

National Biodiversity Future Center - SPOKE 2 - Activity 4

Biodiversity mainstreaming in Maritime Spatial Planning (MSP4BIODIVERSITY)

Maritime Spatial Planning, in addition to being an obligation under a European Directive, is a great opportunity to reconcile balanced and shared development of sea and coastal uses and actions for the conservation of marine biodiversity.

The main goal of MSP4BIODIVERSITY project is to mainstream biodiversity in the Marine/Maritime Spatial Planning (MSP) policy process and practice, in the Italian marine waters and the surrounding Mediterranean waters, to promote Sustainable Blue Economy (SBE).

The MSP4BIODIVERSITY project develops tools and proposes solutions and actions to protect biodiversity and marine ecosystems. for direct application to national marine waters, to support the implementation and evolution process of the recently approved Italian Maritime Spatial Plans. The approach used is socio-ecological and strongly transdisciplinary. The ambition is also to give continuity to the process, through the creation of a "Transdisciplinary Centre for Maritime Spatial Planning and Sustainable Blue Economy" to be developed within the Biodiversity Science Gateway.

MSP4BIODIVERSITY is a research project coordinated by CNR-ISMAR, funded by the European Union through the Next Generation EU fund and developed within the National Biodiversity Future Center (NBFC) – Spoke2 (Solutions to reverse marine biodiversity loss and manage marine resources sustainably). The project involves six partners: CNR (through the Institutes ISