknowledging the role of humans and the effects on society. EB-MSP aims to balance the conservation of biodiversity and ecosystem services with the sustainable development of human activities (Ehler and Douvere, 2009). However, despite the growing recognition of its benefits, EB-MSP is not fully implemented in European countries (Depellegrin *et al.*, 2021). The main reason for this is that there are still many challenges and gaps that hinder its effective application, such as the lack of data, coordination among institutions, stakeholder involvement, and evaluation methods (Jay *et al.*, 2016; Katsanevakis *et al.*, 2011). It is expected that by 2030, marine spatial plans should be implemented in more than 30% of marine areas under national jurisdiction (UNESCO-IOC/European Commission, 2021), with 10% afforded strict protection, creating an urgent need to provide information and guidance towards considering an EBA to MSP.

The present deliverable describes the process of developing an EB-MSP implementation process that in turn could be used to assess how well a spatial plan fulfils key ecosystem-based management (EBM) criteria and therefore qualifies as EB-MSP. The EB-MSP implementation process template presented here is developed based on previously proposed frameworks (i.e., Foley *et al.* (2010); Stelzenmüller *et al.* (2013a); Ansong *et al.* (2017)), and recommendations identified in previous studies (i.e., Ehler and Douvere (2009), Altvater *et al.* (2019b) Altvater *et al.* (2019a) (i.e.,); Piet *et al.* (2021); Strosser *et al.* (2021a); Strosser *et al.* (2021b). Thus, this deliverable aims to:

(i) Identify challenges in operationalising EB-MSP.
(ii) Support a common understanding of the most frequently used terms in the framework of MSP and EBA to MSP.
(iii) Definition of EB-MSP operating principles.
(iv) Propose an EB-MSP process assessment template.
(v) Provide an EB-MSP process assessment completion guidance.
(vi) Definition of future works in terms of the implementation of the EB-MSP process template in Planning Sites and the development of a Decision Support System to facilitate its use.

Under the MarinePlan project, the EB-MSP process assessment template will be applied and tested at the selected Planning Sites with the aim of continually adapting and improving the assessment framework, and, ultimately, deriving supporting knowledge and best practice guidance for EB-MSP implementation. Thus, the EB-MSP process assessment template is intended to identify the current barriers and impediments the EB-MSP implementation and highlight opportunities to unlock them to provide flexibility to current MSP processes.

The EB-MSP process template seeks to be geographically flexible in its use, and it will be made publicly available as an interactive web app tool (Decision-Support System) to reach potential end-users.

## 1.1 CONTRIBUTORS

*Table 1. Names and roles of contributors to this deliverable.*

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# 2 INTRODUCTION

Marine Spatial Planning (MSP) is defined as a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process (UNESCO, 2021). MSP arises from the need to foster sustainable development, contributing to the objectives of the United Nations 2030 Agenda for Sustainable Development Goals (United Nations, 2016) and the global trend towards a sustainable Blue Economy. In this sense, MSP is widely recognised as having changed the paradigm for managing maritime space, from one based on uncoordinated and sometimes contradictory sectoral policies to an integrated, multi-sectoral and participatory process (EC and IOC-UNESCO, 2022). However, it is interpreted in various ways including defining where activities could be allowed, where activities already exist or where they should be allowed because of the demand for space and/or competition with other industries (Elliott *et al.*, 2018).

In Europe, the need for an integrated planning and management approach to deal with the rapidly increasing multisectoral demand for maritime space, led to the development of the Integrated Maritime Policy for the European Union (IMP; (EC, 2007), including its environmental pillar the Marine Strategy Framework Directive (MSFD) 2008/56/EC (EC, 2008). MSP is identified as a cross-cutting tool, enabling public authorities and stakeholders to apply a coordinated, integrated and transboundary approach for the sustainable development of marine areas and coastal regions, and the recovery of European seas' environmental health. In particular, MSP is identified as part of the Programme of Measures required for implementing the MSFD.

The year 2014 marked the entry into force of the EU's Maritime Spatial Planning Directive (MSPD; 2014/89/EU; (EC, 2014)), establishing a common framework for MSP in Europe. This Directive established that all Member States were expected to develop and release their national maritime spatial plans by the end of March 2021 and implement them thereafter. The progressive increase of human activities in the marine space prompted some pioneering countries, such as Germany (in 2009) and Belgium (in 2014), to establish their MSPs before 2014. The MSPD invokes the need to manage the marine space to accommodate different present and future human activities that converge in the same area, often with competing goals, while preserving biodiversity and protecting marine ecosystems and their proper integrity and functioning. This necessitates the planning to be based on the best available scientific knowledge of affected ecosystems and their dynamics (HELCOM & OSPAR, 2003). To this end, the MSPD states that MSP should promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources by applying an EBA, as referred to by the MSFD (Article 1(3)), with the aim of ensuring that the collective pressure of all 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 contributing to the sustainable use of marine goods and services by present and future generations.

EBA can be understood as a strategy for the integrated management of land, water and living resources that recognises the complexity of ecological systems and integrates social, ecological, economic and governance principles to ensure the sustainable use of natural resources in an equitable way (hence fulfilling the principles of the Convention for Biological Diversity). Thus, EBA integrates the complexity of ecosystems as well as the interactions between humans and ecological systems into

management decisions (Buhl-Mortensen *et al.*, 2017; Long *et al.*, 2015). In this context, MSP has been identified as a mechanism to enable the operationalization of EBM (Dunstan *et al.*, 2021), emphasizing the need for a holistic, adaptive, multisectoral and strategic approach that involves stakeholders and delivers social and economic benefits within ecosystem boundaries (Altvater and Passarello, 2018). This requires MSP to integrate information on ecosystem patterns and processes, the biological and physical dynamics of marine and coastal systems, and the interconnectedness of marine and coastal ecosystems (Elliott *et al.*, 2023; Zuercher *et al.*, 2022). The transition from a Blue Growth-driven planning approach to the implementation of EB-MSP involves a fundamental change in the narrative of most European MSP processes (Trouillet and Jay, 2021), but also at a worldwide scale.

In Europe, the prominence of EB-MSP among MSP practitioners and policymakers is undoubtedly linked to the MSPD. However, the development of an EBA in policy dates back to the 1990s. Notably it gained traction at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro and the Agenda 21 Action Plan, and especially the Workshop on the Ecosystem Approach, developed under the auspices of the Convention of Biological Diversity (CBD) in 1998, leading to the adoption of the 12 principles characterizing the ecosystem approach also known as the Malawi principles (see Section 3). Then, in 2006 the IOC-UNESCO held the first international workshop on the use of marine spatial planning as a tool to implement ecosystem-based sea use management (see Douvere and Ehler (2007)), which was followed, in 2009, by the publication of the first guide on implementing EBM in MSP (see Ehler and Douvere 2009). EB-MSP is assumed to be embedded within the concept of strong sustainability which implies that the environmental goals, i.e. safeguarding biodiversity, should take precedence when considering trade-offs between protection, restoration and blue economy goals, and to serve as the basis for a transparent decision-making process.

There have been numerous developments since then and today there is a strong and growing body of scientific publications (e.g., Douvere (2008); Gilliland and Laffoley (2008); Foley *et al.* (2010); Long *et al.* (2015); Ehler *et al.* (2019); Flannery *et al.* (2020)) and technical reports (e.g., HELCOM-VASAB 2016; ICES 2016; WWF 2017, 2019; EC and IOC-UNESCO 2022) on EB-MSP, but MSP will not fulfil its potential for supporting global goals for a healthy and productive ocean if this theory is not translated into practice (Reimer *et al.*, 2023b; Trouillet, 2020). Current guidance and tools for MSP often refer to concepts or particular aspects of a planning process; however, they lack multi-functionality and the capability to develop realistic scenarios. Some of the key challenges include institutional shortcomings (Olsen *et al.*, 2014), the exclusion of stakeholders (Flannery et al., 2018), a failure to account for the human and social dimensions of marine regions (Dalton *et al.*, 2010), the marginalization of different types of knowledge (Said and Trouillet, 2020) and the increasing need to adapt to global environmental change (Frazão Santos *et al.*, 2020).

Despite the growing recognition of its benefits, EB-MSP is not fully implemented in European countries (Depellegrin *et al.*, 2021; WWF, 2021). Current practices in the EU vary greatly due to the ambiguous and open formulations of the Directive (Fraschetti *et al.*, 2018; Kirkfeldt, 2021) and the lack of a standardized framework for EBA implementation, resulting in different application forms with a mixed combination of principles (see Arkema *et al.* (2006); Long *et al.* (2015); Domínguez-Tejo *et al.* (2016)). Additionally, present national MSP processes differ greatly, as local conditions and governance frameworks tend to emphasize specific issues that drive site-specific approaches (Stelzenmüller *et al.*, 2021b; WWF, 2017).

Given the target of implementing MSP in more than 30% of marine areas under national jurisdiction by 2030 (UNESCO-IOC/European Commission, 2021) and to effectively protect 30% of the European seas halting biodiversity loss by 2030, including affording 10% struct protection (EU Biodiversity Strategy for 2030), there is an urgent need to build on the momentum of MSP and maximize its potential to integrate the diverse elements in sectoral planning with protection and restoration measures. Reinforcing dialogue between science and policy is a crucial requirement in this regard. It is also important that the experiences of regions that are well underway with their MSP journey are critically assessed, so that good practices may be shared and momentum built for the adoption of new meaningful commitments in the future. Although persistent and emerging challenges are causing concern, initial efforts to develop MSP over the last two decades must be built upon. This will provide a structured framework for incorporating EBA within the context of MSP and assist member states in achieving conservation targets while securing sustainable development.

# 3 CHALLENGES IN OPERATIONALISING EB-MSP

Taking all of this into account, MarinePlan provides an outline to simplify the implementation of the EB-MSP by responsible authorities and consultants. This consists of a literature review that provides a baseline for the current state of the implementation for of EBA in MSP, and from that derives challenges towards its operationalisation. The most relevant EB-MSP literature (i.e., 22 scientific publications and 14 technical reports; see Annex 1 for the full list of references) was analyzed with the purpose of: (i) identifying the main challenges hindering the implementation of EB-MSP reported in scientific publications and technical reports (see Section 3); (ii) defining the most frequently used terms in the framework of MSP and EBA (see Section 4); (iii) defining the key operating principles for the operationalization of EBA in MSP (see Section 5), and (iv) selecting the most appropriate structure for the development of an operational EB-MSP implementation process template (see Section 6).

Relevant literature for the review was identified through online scholarly databases and internet searches, that helped to identify technical documents/reports produced by different institutions and organisations, including the European Commission, Regional Sea Conventions, NGOs (e.g. WWF) and the MSP Platform. The documents were downloaded and scanned (Figure 1). Finally, a structured information extraction was performed to identify the most important challenges related to the implementation of EB-MSP.

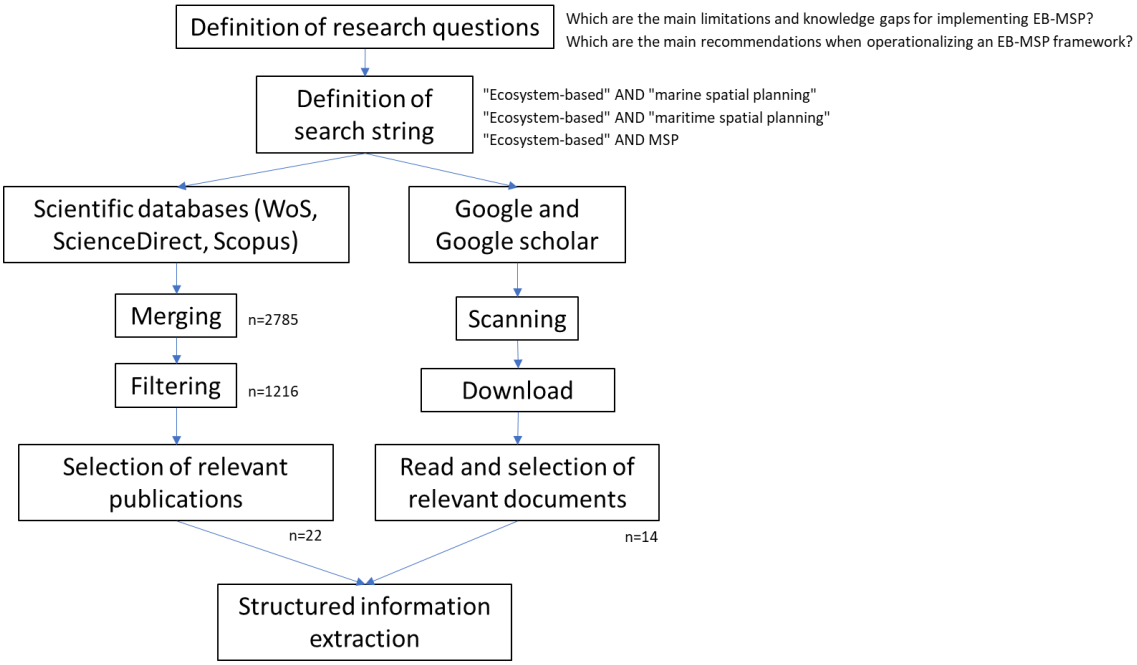


*Figure 1. Workflow for the identification of relevant scientific and technical documents.*

It was noted that the same constraints were recurrently mentioned in the documents reviewed. A total of 20 challenges were identified which were grouped into three general themes; 'lack of standardised procedures', 'governance and management' and 'data and knowledge gaps' (Table 2).

*Table 2. Challenges for the implementation of EB-MSP identified in the literature review.*

| | |
|---|---|
| **Lack of standardised procedures** | (1) insufficient guidelines on how to operationalise an EB-MSP framework;<br>(2) absence of time-bounded goals and objectives and poor definition of targets;<br>(3) lack of standardised indicators, thresholds and tipping points (for environmental status, economic and social);<br>(4) absence or inadequate definition of spatial and temporal boundaries;<br>(5) lack of harmonised stakeholder engagement mechanisms;<br>(6) lack of methods for the assessment and valuation of ecosystem services and societal goods and benefits;<br>(7) lack of tools for the assessment of cumulative pressures and impact and for alternative future scenarios analyses;<br>(8) ill-defined and incomplete monitoring and lack of harmonisation between directives;<br>(9) incomplete assessment and evaluation and lack of specific measures;<br>(10) lack of operating mechanisms that enable adaptive management; |
| **Governance and management** | (11) lack of legal framework that enables the alignment of high-level, normative goals and operational objectives (fragmented policy making);<br>(12) a lack of integrated management strategies that take into consideration land-sea interactions and transboundary issues (e.g., lack of harmonization among management strategies or hindered information exchange across boundaries);<br>(13) institutional complexity and challenges of governance models which pose barriers to implementation;<br>(14) not all sectors are equally represented an there is an absence of coordination among sectoral policies and institutions;<br>(15) economic incentives and financing possibilities for the protection of ecosystem biodiversity are not considered; |
| **Data and Knowledge gaps** | (16) uncertainties of future spatial use scenarios, changes in the dynamics of ecosystems and climate change effects (environmental and socioeconomic);<br>(17) lack or limited data and difficulties of accessibility to existing data;<br>(18) lack of information on cultural heritage;<br>(19) lack of understanding and consideration of socio-ecological systems;<br>(20) limited scientific knowledge on ecosystem functioning and uncertainty in cause-consequence pathways of pressures and cumulative environmental impacts. |

# 4 EB-MSP CONCEPTS AND DEFINITIONS

The purpose of this section is to support a common understanding of the most frequently used terms in the framework of MSP[1] and the EBA.

The work was based on "Marine Strategy Framework Directive Terminology Definitions and Lists" developed by Smith *et al.* (2022) in the context of the European Project GES4SEAS (https://www.ges4seas.eu/) and completed with additional concepts and definitions to fit the MarinePlan project needs.

The definitions were adopted following a bibliographic and technical document search under the following ranked criteria:

1. Official documents (e.g., MSPD, MSFD, Habitats Directive (HD), Birds Directive (BD), Biodiversity Strategy and the Green Deal).
2. Technical reports published or contracted by the European Commission (EC), European Environment Agency (EEA), etc.
3. Other high-level international institutions such as the Convention on Biological Diversity (CBD), Regional Sea Conventions, etc.
4. Scientific publications and technical reports.

A total of 24 frequently used terms in the framework of MSP and EBA were identified and their corresponding definitions were formulated (Table 3). Those definitions serve as a common understanding during the EB-MSP implementation process.

*Table 3. Frequently used terms in the framework of Maritime Spatial Planning and the Ecosystem-based approach and their corresponding definitions.*

| **Ecosystem-based approach (to management) (EBA)** |
|---|
| **Definition** |
| An 'ecosystem-based approach' (EBA) or 'ecosystem-based management' (EBM) is an integrated approach to the management of human activities that considers the entire ecosystem including humans (CSWD, 2020). |
| **Additional information** |
| The main goal of ecosystem-based management is to maintain ecosystems in a healthy, clean, productive and resilient condition so that they can create ecosystem services and then in turn provide humans with the benefits and goods upon which they depend. It is a special approach that builds around a) acknowledging connections, b) cumulative impacts and c) multiple objectives. In this way, it differs from traditional approaches that address single concerns (e.g., species), sectors, or activities (CSWD, 2020).<br><br>Other definitions: |

[1] It shall be understood as a synonym for "marine spatial planning" or "maritime spatial planning."

The comprehensive integrated management of human activities based upon the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the Good Environmental Status (GES according to Marine Strategy Framework Directive; MSFD) of marine ecosystems, thereby achieving sustainable use of goods and benefits and maintenance of ecosystem integrity (ICES, 2004).

An interdisciplinary management approach that acknowledges the complex nature of ecological systems and integrates social, ecological, and governance principles to achieve sustainable use of natural resources equitably (Domínguez-Tejo *et al.*, 2016).

## Marine or Maritime Spatial Planning (MSP)

**Definition**

'Maritime spatial planning' means a process by which the relevant Member State's authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives (EC, 2014).

**Additional information**

A process to apply an adaptive ecosystem-based approach (as referred to in Article 1(3) of MSFD Directive 2008/56/EC9) in order to manage the oceans towards the sustainable use of marine resources, this is, ensuring that the collective pressure of all activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised while contributing to the sustainable use of marine goods and services by present and future generations (MSPD, (EC, 2014)).

MSP is also part of the overarching "Integrated Maritime Policy of the EU" (COM(2009)0540), which has its objective to 'support the sustainable development of seas and oceans and to develop coordinated, coherent and transparent decision-making in relation to the European Union's sectoral policies affecting the oceans, seas, islands, coastal and outermost regions and maritime sector. While the terms 'marine' and 'maritime' are used interchangeably in various contexts, the latter is regarded as being related to the human uses of the seas, i.e. all maritime aspects are included in the term marine but not vice versa.

Other definition:

The process by which relevant authorities analyse and allocate the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have been specified through a political process (UNESCO/IOC).

## Ecosystem-based marine spatial planning (EB-MSP)

**Definition**

The comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity (HELCOM and OSPAR, 2003)

| **Additional information** |
| --- |
| The application of an ecosystem-based approach in MSP will contribute to promoting the sustainable development and growth of the maritime and coastal economies and the sustainable use of marine and coastal resources (MSPD, (EC, 2014)). |
| |
| **Marine Protected Area (MPA)** |
| **Definition** |
| Geographically distinct zones for which protection objectives are set (EEA, 2018). |
| **Additional information** |
| According to Grorud-Colvert *et al.* (2021), MPAs are conservation tools intended to protect biodiversity, promote healthy and resilient marine ecosystems, and provide societal benefits. MPAs have become the main management tools in coastal ecosystems to maintain key habitats and viable fish populations. However, in attempting to reach the required level of MPA coverage (i.e. 30% by 2030), de-facto MPAs are including, amongst other, Natura 2000 sites (Special Areas of Conservation and Special Protected Areas under Habitats and Wild Birds Directives respectively). |
| |
| **Natural habitat types of Community Interest** |
| **Definition** |
| Habitats which, within the territory referred to in Article 2: (i) are in danger of disappearance in their natural range, or (ii) have a small natural range following their regression or because of their intrinsically restricted area; or (iii) present outstanding examples of typical characteristics of one or more of the five following biogeographical regions: Alpine, Atlantic, Continental, Macaronesian and Mediterranean. Such habitat types are listed or may be listed in Annex I (Directive 92/43/EEC). |
| **Additional information** |
| If included as de-facto designated MPAs, these habitats will be subject to management plans focussed on maintaining Favourable Conservation Status as the conservation objective (for habitat in question). |
| **Species of Community Interest (SCI)** |
| **Definition** |
| Animal and plant species including endangered, vulnerable, rare and endemic species, or those requiring particular attention (Directive 92/43/EEC). |
| **Additional information** |
| Such species are listed or may be listed in Annex II and/or Annex IV or V of the Habitats Directive. These species will also be the designated conservation objective for which Favourable Conservation Status should be addressed in relation to any plan or project within a designated area; the species would be subject to an Appropriate Assessment under the Habitats and Wild Birds Directives. |
| |

| **Special Protection Areas (SPA)** |
|---|
| **Definition** |
| Suitable territories/habitats designated by Member States ensuring their protection for endangered and migratory bird species included in Annex 1 (Birds Directive, 2009/147/EC). |
| **Additional information** |
| Since 1994, all SPAs have been included in the Natura 2000 ecological network, set up under the Habitats Directive 92/43/EEC. The SPAs should have management plans to ensure Favourable Conservation Status (FCS) and be subjected to Appropriate Assessments if a plan or project occurs inside the designated area or sufficiently nearby to affect the area. |
| |
| **Special Areas of Conservation (SAC)** |
| **Definition** |
| A site of Community Importance designated by the Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and /or the populations of the species for which the site is designated (Directive 92/43/EEC). |
| **Additional information** |
| The SACs should have management plans to ensure Favourable Conservation Status (FCS) and be subjected to Appropriate Assessments if a plan or project occurs inside the designated area or sufficiently nearby to affect the area. |
| |
| **Ecologically and Biologically Significant Areas (EBSA)** |
| **Definition** |
| Special areas in the ocean that serve important purposes, in one way or another, to support the healthy functioning of oceans and the many services that it provides (CBD, 2006). |
| **Additional information** |
| CBD scientific criteria for ecologically or biologically significant areas (EBSAs) (CBD, 2008) (Annex I, decision IX/20): Uniqueness or Rarity; Special importance for life history stages of species; Importance for threatened, endangered or declining species and/or habitats; Vulnerability, Fragility, Sensitivity, or Slow recovery; Biological Productivity; Biological Diversity; Naturalness. |
| |
| **Human activities** |
| **Definition** |
| Various actions for recreation, living, or necessity done by people.<br><br>In the marine environment, EEA identifies the following activities related to six key sectors: energy, industry, transport, fishing and aquaculture, tourism and recreation, and households. |
| **Additional information** |
| These are the all the actions and operations carried out by society in order to fulfil basic human needs (Drivers) and to manage and remediate/restore areas that had been degraded; at the highest |

level, the sectors (fishing, navigation, recreation, etc.) will contain many activities and subactivities; Elliott *et al.* (2017) lists the main activities.

## Drivers

**Definition**

Drivers or driving forces describe the social, demographic, and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns (EEA, 1999).

**Additional information**

These are the societal basic needs – the qualities and their quantities that humans need from the natural and built environment for health and well-being, e.g., space, food, water, clean air, shelter, energy, comfort, employment, enjoyment and relaxation, education, and good mental and physical health (in Smith *et al.* (2022) from Elliott *et al.* (2022)).

## Pressures

**Definition**

Resulting from [human] activities - defined as the mechanisms (as rate processes) of change, in the way in which an activity will change the natural and societal systems, by modifying the structure and functioning of the systems (in Smith *et al.* (2022) from Elliott *et al.* (2022)).

**Additional information**

Elliott *et al.* (2017) lists the pressures relating to the activities; the pressures can be divided into endogenic managed pressures in which the causes and consequences of change are both managed within the management area, and exogenic unmanaged pressures in which the causes may emanate from outside the management area (such as the climate change suite of pressures) whereas the consequences should be managed within the management area (e.g. sea level rise consequences).

## Cumulative impacts

**Definition**

The spatial and temporal impacts (positive or negative, direct and indirect, long-term and short-term) arising from a range of activities throughout an area or region, where each individual effect may not necessarily be significant if taken in isolation (European Commission, 1999).

**Additional information**

The impacts can arise from the growing volume of marine traffic, increasing the combined effect of a number of agricultural activities leading to more intensive production and use of chemicals, etc. Cumulative impacts include a temporal dimension as they should assess the impact on environmental resources resulting from changes caused by past, present and reasonably foreseeable future actions (European Commission, 1999).

Other definition:

Aggregated, collective, accruing, and (or) combined ecosystem changes that result from a combination of human activities and natural processes (Scherer, 2011). They can be antagonistic, synergistic, and additive (in Smith *et al.* (2022) from Birk *et al.* (2020)).

## Cumulative Effects Assessment-CEA (Combined Effects Assessment, Cumulative Impact Assessment, In combination Effects Assessment)

**Definition**

Assessment of ecosystem changes that accumulate from multiple pressures, both natural and manmade (in Smith *et al.* (2022) from Dubé *et al.* (2013)).

**Additional information**

Terminology varies slightly between studies and Directives (e.g., cumulative/collective/combined impacts/effects), but Piet *et al.* (2021) provides a distinction where impact is defined as a change in state whereas effect can be any consequence of a stressor on a receptor, e.g. change in spatial distribution. Essentially, however, both CEA and CIA refer to a methodological approach to map and analyse the potential effects of multiple human pressures on marine species, habitat and communities (Kirkfeldt and Andersen, 2021). However, the terms have been used and adopted interchangeably (Blakley and Franks, 2021).

Other definition:

Holistic evaluations of the combined effects of human activities and natural processes on the environment that constitute a specific form of environmental impact assessment (Gissi *et al.*, 2021; ICES, 2019; Jones, 2016). Simeoni *et al.* (2023) recently reviewed the current frameworks.

## Types of cumulative pressures

**Definition**

Additive: the cumulative pressure is equal to the sum of the individual pressures.

Antagonistic or countervailing: the cumulative pressure is less than the sum of its individual pressures.

Synergistic: the cumulative pressure is greater than the sum of the individual pressures.

**Additional information**

## Endogenic managed pressure

**Definition**

Anthropogenic pressures which originate within the management system, i.e. the causes of change can be controlled and their consequences addressed (Borja *et al.*, 2010).

**Additional information**

## Exogenic unmanaged pressure

**Definition**

Causes of change which have their origin outside of a management system and cannot be controlled by local measures whereas the consequences which occur in the management site are subject to management measures (Borja *et al.*, 2010).

**Additional information**

The causes of exogenic unmanaged pressures requires global or at least regional action (e.g. reducing greenhouse gas emissions).

## Ecosystem services

**Definition**

The outputs or products from ecosystems that are directly consumed, used (actively or passively) or enjoyed by people (CSWD, 2020).

**Additional information**

The Common International Classification of Ecosystem Services (CICES) is the 'EU reference' typology for all ecosystem services (CSWD, 2020).

CICES defines ecosystem services as the contributions that ecosystems make to human well-being, and distinct from the goods and benefits that people subsequently derive from them (Elliott, 2023; Haines-Young and Potschin, 2018).

## Social-Ecological system (SES)

**Definition**

Complex adaptive systems where human societies are embedded in nature and where an ecological (biophysical) system is intricately linked with and affected by one or more social (human) systems (adapted from Anderies *et al.* (2004).

**Additional information**

It is considered a helpful framework for understanding and management of complex systems, where bidirectional human-nature interactions occur through multiple feedback mechanisms (Berkes F. Colding, 2002; Everard, 2020; Gain *et al.*, 2020). Usually, the objective of applying the SES framework is to improve resource management (Colding and Barthel, 2019).

## Systematic Conservation Planning (SCP)

**Definition**

The science of systematic conservation planning is concerned with the optimal application of spatially-explicit conservation management actions to promote the persistence of biodiversity and other natural features *in situ* (Margules and Pressey, 2000; Margules and Sarkar, 2017). It involves a transparent process of setting clear goals and objectives, and of planning conservation actions that meet them (Pressey and Bottrill, 2009).

**Additional information**

The most common form of systematic conservation planning is creating networks of protected areas.

SCP focuses on locating, designing, and managing conservation areas that collectively represent the biodiversity of a region for the least socioeconomic cost (Watts *et al.*, 2017).

A fundamental characteristic of systematic conservation planning is the principle of complementarity. Since the first publications in this research field, systematic methods have identified systems of conservation areas that are complementary to one another in terms of collectively achieving objectives (Watson *et al.*, 2011). Gilby *et al.* (2021) recently revised the Pressey and Bottrill (2009) framework to include restoration approaches.

Systematic Conservation Planning (SCP) involves a series of steps to identify conservation areas and develop management strategies, incorporating feedbacks, revisions, and iterations at any stage (Fabbrizzi *et al.*, 2023).

## Decision support tool (DST)

**Definition**

Software-based simulative and analytical tool that provides support in an evidence-based, decision-making process (Rose *et al.*, 2016).

**Additional information**

A decision support tool is a specific tool or software application that provides information and guidance to support decision-making. They can be either fully computerised, human-powered or a combination of both (Curtice *et al.*, 2012; Rose *et al.*, 2016). It may include features such as data analysis, modelling, and visualization, but is typically focused on providing a specific type of support for a particular decision-making process.

DSTs can help users, including managers (but also scientists, industry, or NGOs, among others) by supporting decision-making processes and making them more systematic and objective, and enabling the development of alternative management plans, including EB- MSP (Pınarbaşı *et al.*, 2017). These tools can also be used for data and information transfer, analysis or storage (Rose *et al.*, 2016).

A DST is a component of a decision support system (DSS), which is a broader and more comprehensive system for supporting decision-making.

## Decision support system (DSS)

**Definition**

A decision support system (DSS) is an information system that supports decision-making activities.

**Additional information**

Decision support systems are comprehensive and integrated systems that include a range of tools and resources to support decision-making. Thus, a DSS typically includes multiple decision support tools (DSTs), databases, and other resources that are integrated to provide a comprehensive and

unified decision-making environment. It may also include features such as communication and collaboration tools, decision-making processes, and feedback mechanisms to support ongoing improvement.

DSS specifically focused on features which render them easy to use by non-computer-proficient people in an interactive mode, facilitating knowledge- and data-based in decision-making.

## Ecosystem component

**Definition**

Biotic and abiotic elements that constitute the ecosystem.

**Additional information**

The ecosystem components are likely to include the habitats and species that constitute the conservation objectives for Marine Protected Areas as mentioned in management plans. They are the receptors on which the pressures act and show the state changes to be managed following human activities.

## Ecosystem restoration

**Definition**

The process of halting and reversing degradation, results in improved ecosystem services and recovered biodiversity (The United Nations Decade on Ecosystem Restoration).

**Additional information**

Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice. In particular, active restoration (i.e., the process of actively assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed; Society for Ecological Restoration International Science Policy Working Group, 2004) is considered an effective strategy to supplement current conservation and management actions when the natural recovery of ecosystems is precluded. This encompasses many terms from ecological engineering (ecoengineering) and geoengineering such as restoration, recreation, rehabilitation, etc. (see Elliott *et al.* (2007) and Gilby *et al.* (2021)).

## Assimilative/Carrying Capacity

**Definition**

Carrying Capacity is the maximum number of users (population and community) that can be supported by the ecological or economic goods and services provided by an area. Assimilative capacity is the amount of human activities than can be absorbed without damaging structure and functioning of an ecosystem.

**Additional information**

The aim of successful restoration therefore is to regain, maximise or enhance the carrying and assimilative capacities (modified from Elliott *et al.* (2007))

| **Resilience and resistance** |
| --- |
| **Definition** |
| Resistance is the ability to withstand the impact of pressures whereas resilience is the ability to recover from them (Tett *et al.*, 2013). |
| **Additional information** |
| |

# 5 EB-MSP OPERATING PRINCIPLES

The Malawi principles were defined for the first time in 1998, in a Workshop on the Ecosystem Approach (Lilongwe, Malawi, 26-28 January 1998), whose report was presented at the Fourth Meeting of the Conference of the Parties to the Convention on Biological Diversity (Bratislava, Slovakia, 4-15 May 1998, UNEP/CBD/COP/4/Inf.9). As previously mentioned, when referring to the EBA, it is necessary to mention the CBD and the 12 principles characterizing the ecosystem approach (or Malawi Principles), highlighting their complementary and interlinked nature:

1. Management objectives are a matter of societal choices.
2. Management should be decentralised to the lowest appropriate level.
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognizing potential gains from management there is a need to understand the ecosystem in an economic context, considering, e.g., reducing market distortions that adversely affect biological diversity, aligning incentives to promote sustainable use and internalizing costs and benefits in the given ecosystem to the extent feasible.
5. A key feature of the ecosystem approach includes the conservation of ecosystem structure and functioning.
6. Ecosystems must be managed within the limits of their functioning.
7. The ecosystem approach should be undertaken at the appropriate scale.
8. Recognizing the varying temporal scales and lag effects which characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognize that change is inevitable.
10. The ecosystem approach should seek the appropriate balance between protection and use of biological diversity.
11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Since then, the concepts of EBA or EBM, which are used interchangeably in the scientific literature and different technical documents at European and international levels (e.g., Long *et al.* (2015) and (WWF, 2017)), have evolved over time, using, in many cases, the Malawi Principles as a basis. However, the different interpretations of the broad concept of the ecosystem approach given by the MSP Directive has resulted in an incomplete implementation of EBA principles and the lack of a universally applicable framework (Piet *et al.*, 2021; WWF, 2017,2021). Thus, in order to make progress in this field, those documents that shaped the evolution of EBA, and its principles, over the years were reviewed and used as the basis for the definition of MarinePlan's operating principles and the development of the EB-MSP process template.

Briefly, Arkema *et al.* (2006) reviewed the scientific definitions of EBM and different management plans (i.e., 49 plans at 8 sites) and identified 17 criteria used to characterise EBM: three general criteria, dealing with: (1) sustainability, (2) ecological health and (3) inclusion of humans in ecosystems; three ecological criteria, related to: (4) the complexity of the linkages of ecosystem components, (5) the temporal scale and dynamic character of ecosystems and (6) the spatial scale of ecosystem processes; three criteria integrating the human dimension, such as (7) the human use of

ecosystem goods and benefits, (8) economic value of ecosystems and (9) stakeholder engagement in the management planning processes; and eight specific management criteria, including (10) science-based; (11) spatial boundaries; (12) use of technological tools to monitor ecosystems and evaluate management options, (13) adaptive; (14) co-management between multiple levels of government and stakeholders; (15) precautionary approach; (16) interdisciplinary knowledge, and (17) monitoring.

In 2014, the English Marine Management Organization (MMO, 2014), aiming at improving the implementation of the principles of EBA in MSP, reviewed the ecosystem approach principles proposed by different organizations (i.e., DEFRA, Australian Government, CBD), and suggested a modified set of 10 principles. The following list constitutes the principles that differ from, or suggest improvements to, those of the CBD: (1) 'targets and indicators should be linked to long-term objectives in order to monitor progress'; (2) 'the integration of social and economic factors is necessary to support sustainable development'; (3) 'a robust dynamic baseline should be established against which progress towards achievement of objectives can be measured'; (4) 'monitoring, review and adaptive management are important elements of the planning and management cycle',; and (5) 'a coordinated and integrated approach should be adopted when considering effects of human activity, particularly taking into account of cumulative effects'.

Then, Long *et al.* (2015) conducted a systematic analysis of theoretical literature on EBM, covering academic, government and NGO sources, to identify the key principles needed to successfully implement EBM. In total, 13 documents were selected (covering the 1994-2010 period) and 26 principles were identified, of which 15 were selected as 'Key Principles of EBM' based on the performed frequency analysis (i.e., the more frequent presence of these principles in the reviewed publications). Most of the identified Key Principles are in line with those of the CBD, with the exception of (1) 'Recognize coupled Social-Ecological Systems', (2) 'Distinct Boundaries' and (3) 'Appropriate monitoring'. Additionally, the authors noted that some principles, although not considered key at the time of first publication, were predominant in the most recent publications, indicating that they were beginning to be associated with EBM and could become 'Key Principles' in the future: (4) 'Apply the precautionary approach', (5) 'Consider cumulative impacts' and (6) 'Explicitly acknowledge trade-offs'. For this review, two other principles should be noted, (7) organizational change and (8) use of incentives, as they are different from those proposed by the CBD.

Subsequently, in 2016, HELCOM-VASAB (2016) presented non-binding guidance for implementing the EBA in the context of MSP in the Baltic Sea and identified the following key elements for the operationalization of the EBA, in line with the Malawi Principles: (1) 'achieving and/or maintaining GES', (2) 'best available knowledge and practice', (3) 'precaution', (4) 'alternative development', (5) 'identification of ecosystem services', (6) 'mitigation', (7) 'relational understanding', (8) 'participation and communication', (9) 'subsidiarity and coherence' and (10) 'adaptation'.

In 2020, acknowledging the difficulties faced by policymakers and MSP practitioners when implementing EB-MSP, and to avoid inconsistencies between plans at the European level, the WWF released a position paper entitled '*Achieving Ecosystem-based Marine Spatial Plans*' (WWF, 2020), summarising key principles and criteria to deliver an EB-MSP in the context of the MSP Directive. The WWF key criteria, 17 in total, were classified within three macro-principles: 'conservation measures', 'transparency and governance' and 'monitoring, enforceability and funding'. WWF (2021) extracted this information, associating a set of EB-MSP principles to each of the themes, as follows: 'conservation measures' encompassed (1) 'based on and use the best available science or knowledge',

(2) 'is based on data and assessments of the functionality of natural processes, ecosystem services and cumulative effects of human pressures', (3) 'is based on spatio-temporal analysis and protection of species and habitats sensitivity in the long run and considers climate change impacts', (4) 'follows ecosystems boundaries and where needed transcends national borders', (5) 'complemented by Integrated Coastal Management', (6) 'features area-based conservation management such as Marine Protected Areas (MPAs)', (7) 'applies the mitigation hierarchy', (8) applies the precautionary principle' and (9) use Strategic and Environmental Impact Assessments'; 'transparency and governance' comprised (10) 'based on SMART objectives associated with management measures and indicators to allow for proactive, iterative and adaptative management', (11) 'adopts a long-term perspective', (12) 'ensures cross-border cooperation', (13) integrates across sectors', (14) 'integrates political considerations, social values, local livelihoods and public attitudes', (15) 'reflects social and economic impacts', (16) 'ensures community, multi-stakeholder and public participation' and (17) 'transparent'; and finally, 'monitoring, enforceability and funding' included (18) 'sets up harmonised monitoring means', (19) 'regulatory and enforceable' and (20) 'follows the principles of the sustainable blue economy and finance'.

Similarly, and to facilitate the operationalisation of EBA, Piet *et al.* (2021) proposed the classification of the 15 key principles defined by Long *et al.* (2015) into three broad themes reflecting the most relevant aspects of EBA considering MSP: (1) capturing the integrity, functioning and dynamics of marine ecosystems; (2) accounting for relevant human activities and socio-economic considerations, including their interconnections with marine ecosystems; and (3) organising the MSP process with regard to governance and management, where some principles fit under more than one theme. This was further elaborated by Strosser et al. (2021b), separating theme 3 into 'Organising the MSP process' and 'Accounting for uncertainty to support adaptive management'.

As shown here, the EBA concept has been continuously evolving since the 1990s, including new principles as the knowledge advances. This highlights the necessity of up-to-date principles for the implementation of an optimal EBA in MSP. In this context, and after having reviewed the definitions and criteria proposed by several publications, the MarinePlan operating principles for the operationalization of EBA in MSP were defined, using, as a basis those proposed by Gilliland and Laffoley (2008) and updating them to accommodate present status of operationalisation of EBA into MSP. Hence, the 17 MarinePlan operating principles are classified and grouped into four themes, according to the proposal of Piet *et al.* (2021) and Strosser *et al.* (2021a):

**Capturing the complexity of marine ecosystems**

- Balanced economic, social, and environmental objectives, which reflect societal choice, for the achievement of a long-term sustainable Blue Economy (using Specific, Measurable, Achievable, Realistic and Time-bounded objectives (SMART), linked to targets and indicators).
- Consider the ecological integrity, biodiversity, functioning and resilience of marine ecosystems.
- Provide a framework to identify, conserve, and where appropriate, restore important components of coastal and marine ecosystems, including key species, species diversity, habitats, connectivity, physical features, natural processes and natural heritage.
- Account for the dynamic nature of ecosystems at the appropriate spatial and temporal scales, by setting long-term management objectives.

**Accounting for human activities, socio-economic considerations and human-ecosystem connections**

- Promote sustainability by safeguarding the ecological integrity, structure and functioning of ecosystems, thus ensuring the environment retains the capacity to deliver ecosystem services and support social and economic goods and benefits (i.e. achieving the balance between conservation and socio-economical contexts).
- Embrace all existing and future marine uses, developments and activities, together with the actual and potential effects on natural resources, features, and ecosystem processes and assess them at the appropriate spatial and temporal scales.
- Efficient and rational use of marine space to provide a balanced view between competing uses, helping avoid or minimise conflicts of interest, and, where possible, identifying trade-offs among sectors and optimising the co-use and co-location of compatible activities.
- Ensure a good understanding of ecosystem resistance and resilience and the cumulative effects of different types of human activities on ecosystems in order to forecast present and future ecosystem health under different management strategies.

**Organizing the MSP process with regard to governance and management**

- Effective governance system, providing the means to articulate policies and improve integration between sectoral policies and human activities affecting the marine area, to achieve multiple, shared objectives (where governance is defined as the sum of policies, politics, administration and legislation).
- Enable efficient decision-making, by offering economic, societal and ecological incentives to marine managers, regulators and users to implement the management measures and protect ecosystems, while promoting equity.
- Acknowledge the connectivity of ecosystem processes and the effects of human activities on adjacent areas, transcending sometimes regional and national boundaries, by promoting cooperation and shared governance mechanisms (including at the transboundary level).
- Achieve coherent planning by containing a hierarchy of nested spatial scales (transboundary, regional, national, and local levels), which are vertically linked whilst enabling management to the lowest appropriate level and providing enough flexibility to support adaptive management approaches.
- Engage the active participation of a well-balanced cross-sectorial stakeholder group (e.g., marine users, the interdisciplinary scientific community, local communities, environmental NGOs and transboundary stakeholders, if needed), which reflect social/cultural, economic and ecological interests in the management area, at all stages of the plan and ensure the establishment of open and transparent communication channels and the creation of synergies with other processes.
- Facilitate coordination with and between other governance tools and maritime policies and legislative instruments, such as land use planning, catchment management, and area-based conservation management measures (MPAs, Ecologically and Biologically Significant Areas

(EBSAs), Vulnerable Marine Ecosystems (VMEs), Other Effective Conservation Measures (OECMs), de-facto MPAs (SPA, SAC)), contributing to integrated management and the maintenance of ecological processes and control of potential risks.

- Promote transparency in decision-making processes and encourage data availability by ensuring a cost-effective approach to information gathering, management storage and sharing.

**Accounting for uncertainty to support adaptive management**

- EB-MSP shall be based on the best-available information, including scientific and local knowledge, and evidence of the functioning and dynamics of Socio-Ecological Systems (SES) and potential hazards and risks, obtained through fit-for-purpose harmonised monitoring. Where information is lacking, uncertainty should be acknowledged and decisions should be guided by the precautionary principle, until acquiring relevant information that can improve the management process (adaptive management) and can help in the establishment of mitigation and/or compensation measures (such as biodiversity offsets).
- It should be based on a rigorous and defendable Risk Assessment and Management framework which incorporates the source of hazards, which may be natural or anthropogenic, and the risks to human lives and welfare that emanate from those hazards.
- Take into consideration the uncertainties associated with climate change, the non-linear temporal and spatial variability of ecosystems and/or economic/political constraints that might affect the functioning of ecosystems (exogenous drivers), and the interactions (additive, synergistic or antagonistic) among human impacts on marine ecosystems.

# 6 EB-MSP PROCESS ASSESSMENT

The monitoring and evaluation of a planning process is key to inform best practices, adaptive management and plan iteration (Stelzenmüller *et al.*, 2021b). Specifically, when assessing whether a plan is aligned with EBM criteria, it should be considered, among others, (i) that during its development and implementation, the goals and objectives of the plan are aligned with EBM principles (Long *et al.*, 2015); (ii) whether costs, benefits, risks, and uncertainties of management options, have been evaluated (Gregory *et al.*, 2012); (iii) whether the potential impacts and trade-offs of the plan on the different components and services of the ecosystem, such as biodiversity, productivity, resilience, and human well-being, have been analyzed (Arkema *et al.*, 2015); (iv) whether equal and just participation of stakeholder has been guaranteed; (v) whether the cumulative effects that may result from the combination of different projects and activities have been assessed (Stelzenmüller *et al.*, 2018), or (vi) whether measures to monitor and adapt the plan as needed have been adopted (Armitage *et al.*, 2009). In practice, the implementation of an EB-MSP is complex and shows several challenges which have hindered its operationalisation and hence need to be overcome (e.g., Franco *et al.* (2023)).

As many initiatives worldwide are in the pre-planning and plan preparation phases of MSP (Ehler, 2021), and given the growing prominence of blue economy discourses and policies (Golden *et al.*, 2017; Silver *et al.*, 2015) now is a critical time for providing guidance that ensures that MSP theory informs practice (Reimer *et al.*, 2023b). For implemented spatial plans, standardised evaluation is important as it provides insights into weaknesses of the plan for which specific actions should be adopted during the review and adaptation of the plan. Furthermore, it could serve as good practice guidance for planning processes in the early stages. It could also be used to define the plan development strategy and make the process more cost-effective. An evaluation can take the form of a formal third-party audit or a less formal review by the planning competent authority in consultation with stakeholders (Stelzenmüller *et al.*, 2021b).

The EB-MSP process template proposed here has the intention to:

i. Conduct an audit and identify impediments to the implementation of EB-MSP and the solutions to overcome them;

ii. identify shortcomings and opportunities for the governance processes to implement EB-MSP;

iii. ensure that relevant stakeholders are included in a meaningful way, reveal power imbalances that might impede the development of more adaptive approaches and empower marginalised stakeholders (Flannery *et al.*, 2018);

iv. provide an overview, knowledge gaps and recommendations for effective implementation of EB-MSP;

v. identify barriers and recommendations for a realistic implementation of EB-MSP and pathways for improved science-based EB-MSP;

vi. identify and address conflicts that may undermine change (Bennett *et al.*, 2017);

vii. include, identify and determine methods to overcome barriers to the deployment of more adaptive approaches;

viii. identify pathways for transdisciplinary and transboundary knowledge to support integrated planning and disseminate good practice;

ix. inform EB-MSP to contribute to the coherent, sustainable and successful implementation of policies;

x. identify and address capacity-building needs so that institutions have the appropriate capacity to implement new conservation efforts and achieve sustainability (Bennett *et al.*, 2017);

xi. facilitate the incorporation of outputs in operational management advice and future terms of reference;

xii. derive key action points to foster EB-MSP implementation;

xiii. increase end-user awareness and demonstrate how EB-MSP can achieve long-term sustainability goals including achieving biodiversity and good environmental status;

xiv. contribute to transparency and participatory spatial planning.

## 6.1 EB-MSP PROCESS ASSESSMENT FRAMEWORK

The ultimate aim of WP1 within MarinePlan is to derive an EB-MSP process assessment framework which is intended to assess whether a certain spatial plan fulfils the EBA principles, while highlighting strengths and weaknesses of the plan development and implementation process. The outputs obtained should be valuable to inform MSP practitioners and contribute to unlocking the current barriers and impediments to the operationalisation of EB-MSP. This is to be achieved by developing an EB-MSP process template that guides users through the different phases of the MSP process, while ensuring that EBA principles are embedded in each of the stages. This template could be used to assess how far or close a spatial plan is from fulfilling EBA principles. To do this, the first step was the review the different EB-MSP frameworks present in the literature to establish the basis for the development of MarinePlan´s EB-MSP process assessment framework.

Different examples of MSP processes, of lower and higher complexity, can be found in the literature and the most relevant ones will be described and discussed in this section.

In this regard, it is necessary to mention the report by Ehler and Douvere (2009), since the IOC-UNESCO developed the first guideline on implementing EBA on MSP. There, a ten-step-cycle MSP process is proposed, which consists of: (1) identifying need and establishing authority; (2) obtaining financial support; (3) organizing the process through pre-planning, which entails forming the team and developing a work plan, defining principles, goals and objectives and specifying boundaries and time frames; (4) organizing stakeholder participation; (5) defining and analyzing existing conditions, including the mapping of important biological and ecological areas, identifying spatial conflicts and compatibilities and mapping existing areas of human activities; (6) defining and analyzing future conditions, which consists in mapping future demands for ocean space, identifying alternative spatial scenarios and selecting a preferred one; (7) preparing and approving the spatial management plan, which is based on identifying alternative spatial management options, developing and evaluating the plan and approving it; (8) implementing and enforcing the spatial management plan; (9) monitoring and evaluating performance; and (10) adapting the marine spatial management process. In this report,

it is mentioned that this process is not linear, but characterized by feedback loops, and that needs to accommodate changes as the process evolves over time.

Building upon the MSP process described by Ehler and Douvere (2009) and focusing on the ecological principles (i.e., maintain or restore native species diversity, habitat diversity and heterogeneity, key species and connectivity) that could be used to meet the goals and objectives of EB-MSP, Foley *et al.* (2010) proposed a flow diagram consisting of seven steps: (1) planning goals and objectives; (2) defining existing and future conditions; (3) spatially explicit decisions; (4) creating a marine spatial plan; (5) implementation; (6) monitoring and evaluation, and (7) adaptive management that could lead to changes and improvements in the definition of existing and future conditions.

Stelzenmüller *et al.* (2013a), building up on the lessons learned in Katsanevakis *et al.* (2011), proposed an assessment framework which consisted of an iterative process comprising the key elements of scoping, performance measures, assessment, evaluation and adjustment. The framework describes seven key steps to evaluate and monitor spatially managed areas (SMA), involving (1) the definition of temporal and spatial boundaries, desired outcomes and management objectives, (2) identification, collation and mapping of existing information (i.e., ecosystem components, pressures and impacts, existing and proposed management measures), (3) identification of performance indicators together with their reference points, (4) monitoring and risk analysis, (5) assessment of findings against operational objectives, (6) evaluation of management effectiveness and (7) summary of assessment results and recommendations for adaptation. In addition, it also emphasises the need to establish rigorous and comprehensive links with different governance processes, so, in parallel to the assessment framework a structured governance analysis is proposed for the assessment of the SMAs, aiming at identifying the legal framework, potential conflicts and incentives and key stakeholders, and to explore the way of achieving strategic objectives in an effective and equitable manner.

Afterwards, Ansong *et al.* (2017) proposed a four-step framework: (1) defining and analysing existing conditions, involving the definition of the planning area, stocktaking and the assessment and analysis of obtained data and maps; (2) planning phase, consisting in the definition of objectives, management measures and indicators, making trade-off analysis and future scenarios, securing sustainable options and zoning; (3) implementation, involving compliance and enforcement; and (4) monitoring and evaluation, where adaptive management enables the transfer of learned lessons into the next planning cycles. Besides, stakeholders' participation is considered as the backbone of a successful EB-MSP, pursuing their engagement in all the stages of the process.

These approaches have more recently been combined into an integrated systems analysis framework which consists of three parts - firstly, the need to define the priorities for an area including its vision, issues, pressures and activities; secondly to obtain the appropriate ecological, socio-ecological and socio-economic information, to check its provenance and have appropriate resources, and thirdly to use this information in stakeholder, governance and management actions, thereby fulfilling the vision and priorities for a marine area (Elliott *et al.*, 2023).

Finally, Altvater *et al.* (2019b), in the framework of the Pan Baltic Scope project, simplified the ten-step framework proposed by Ehler and Douvere (2009) and suggested a five-stage MSP process, consisting of (1) defining, (2) developing, (3) assessing, (4) implementing and (5) follow-up stages. Also, they reviewed the available literature to identify the possible EBA principles and classified them according to the proposed MSP process and the MSPD requirements. This five-stage EB-MSP framework has been recently endorsed by the European Commission's 'Guidelines for implementing

an Ecosystem-based Approach in Maritime Spatial Planning' (Piet *et al.*, 2021), where the stages have been defined as follows:

1. **Defining:** setting the frame for the MSP, organising the MSP process and identifying its priority objectives and principles.
2. **Developing:** building the knowledge base, including stocktaking and analysing data and other information.
3. **Assessing:** Assessing and weighing different alternatives for sharing maritime space so the "best" alternative is chosen.
4. **Implementing:** Implementing and enforcing the plan, establishing different delivery mechanisms that will translate the plan into practical actions and projects.
5. **Following-up:** Evaluating results and performance on the basis of monitoring data, identifying recommendations and possible adaptations in response to activities and outcomes of previous planning stages.

After reviewing the most used EB-MSP frameworks, and bearing in mind that the main objective is to assist MSP practitioners and policymakers in the operationalisation of the EB-MSP, the framework proposed by Piet *et al.* (2021) and Strosser *et al.* (2021b), based on five stages, was selected for structuring EB-MSP process template to be further developed in the framework of the MarinePlan project.

The EB-MSP process template proposed reflects successive actions and tasks to be adopted at each stage of a spatial planning process that fits with EBA Principles. Within the EB-MSP process template, each stage is divided into substages that would guide users through the MSP process. The selection of the stages, substages and the statements/actions present in the MarinePlan EB-MSP process template are the result of the aforementioned literature review (e.g., Ekebom *et al.* (2008); Ehler and Douvere (2009); Foley *et al.* (2010); Stelzenmüller *et al.* (2013a); ICES (2016); HELCOM-VASAB (2016); Piet *et al.* (2021); Strosser *et al.* (2021a); Strosser *et al.* (2021b); WWF (2021)).

The EB-MSP process must be understood as a continuous and iterative cycle, where the monitoring and evaluation of the results (Stage 5: following-up stage) will lead to recommendations and improvements for the next cycle (adaptive management). Although for practical reasons cycles of a certain duration are established, often in line with the cycles of other legal requirements (i.e., six-year cycles as in the case of the Water Framework Directive (WFD; (EC, 2000)) and the MSFD, this process should be open to the continuous acquisition of new information, and therefore, allow for changes during the implementation of the MSP without having to complete the entire cycle (see Ehler and Douvere (2009); Piet *et al.* (2021)). In essence, the different stages and substages of the proposed EB-MSP process template are as follows (Table 4):

***Stage 1 Defining****:* corresponds to the identification of the problems to be solved by the MSP, the definition of objectives and goals and the establishment of the spatial and temporal boundaries of the Plan, considering both the natural systems and the administrative, jurisdictional/legal and ecological boundaries.

***Stage 2 Developing:*** corresponds to the characterization of marine ecosystems, assessment of human pressures and impacts and the characterization of potential conflicts and in/compatibilities, identifying different options for sharing the maritime space. In these first two stages, a very relevant

role is played by the contextualisation of the legal framework under which the Plan will be developed, the governance mechanisms and the institutional organization to carry out the Plan, including the need to ensure coherence and equivalence at the transboundary level, where necessary.

***Stage 3 Assessing:*** deals with assessing the planning options with the consideration of future scenarios, the selection of the optimal option, the preparation of the planning proposal and, finally, its approval.

***Stage 4 Implementing****:* corresponds to the implementation of the Plan, and, therefore, the different actions contemplated are fundamentally aimed at supervising the development of the Plan and guaranteeing its implementation and enforcement by establishing synergies with other processes.

***Stage 5 Following-up:*** is divided into two substages, that is, monitoring and evaluation. The first focuses on issues such as having an operational monitoring plan, actively involving all relevant stakeholders and public bodies with monitoring responsibilities and ensuring that the monitoring plan can be adapted to integrate new data and knowledge. The second substage focuses on ensuring that the Plan has been effectively implemented and that its performance (i.e. the positive, negative and unintended effects) have been evaluated, the information gaps and sources of uncertainty have been identified and that, ultimately, the process is adaptive, allowing the incorporation of new information and knowledge to launch management recommendations.

*Table 4. Actions and tasks to be adopted at each stage of the planning process. MSP: marine (or maritime) spatial planning. Modified from Altvater et al. (2019b) and Piet et al. (2021).*

| Planning process stage | Actions and tasks |
|---|---|
| **Stage 1** | **Defining** |
| | **Identification of the problem(s) that MSP can solve (problem definition)** |
| | **Defining goals and objectives** |
| | **Geographical and temporal boundaries** |
| | **Legal framework and governance** |
| | **Stakeholder engagement and participation process** |
| | **Public communication** |
| **Stage 2** | **Developing** |
| | **Capturing the integrity, functioning and dynamics of marine ecosystems (inventory and mapping)** |
| | **Assessment of human pressures and impacts (inventory and mapping)** |
| | **Characterise use conflicts and compatibilities identifying current environmental, social and economic implications** |
| | **Identify different options for sharing maritime space** |
| | **Governance and institutional set-up** |
| | **Stakeholder participation** |
| **Stage 3** | **Assessing** |
| | **Assess the planning options and compare the future scenarios** |
| | **Selection of the optimal option** |
| | **Stakeholder participation** |
| | **Prepare the planning proposal** |
| | **Public consultation** |

| Planning process stage | Actions and tasks |
|---|---|
| | **Approval** |
| **Stage 4** | **Implementing** |
| | **Implementation of the plan** |
| **Stage 5** | **Following-up** |
| | **Monitoring**<br>**Evaluation** |

The EB-MSP process template is intended to help assess whether a specific area or region under a spatial management plan fits EBA criteria. It has been organized as a checklist, composed of statements reflecting specific actions or tasks, aligned with EBA operating principles (see section 6.2.). The checklist approach has been widely used to support the standardisation and efficiency of assessments and evaluations, as, once completed, it provides an overview of the unrepresented aspects (WWF, 2017).

In total, the whole EB-MSP process template comprises 129 statements, which have been associated with the different stages and substages, as follows: 42 correspond to Stage 1 (Defining), 39 to Stage 2 (Developing), 27 to Stage 3 (Assessing), 4 to Stage 4 (Implementing), and 17 to Stage 5 (Following-up). Understanding the overall complexity of the EB-MSP process, the wording of the statements is made as concrete as possible to avoid ambiguity. Explanations about the information asked of users when compiling the checklist can be found in Section 6.2.

The statements encompass the cross-cutting nature of EBA and address the most relevant topics and the EB-MSP process template needs to incorporate the general linkages between environmental, economic and social attributes of a marine system in the light of climate change, linking ecosystem function and human uses to ecosystem services to support EB-MSP (Galparsoro *et al.*, 2021b), and the linkages and potential impacts of human uses to a wide range of ecosystem components (Borgwardt *et al.*, 2019). Thus, each statement is identified to be linked to 10 main topics related to EB-MSP, and each topic plays a role at different stages of the planning process (see Table 5 and Table 6).

*Table 5. Most relevant topics and number of actions and/or tasks to be addressed at each stage of the Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process.*

| Topic | EB-MSP implementation process stage | Number of actions and/or tasks |
|---|---|---|
| Definition of targets and operational objectives | Stage 1. Defining | 22 |
| Legal framework | Stage 1. Defining | 7 |
| | Stage 3. Assessing | 3 |
| | Stage 4. Implementing | 3 |
| | Stage 5. Following-up | 1 |
| Governance | Stage 1. Defining | 3 |
| | Stage 2. Developing | 1 |
| | Stage 3. Assessing | 3 |
| Stakeholder engagement | Stage 1. Defining | 8 |
| | Stage 2. Developing | 3 |
| | Stage 3. Assessing | 4 |
| | Stage 4. Implementing | 1 |
| | Stage 5. Following-up | 2 |
| Environmental status, conservation, protection and restoration | Stage 2. Developing | 5 |
| | Stage 3. Assessing | 2 |
| Ecosystem processes and functioning | Stage 1. Defining | 2 |
| | Stage 2. Developing | 12 |
| Human activities and their effects | Stage 2. Developing | 13 |
| | Stage 3. Assessing | 3 |

| Topic | EB-MSP implementation process stage | Number of actions and/or tasks |
|---|---|---|
| Future scenarios | Stage 2. Developing | 5 |
| | Stage 3. Assessing | 6 |
| Monitoring and evaluation | Stage 3. Assessing | 2 |
| | Stage 5. Following-up | 14 |
| Approaches, tools and methods | Stage 3. Assessing | 4 |
| **Total** | | **129** |

*Table 6. Based on each stage of the Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process, the most relevant topics and number of actions and/or tasks to be addressed.*

| EB-MSP implementation process stage | Topic | Number actions and/or tasks |
|---|---|---|
| **Stage 1. Defining** | Definition of targets and operational objectives | 22 |
| | Ecosystem processes and functioning | 2 |
| | Governance | 3 |
| | Legal framework | 7 |
| | Stakeholder engagement | 8 |
| **Stage 2. Developing** | Ecosystem processes and functioning | 12 |
| | Environmental status, conservation, protection and restoration | 5 |
| | Future scenarios | 5 |
| | Governance | 1 |
| | Human activities and their effects | 13 |
| | Stakeholder engagement | 3 |
| **Stage 3. Assessing** | Approaches, tools and methods | 4 |
| | Environmental status, conservation, protection and restoration | 2 |
| | Future scenarios | 6 |
| | Governance | 3 |
| | Human activities and their effects | 3 |
| | Legal framework | 3 |
| | Monitoring and evaluation | 2 |
| | Stakeholder engagement | 4 |
| **Stage 4. Implementing** | Legal framework | 3 |
| | Stakeholder engagement | 1 |
| **Stage 5. Following-up** | Legal framework | 1 |
| | Monitoring and evaluation | 14 |
| | Stakeholder engagement | 2 |
| **Total** | | **129** |

The following section details the tasks to be addressed for each identified topic of the EB-MSP implementation process:

### (1) Definition of targets and operational objectives

MSP involves the definition of targets and operational objectives to guide the sustainable use of marine resources and the preservation of habitats and species (Tunnicliffe *et al.*, 2020). Targets and operational objectives refer to measurable goals and specific actions that guide the management and use of marine resources and ecosystems (Tunnicliffe *et al.*, 2020). Well-defined goals and objectives are crucial in MSP as they drive management plans and improve their effectiveness (Kirkfeldt and Frazão Santos, 2021). Hence, it is emphasised that if the goals and objectives are not clearly defined at the start of the process, there will be no way of showing that they have been achieved at the end of the process. In that sense, specific, measurable, achievable, realistic and time-limited (SMART) objectives need to be defined (Stelzenmüller *et al.*, 2013a). These objectives should reflect existing sustainable management and conservation targets of political commitments, declarations and legal obligations related to the marine environment (e.g., United Nations 2030 Agenda, United Nations Sustainable Development Goals, CBD Post-2020 Global Biodiversity Framework, MSFD, MSPD, EU Biodiversity Strategy for 2030, UN Decades for Oceans and Ecosystem Restoration, etc.). In addition, they should also consider the ecological functioning of conservation features and the costs and benefits associated with different activities (Frazão Santos *et al.*, 2019).

The EB-MSP process template adopts 22 actions and tasks that should be addressed at Stage 1 of the planning process (Table 7). The statements seek to ensure that the defined targets are clear and objectives are SMART, since vague language (e.g., sustainable development) in defining objectives, has the potential to signal progressive approaches to ocean governance while resisting evaluation and allowing for the continuation of environmentally or socially detrimental practices (Clarke and Flannery, 2020). Therefore, the EB-MSP process template maps out environmental, economic and social legal objectives, and analyse their linkages and hierarchy. It should be acknowledged and taken into account that defined objectives might vary depending on contextual factors such as local circumstances and national priorities, and those aspects should be captured in the framework. In addition, the definition of objectives should also include the time boundary indicating whether the defined goals are short-term (<6 years; i.e., the Plan is linked to other legislative cycles and sectoral strategies), or conversely, whether they are long-term strategic goals (>6 years), for example, when climate change consideration and long-term conservation and sustainability are considered in the plan.

*Table 7. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage when defining targets and operational objectives.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | MSP vision is built on clear narratives which are confined by spatial and temporal boundaries |
| Stage 1 | The need to maintain the balance between ecosystem protection and long-term sustainable use of marine areas, resources and services is acknowledged |
| Stage 1 | Sustainable development is prioritised |
| Stage 1 | The need to implement an ecosystem approach to management is clearly specified |
| Stage 1 | Environmental issues and biodiversity loss are specified |
| Stage 1 | Climate change and its effects are clearly specified |

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | The need for new space for the diversification of blue economy sectors is clearly recognised |
| Stage 1 | Cross-sectoral issues are clearly raised |
| Stage 1 | The need for transnational cooperation is clearly acknowledged |
| Stage 1 | Human well-being is identified as the overarching objective of the plan |
| Stage 1 | Short-term strategic goals are defined (<6 years; i.e., the Plan is linked to other legislative cycles and sectoral strategies) |
| Stage 1 | Long-term strategic goals are defined (>6 years), including climate change consideration and long-term conservation and sustainability |
| Stage 1 | Sectoral goals have been identified and addressed |
| Stage 1 | Common goals for different sectors sharing the same space have been addressed |
| Stage 1 | Ecological objectives are defined, accounting for biodiversity, natural values, and preservation of ecosystem components and services |
| Stage 1 | Ecological objectives are SMART (specific, measurable, achievable, relevant, and time-bound) |
| Stage 1 | Broad restoration goals have been defined (e.g., an increase of habitat area in good condition) |
| Stage 1 | Restoration objectives are SMART (specific, measurable, achievable, relevant, and time-bound) |
| Stage 1 | Societal objectives are defined. Justify |
| Stage 1 | Societal objectives are SMART (specific, measurable, achievable, relevant, and time-bound) |
| Stage 1 | Economic objectives are defined. Justify |
| Stage 1 | Economic objectives are SMART (specific, measurable, achievable, relevant, and time-bound) |

### (2) Legal framework

Most regions and countries have a complex governance framework of legislation and administration which has to encompass vertical integration, from the local to the global and vice versa, and horizontal integration across sectors and areas (Cormier et al 2022, and references therein). In Europe, MSP is an important component of the regional marine policies (Paramana *et al.*, 2023), and needs to be integrated with existing regional and national legal obligations. In particular, it is a central part of the Programme of Measures required to achieve Good Environmental Status under the EU MSFD. From a global perspective, the implementation of marine legislation and policy, including MSP, can be fragmented in certain regions, which in turn, hinders the proper and effective development of the management plan. MSP requires considering achieving the enabling or overcoming the disabling conditions of the planning process, including plan attributes, legal context, plan development, social context, and integration (Zuercher *et al.*, 2022), which in turn should facilitate its implementation.

In the framework of the EB-MSP implementation process template, the legal framework context is represented by 14 statements distributed in Stages 1, 3, 4 and 5 of the implementation process (Table 8).

*Table 8. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage when defining the legal framework under which the plan is developed.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | The planning area is defined by jurisdictional boundaries |
| Stage 1 | Local legislation has been considered |
| Stage 1 | National legislation has been considered |
| Stage 1 | Regional legislation and instruments/agreements/obligations have been considered |
| Stage 1 | International legal obligations and agreements have been considered |
| Stage 1 | Land-sea interactions. The achievement of consistency between terrestrial planning (including coastal zones) and maritime planning is pursued |
| Stage 1 | A Strategic Environment Assessment (SEA) and/or other relevant (regional Environmental Assessment) have been conducted |
| Stage 3 | Opinions and statements have been received and integrated into the proposal |
| Stage 3 | A statement of how considerations have been integrated into the plan and the reasons for choosing the plan in light of the other reasonable alternatives has been published |
| Stage 3 | The adopted Plan has been announced and it is accessible |
| Stage 4 | Actions required to implement, ensure compliance with, and enforce the Plan are in place |
| Stage 4 | A steering group has been designated to monitor the implementation process |
| Stage 4 | There are established synergies with other processes to deliver cost-effective implementation |
| Stage 5 | The Plan has been written in different languages including bordering country languages and minority languages |

### (3) Governance

MSP has been increasingly recognised as an important framework for integrated ocean governance, seeking to achieve specific environmental and socioeconomic objectives implemented by governmental authorities, maritime sectors and society through regulatory and nonregulatory instruments (UNESCO-IOC, 2021). Here, governance is defined as the sum of policies, politics, administration and legislation (Cormier *et al.*, 2022). As an approach intending to deal with complex, emerging and strategic marine issues, MSP can function as an overarching coordination mechanism for marine and coastal policies established in a country or a transboundary region, reduce conflicts and promote coexistence and synergies in the marine domain (Elliott and Wither, 2023; UNESCO-IOC, 2021). MSP can promote sustainable marine governance (Paramana *et al.*, 2023) and it can and should aim to achieve coherence and equivalence in outcomes in marine management between adjacent nation states (Elliott *et al.*, *2023*). Measures taken as part of marine governance can have significant implications for the social, economic and cultural interests and identities of individuals and groups of people (Langlet, 2023). However, social and legitimacy aspects generally receive quite limited attention and tend to be addressed mostly through public participation, a practice that in itself is associated with considerable legitimacy challenges (Langlet, 2023).

The EB-MSP process template adopts seven actions at Stages 1, 2 and 3 of the planning process (Table 9). They mainly focus on whether a governance structure has been set up, both at vertical and horizontal (transboundary) scales.

*Table 9. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage in terms of governance aspects.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | It is a transboundary planning area (regional and sub-regional scale) |
| Stage 1 | A nested (vertical or decentralised) governance system has been adopted within the planning area (i.e. national and local) |
| Stage 1 | A nested (vertical) governance system has been adopted within the planning area at the transboundary level |
| Stage 2 | A governance structure has been set up to capture information and knowledge, including indigenous and/or local knowledge, of human activities and their management |
| Stage 3 | Timing (e.g., the time required to achieve results), political considerations and feasibility of financing have been considered when selecting the optimal option |
| Stage 3 | The selected option promotes equitability and sustainability |
| Stage 3 | Received statements have been publicly acknowledged and the results of discussions have been published and disseminated to the wider public |

### (4) Stakeholder engagement

Stakeholders play a fundamental role in the EB-MSP and their function is considered to be transversal, as they should be incorporated in all stages of the Plan development (Flannery *et al.*, 2018). However, it is especially in the first three stages where it is essential to engage them and ensure their participation to gain a wider acceptance of the Plan. Thus, the most relevant stakeholders affected by the Plan should be identified (e.g., authorities, NGOs, scientists, representatives of all affected sectors, including minorities) and actively involved when defining the objectives of the Plan (Stage 1), developing the different planning options (Stage 2) and discussing the trade-offs of the planning options (Stage 3) (Table 10). In addition, it is very important to involve the general public and to establish effective means of communication in these stages: when initiating the planning process (Stage 1), making public the objectives, the participation procedure and the stakeholders involved and their roles, but also by publishing the results of stakeholder participation during the development of the planning options (Stage 2), as well as in the consultations before the approval of the Plan (Stage 3) the implementation phase (Stage 4) and the monitoring and evaluation of the Plan (Stage 5). The involvement of stakeholders in Stages 4 and 5 is highly relevant, as they can enforce the proposed management measures and encourage compliance and they can assist in the evaluation of the overall performance of the Plan and the achievement of the goals and objectives.

*Table 10. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage in terms of stakeholder engagement and participation.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | Authorities, NGOs and other interested parties whom the plan may concern and/or are interested in being involved have been identified |

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | Focus groups and other methods with a panel of interdisciplinary experts and stakeholders have been established |
| Stage 1 | Links with parallel stakeholder participation processes have been established |
| Stage 1 | Stakeholders have been facilitated with the opportunity to participate in the definition of objectives in a just and open manner to provide insights into societal choices |
| Stage 1 | Relevant stakeholders that have taken part in other planning processes have participated (e.g., terrestrial plans) |
| Stage 1 | Cross-border stakeholders have been facilitated with the opportunity to participate in the definition of objectives in a just and open manner |
| Stage 1 | At the start of the planning process, the goals and the participation procedure were announced and published |
| Stage 1 | The participating stakeholders and their roles have been published |
| Stage 2 | Expert groups have been designated for integration of the most recent knowledge |
| Stage 2 | Relevant stakeholders who could be affected by the plan options have been engaged and consulted |
| Stage 2 | The success of the stakeholder participation process has been assessed and the results published |
| Stage 3 | Workshops or other methods with relevant sectors have been performed to assess and discuss trade-offs of the different planning options |
| Stage 3 | Feedback from stakeholders has been used to inform optimal planning options |
| Stage 3 | The planning proposal has been publicly displayed and invited authorities, stakeholders and the general public to take part in the consultation process |
| Stage 3 | Dissemination mechanisms have been implemented to guarantee that the planning options have reached relevant stakeholders and the wider public |
| Stage 4 | Stakeholders have been informed about the implementation of the Plan |
| Stage 5 | Stakeholders are engaged and actively participating in the monitoring process |
| Stage 5 | Stakeholders have been informed about the results of the evaluation and their comments have been considered for adaptive management |

**(5) Environmental status, conservation, protection and restoration**

Determining and ensuring marine environmental status, conservation, protection, and restoration are highly relevant aspects of marine management and are often the ultimate aim; thus, the degradation of marine ecosystems and the loss of marine biodiversity are significant concerns which require effective measures to be addressed (Boissery *et al.*, 2023). Among other measures, the establishment of MPAs and the implementation of ecological restoration actions have been recognized as strategies to reverse the detrimental trend and increase the flow of marine ecosystem services and deliver societal goods and benefits (Manea *et al.*, 2023).

EB-MSP should account for effective marine conservation, protection and restoration when addressing the management of human activities and the effects that they exert on the marine ecosystem. The EB-MSP accounts for the environmental status, conservation, protection and restoration, by considering seven statements distributed in Stages 2 and 3 of the planning process (Table 11). This topic centres on the ecosystem processes and functioning considerations that are treated as another (complementary) topic in the planning process.

*Table 11. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process in terms of environmental status, conservation, protection and restoration.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 2 | The current environmental/conservation status of marine ecosystems, habitats and species has been collated (to be used in subsequent knowledge integration and development of the Plan) |
| Stage 2 | Information on existing or planned protected areas has been collated (location, area, etc.) |
| Stage 2 | Information on existing or planned restoration areas has been collated (location, area, etc.) |
| Stage 2 | Information on restoration actions (passive and active) has been collated |
| Stage 2 | The sensitivity of ecosystem components to pressures has been assessed |
| Stage 3 | Priority areas for conservation have been included |
| Stage 3 | Priority areas for restoration have been included |

### (6) Ecosystem processes and functioning

EB-MSP aims to balance the use of marine resources while respecting the natural environment (United Nations Office of Legal Affairs, 2023). Thus, EB-MSP should aim for the preservation of marine ecosystem integrity and resilience (Ehler and Douvere, 2009), while managing marine uses efficiently and delivering the goods and benefits required by and for society. This means that EB-MSP should incorporate ecosystem processes and functioning in decision-making, by considering the interactions, dependencies and trade-offs among different marine activities and sectors, as well as the cumulative impacts of human activities on marine ecosystems (Elliott *et al.*, 2020a; Elliott *et al.*, 2020b; Hammar *et al.*, 2020b; Lonsdale *et al.*, 2020).

Hence, the EB-MSP process template incorporates ecosystem processes and functioning (which include capturing the integrity, functioning and dynamics of marine ecosystems), in a set of 14 statements distributed in Stages 1 and 2 of the planning process (Table 12).

*Table 12. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage when addressing ecosystem processes and functioning.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 1 | Ecological indicators and their targets/threshold levels have been defined to monitor the performance of the plan |
| Stage 1 | Ecologically relevant spatial and temporal boundaries have been defined (accounting for ecological processes and functions) |
| Stage 2 | Societal indicators and their targets/threshold levels have been defined to monitor the performance of the plan |
| Stage 2 | Economic indicators and their targets/threshold levels have been defined to monitor the performance of the plan |

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 2 | Information contributing to **EBSA** (Ecologically and Biologically Significant Areas) criteria has been collated (i.e., (i) Uniqueness or rarity; (ii) Special importance for life history stages of species; (iii) Importance for threatened, endangered or declining species and/or habitats; (iv) Vulnerability, fragility, sensitivity, or slow recovery; (v) Biological productivity; (vi) Biological diversity; (vii) Naturalness) |
| Stage 2 | Ecological functioning, integrity and resilience have been addressed |
| Stage 2 | Ecological connectivity has been addressed |
| Stage 2 | Long-time series that capture the dynamic nature of ecosystems have been addressed |
| Stage 2 | Social-Ecological System has been addressed |
| Stage 2 | Mapping, assessment or valuation of ecosystem services has been performed |
| Stage 2 | Ecological carrying capacity and limits to its functioning are addressed |
| Stage 2 | Climate change scenarios and indicators have been defined |
| Stage 2 | An ecological risk assessment (for existing ecosystem components and human activities) has been conducted |
| Stage 2 | The effect of exogenous drivers (e.g., climate change, economic/political constraints) in the dynamic nature of ecosystems, affecting the temporal and spatial distribution of ecosystem components has been addressed |

**(7) Human activities and their effects**

MSP is a crucial tool for managing human activities and their cumulative effects on marine ecosystems. Within the EB-MSP process template, this topic accounts for the present spatial and temporal distribution of activities, as well as the pressures and cumulative effects that the activities produce on the environment. As required by EU environmental policies (e.g. MSFD), MSP should be framework under which the assessment of the impacts of various activities such as offshore energy production, aquaculture, tourism, and transport (Ma *et al.*, 2023) could be performed in combination with other specific directives (i.e. MSFD and WFD). Marine activities should be managed considering the cumulative effects and their assessments (CEA) which should be conducted to understand the combined impacts of marine activities on the environment (Hammar *et al.*, 2020b; Markantonatou *et al.*, 2021). These assessments identify the most influential cause-effect pathways and the distribution patterns of risks (Cormier *et al.*, 2019; Galparsoro *et al.*, 2021a; Galparsoro *et al.*, 2022). The results of these assessments can inform the development of marine spatial plans that aim to balance the sustainable use of marine resources with the conservation of biodiversity (Lonsdale *et al.*, 2020). However, there is still a need for consistent and scientifically accepted approaches and tools to assess and manage cumulative effects, taking into account the three-dimensional nature of the marine environment and temporal trends (Hammar *et al.*, 2020a).

Within the EB-MSP process template, this topic also accounts for the relative relevance of different marine sectors in terms of socio-economic aspects, which might drive the prioritisation of certain activities in relation to others (Grip and Blomqvist, 2021; Hammar *et al.*, 2020a). It also accounts for the identification of existing and potential future conflicts and compatibilities between different human activities, together with the assessment of co-use and co-location options. Such information should be used to assess the trade-offs of different management options (Coccoli *et al.*, 2018) that should be consulted with interested parties.

In the EB-MSP process template, human activities, the interaction among them and their effect on the environment, are represented by 14 statements that should be addressed in Stages 2 and 3 (Table 13).

*Table 13. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage when addressing human activities and their effects.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 2 | Mechanisms for the integration of data and information from different sources have been established |
| Stage 2 | Ocean Accounting data have been collated |
| Stage 2 | Human activities have been identified and assessed at spatial and temporal scales |
| Stage 2 | Pressures produced by human activities have been assessed at spatial and temporal scales |
| Stage 2 | Future human activities and their pressures, at appropriate spatial and temporal scales have been identified |
| Stage 2 | The effects (actual or potential) of activities on adjacent areas have been assessed |
| Stage 2 | Pressures from land-based sources and activities have been assessed |
| Stage 2 | Direct and indirect effects of pressures on ecosystem components have been assessed |
| Stage 2 | Cumulative pressures have been assessed |
| Stage 2 | A Cumulative Effects Assessment (CEA) has been conducted |
| Stage 2 | The dependency of maritime sectors on certain areas of marine space has been considered |
| Stage 2 | Conflicts and compatibilities between different human activities (ongoing and foreseen activities) have been assessed |
| Stage 2 | Co-use and co-location options for activities have been considered |
| Stage 3 | Trade-offs of different management options have been assessed |
| Stage 3 | Solutions to avoid, mitigate or compensate for negative impacts on marine ecosystems and ensure the sustainability of natural resources have been defined |
| Stage 3 | Economic incentives have been defined based on trade-off analysis |

### (8) Future scenarios

MSP should be adopted in a way that addresses the current and future challenges of marine management, such as climate change, biodiversity loss, and conflicts among stakeholders (Frazão Santos *et al.*, 2020). Future scenarios in MSP are hypothetical situations used to explore and understand potential future patterns of spatial development and identify opportunities and conflicts that may arise (McGowan *et al.*, 2019). These scenarios in MSP refer to projections and policies that outline potential future activities and developments in the marine environment, thereby informing decision-making and planning processes (Tolvanen *et al.*, 2019). These future scenarios are important for producing an effective management plan, including conservation (Queirós *et al.*, 2021). The development of these scenarios should involve the active engagement of regional experts and can assist policymakers in adopting an adaptive and participatory approach (Calado *et al.*, 2021; Stelzenmüller *et al.*, 2024). Moreover, future scenarios can help to engage the public and decision-

makers in a participatory and transparent way fostering a shared vision for the sustainable development of the marine environment.

By developing and implementing future scenarios, MSP can explore the possible outcomes of different management options and evaluate their trade-offs and synergies.

In the EB-MSP process template, future scenarios consider both trade-offs and synergies, based on the predicted evolution of human uses and activities that due to different factors are expected to reduce or disappear, or activities that due to present circumstances, priorities or strategies, are expected to grow or to be implemented. In that sense, future scenarios should account for the potential new pressures, cumulative pressures of existing ones and their potential effects on the environment.

Future scenarios also consider those changes due to climate change effects. The integration of climate change into MSP is essential for effective planning and management (Frazão Santos *et al.*, 2020; Gissi *et al.*, 2019). There are well-established links between MSP and climate change, as well as the challenges and potential pathways for integrating climate impacts into MSP

Within the EB-MSP process template, future scenarios are approached by 11 statements that should be addressed in Stages 2 and 3 of the planning process (Table 14).

*Table 14. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage when defining and considering future scenarios.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 2 | Possible alternative future scenarios (e.g., climate change scenarios, invasive species) for the planning area have been defined |
| Stage 2 | Future scenarios in terms of the spatial and temporal needs of human uses have been projected |
| Stage 2 | Spatial and temporal requirements for new demands of ocean space have been estimated |
| Stage 2 | Selected alternative options are aligned with set ecological objectives and consider nature-based solutions in defining some of the options to mitigate/limit potential threats |
| Stage 2 | Other area-based management regulations (e.g., fisheries exclusions) and priority areas for conservation, such as Marine Protected Areas (MPAs), priority areas for restoration, Vulnerable Marine Ecosystems (VMEs), Ecologically and/or Biologically Significant Areas (EBSAs), Other area-based Effective Conservation Measures (OECMs) or critical habitats have been considered |
| Stage 3 | Management alternatives account for the cumulative effects of human activities and how they impact the ecosystem |
| Stage 3 | Management alternatives account for economic impacts |
| Stage 3 | Management alternatives account for social impacts |
| Stage 3 | Environmental and socio-economic effects of the plan have been assessed in the near (<6 years) and far future (>6 years) |
| Stage 3 | Environmental and socio-economic effects of the plan have been assessed beyond MSP boundaries |
| Stage 3 | The impact of alternative restoration interventions has been assessed |

### (9) Monitoring and evaluation

Monitoring is regarded as a means of determining what management measures are required and whether management measures have been successful rather than management measures *per se* (Elliott and Wither 2023). Monitoring and evaluation in MSP are essential for assessing the effectiveness and impact of these maritime plans (Stelzenmüller *et al.*, 2013a; van den Burg *et al.*, 2023; Zuercher *et al.*, 2023), and can improve the quality of MSP by facilitating participatory processes and cross-sectoral learning. The monitoring and evaluation should provide the knowledge and information for the adoption of adaptive management measures (Flannery *et al.*, 2015). However, implementing theory-based evaluation can be challenging, especially for plans lacking well-defined goals and outcomes (Reimer *et al.*, 2023a) and the existing evaluation strategies have limitations in capturing the social, ecological, and economic goals of MSP (Stelzenmüller *et al.*, 2021a).

Monitoring should be designed in a way that provides valuable information for identifying the success or limitations of the implemented plan, while the evaluation process can help identify gaps, challenges, and opportunities for improvement in MSP, as well as measure progress towards achieving the desired objectives and impacts (Collie *et al.*, 2013). At present, few countries are addressing this issue, but the information obtained from the experience of those who do would be highly beneficial for those that are less experienced in the process.

In the EB-MSP process template monitoring and evaluation are addressed by 16 statements allocated in Stages 3 and 5 of the planning process (Table 15).

*Table 15. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage in terms of the definition of monitoring and evaluation aspects.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 3 | A monitoring system for the assessment of the Plan and to inform adaptive management is set |
| Stage 3 | The monitoring programme is coordinated with other established ones |
| Stage 5 | The monitoring plan is operational |
| Stage 5 | The monitoring programme is promoted by periodic announcements to relevant authorities and general public |
| Stage 5 | A dissemination mechanism is implemented to engage and guarantee the active involvement of relevant public bodies and stakeholders with monitoring responsibilities |
| Stage 5 | The monitoring plan is adapted to integrate new data and knowledge |
| Stage 5 | The potential to utilise citizen science as a means of addressing knowledge gaps is promoted by defining engagement mechanisms |
| Stage 5 | The Plan has been effectively implemented and can be demonstrated |
| Stage 5 | The performance of the Plan has been evaluated using indicators and targets |
| Stage 5 | The appropriate balance between the environmental status, conservation, protection and restoration and human activities has been demonstrated |
| Stage 5 | Positive and negative effects of the plan have been accounted for, including unintended effects |
| Stage 5 | The appropriateness of the defined indicators (i.e., ecological, economic and social), to assess the achievement of predefined objectives, has been assessed |

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 5 | The implementation process has produced sufficient information to identify gaps of information and sources of uncertainty |
| Stage 5 | The process is adaptive and allows for the uptake of new information and knowledge to launch management recommendations |
| Stage 5 | The evaluation reports state if previously identified knowledge gaps have been effectively addressed |
| Stage 5 | Then plan demonstrates a significant positive impact on the overarching contribution to human well-being |

### (10) Approaches, tools and methods

MSP requires approaches, tools and methods to collect, analyze and communicate spatial and temporal information, to engage stakeholders and support decision-making. This requires the applications of software, algorithms, and models, including decision support tools (DSTs) and systems (DSSs) intended to support the MSP implementation process in different ways and stages of the process. Some of the tools and methods include GIS, participatory mapping, scenario analysis and trade-off analysis (Gee *et al.*, 2019; Pınarbaşı *et al.*, 2017).

Within the EB-MSP process template, approaches, tools and methods are represented by four statements that are allocated in the assessment phase of the planning process (Stage 3). Even if different approaches and tools can be implemented at all stages of the planning process, the scope of the planning process, and the implementation of tools and methods are centred around the assessment of planning options and comparing the future scenarios, for the selection of the optimal option, and stakeholder participation among others (Table 16).

*Table 16. Actions and/or tasks to be addressed at each Ecosystem-Based Maritime Spatial Planning (EB-MSP) implementation process stage in terms of approaches, tools and methods implemented.*

| EB-MSP implementation process stage | Action and/or task |
|---|---|
| Stage 3 | Uncertainty on information on background information is acknowledged when assessing planning options |
| Stage 3 | The uncertainty is addressed when identifying future management scenarios, accounting for potential climate and socio-economic development changes |
| Stage 3 | The precautionary principle has been adopted |
| Stage 3 | A report, of the potential impacts of the plan has been elaborated (includes environmental, social and economic impact assessments) |

## 6.2 EB-MSP ASSESSMENT CHECKLIST COMPLETION GUIDANCE

The EB-MSP process template and its implementation are intended to evaluate a plan-making process. This should not be confused with the data and analysis that are aggregated to produce a first draft plan as this is only the first step in the planning process (Stelzenmüller *et al.*, 2021b).

The EB-MSP process assessment result is strongly dependent on the context and socio-ecological settings of the Planning Site, in particular with respect to sectorial interests, national priorities and strategies, planning objectives, data availability, stakeholder engagement and participation, together with the MSP implementation stage.

The EB-MSP process template checklist is intended to ensure that environmental, social and economic aspects are properly considered at different stages of the Plan development. It also aims to show that the Plan is developed in a way that includes a representative monitoring plan and that it will produce relevant information for adaptive management.

The EB-MSP assessment framework is not intended to criticise a particular plan but rather to evaluate the plan and assess its consistency with the EBM principles elaborated above. Thus, it focuses on the identification of potential gaps, which could be used to inform the adoption of corrective measures during the adaptive process.

The EB-MSP assessment checklist can be completed in different ways or with different perspectives depending on the scope of the assessment and the MSP development stage:

- To assess whether a certain national MSP is fulfilling EBA principles, the checklist should be completed according to the available legislative instruments (as well as considering the whole MSP process before producing the final document, e.g., assessing phase).
- In case a planning site represents an area in which an MSP is not in place, a user can assess the work already done towards EB-MSP development. That includes the assessment of cumulative impacts, the implementation of Systematic Conservation Planning (SCP) approaches, or any previous research (e.g., research projects), that is producing or has produced information and knowledge that would be useful to inform the future development of a spatial plan.
- In case a planning site covers a transboundary region, a user can assess the individual national spatial plans, evaluate commonalities or differences in terms of EB-MSP principles and determine equivalence or coherence between the outcomes in different national areas.

First, the user is requested to provide general information about the assessed Planning Site or Case Study. This information will be of interest to have the traceability of the assessment and to define the general context of the assessed Plan.

Second, the user can respond to each of the statements or actions that ideally should have been adopted at each stage of the MSP implementation process. Accordingly, each stage is subdivided into statements that describe actions or tasks that should have been addressed, in a form of a checklist. A checklist can be regarded as a means of a probability-based assessment, i.e. if sufficient entries are checked then this implies a specific direction or outcome even when based on best-available expert judgement. The concept of the checklist approach to support MSP practitioners and policymakers in the implementation of EB-MSP was explored by Schmitbauer (2017) in the framework of the Baltic Scope project, aiming at simplifying the process and contributing to the harmonization of the

application of the EBA in MSP. This checklist toolbox consisted of a list of 10 questions, one per key EBA element identified by the HELCOM-VASAB (2016) (see section 4), which required an answer of yes', 'partly' or 'no' with some explanations. This information was used for identifying common grounds and differences between the MSPs assessed (i.e., Sweden, Estonia, Latvia, Poland, Germany and Denmark) and deriving some conclusions. Following this, WWF (2017) developed a checklist consisting of 10 questions, related to several EBA principles (e.g., ecosystem services, stakeholders and community knowledge, precautionary approach, etc.) to assess whether several plans (i.e., seven marine plans from England, Scotland, Wales and Ireland) could be considered ecosystem-based. They compared their checklist to that and compare developed by Schmitbauer (2017). As for the Baltic Scope case, users had to provide a 'yes', 'partly' or 'no' answer and give some explanations. However, as indicated by WWF (2021), currently most MSPs include EBA principles to some extent, and thus, more information could be obtained by using graduated markers for progress and/or free open-text questions. Having taken that into account, users will be asked to provide the following information for each of the statements:

**The task has been addressed**

0: Does not apply / it is not relevant

1: No. It has not been addressed

2: Mentioned but not addressed

3: Partially addressed. It could be acknowledged that it is not properly addressed and that it could be improved in subsequent revisions of the Plan

4: Mostly addressed. There is room for improvement, but it is acceptable

5: Yes, completely addressed

**Relevance:**

Relevance of this task/action for the EB-MSP process in the assessed Planning Site

0: Does not apply

1: Not relevant

2: Slightly relevant

3: Moderately relevant

4: Very relevant

5: Totally relevant

**Short description of implemented approaches, methods and tools:**

Provide the name of the tool/model used and the link/reference

**Main source of knowledge base**

What main knowledge base (data, information and knowledge) has been used to support the action/task

0: Not applicable

1: No knowledge/lack of supporting data and information

2: Some information but from diverse sources (not specific from your site)

3: Based on a consensus of expert groups

4: Empirical data

5: Quality-assured empirical data from accepted methods

**Justification and additional comments**

If needed, here clarify how the task/action has been addressed or provide further explanations about this task/action

**Confidence of the respondent**

Self-assess the confidence of your knowledge of the task/action

0: Not aware of this action/task at this moment

1: Low confidence: Outside of my area of expertise

2: Slightly confident: Touches upon my expertise

3: Moderately confident: Based on my own expertise

4: Fairly confident: Based on consultation with competent authority

5: Completely confident: The response is extracted from official documents and I am confident

Within the MarinePlan project, we are still early in the process of developing a DSS that comprises the EB-MSP process template and allows MSP practitioners and policymakers to assess the degree of operationalisation of the EB-MSP in their respective Planning Site. However, we anticipate that the use of this checklist with graduated progress markers will allow users, in a user-friendly way (i.e. using graphs and/or explanations), to determine the degree of implementation of EB-MSP in their Planning Sites and to identify those statements in need of further attention.

# 7 FUTURE WORKS

The aim of EB-MSP is to allow for the joint protection and use of the sea, and that this aim becomes applicable widely across European Seas, despite the blue acceleration (Jouffray *et al.*, 2020). In WP1 of the MarinePlan project, the focus is the development and application of an EB-MSP process template together with best practice guidance. This is intended to enhance the design and effectiveness of spatial conservation and restoration measures for marine biodiversity. As such, the EB-MSP process template is designed in a generic form, suitable for implementation in European countries and elsewhere.

In the framework of the MarinePlan project, future works will focus on refining the EB-MSP process template and developing a comprehensive DSS. This DSS will align each step of the EB-MSP implementation process to the required data, knowledge and tools. The DSS for EB-MSP will enable both strategic guidance and technical solutions, hence delivering material and approaches to fill the current gap of best practice guidance for EB-MSP.

## 7.1 FURTHER DEVELOPMENT OF EB-MSP PROCESS TEMPLATE

The EB-MSP process template will be tested and refined during MarinePlan based on the responses provided by the Planning Sites. Planning Sites are characterised by their broad geographical coverage, encompassing the Baltic Sea, North Sea, Celtic Sea, Atlantic, and Mediterranean Sea. They vary in terms of the maturity of the MSP process, and the scale and purpose of the designated MPAs as well as the major threats to marine biodiversity and the most importantly ecosystem services and societal goods and benefits.

Planning Sites will develop planning options that address EU Biodiversity Strategy targets. The co-development process and the common research approach will allow us to synthesize the lessons, derive best practices and identify key action points to achieve the EU Biodiversity strategy targets in all regional seas taking into account relevant spatial scales and transboundary issues with the help of EB-MSP. The requirements and recommendations from stakeholders will be considered and incorporated when developing a realistic and applicable EB-MSP process template.

Standardised feedback on the implementation experiences will be collected to be considered in subsequent improved versions of the EB-MSP process template and will feed into the development of best-practice guidance. The EB-MSP best-practice guidance will provide the means to practically align marine systematic conservation planning and restoration prioritization with MSP and provide the basis for monitoring and evaluation of EB-MSP outcomes. Best-practice and lessons learned will then be valuable to inform planning processes far beyond the MarinePlan Planning Sites, as the EB-MSP process template seeks to be flexible for application in any European or Non-European region and will be made publicly available in an interactive web app tool with the aim of reaching to potential end-users.

MarinePlan will communicate the results to decision-makers at multiple levels and provide the means to transfer the knowledge and tools to other European Seas.

## 7.2 DECISION SUPPORT SYSTEM FOR EB-MSP

The EB-MSP process template will be integrated into an Open Access DSS, which will support the guided assessment if a plan fits with EBA principles. The DSS will be founded on a conceptual EB-MSP implementation process shown in Figure 2.

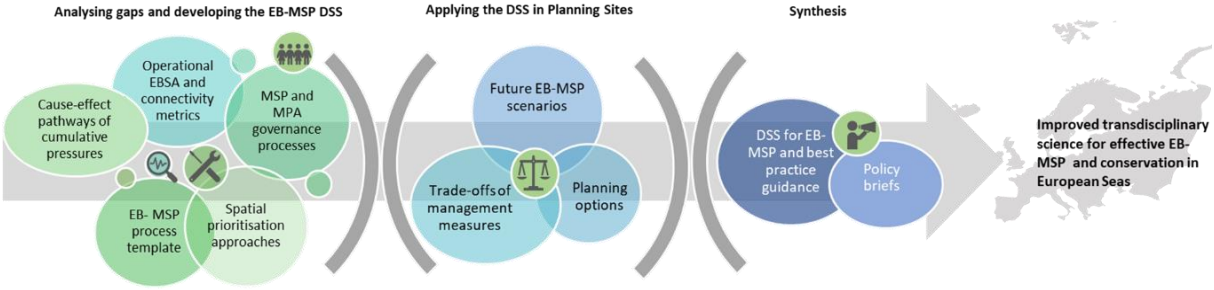


*Figure 2. Illustration of the MarinePlan evolution from developing a Decision Support System (DSS) concept together with the required practical tools to its application at eight planning sites to improve the transdisciplinary science for effective Ecosystem-Based Maritime Spatial Planning (EB-MSP) and conservation in European Seas. EBSA: ecologically or biologically significant areas*

Decision support is a broad field comprising many aspects of planning and implementation. DSSs can be differentiated according to their focus on data, models, knowledge, or communication (Stelzenmüller *et al.*, 2013b). As yet, current DSSs are available for different aspects of MSP (e.g. definition of objectives, management measures, evaluation, etc.), but lack multi-functionality with regard to data gathering, economic analysis, governance assistance, and scenario creation and analysis (Pınarbaşı *et al.*, 2017). An EB-MSP DSS is intended to address this gap consisting of strategic guidelines as well as technical tools (software, scripts, code, methods). An EB-MSP DSS will explicitly provide the user information and links to tools and software for integrating protection, restoration and socio-economic priorities with respect to realistic future scenarios, as will emerge from the co-development process with stakeholders.

The co-development process comprises the iterative steps of engagement with key stakeholders of each Planning Site (such as MSP-competent national authorities, Natura 2000 management bodies, NGOs, and marine industries), advancing the knowledge base, including modelling and gathering the data, development of tools, their deployment and refinement. The bottom-up co-development process will produce a flexible DSS together with best practice guidance and recommendations. As such, the EB-MSP will target end-users comprising, e.g. marine planners, conservationists and the science community to support real-world spatial planning and conservation.

The EB-MSP DSS aims to have wide applicability beyond both the study sites and the project lifetime, and greater coherence among the dominant EU environmental policies (WFD, MSFD, Habitats and Birds Directives (HSD, BD), MSPD and the EU Biodiversity Strategy for 2030).

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# 9 ANNEX

Scientific publications and reports reviewed for analysing proposed EB-MSP frameworks as well as the identification of the main issues hindering the implementation of EBA in MSP.

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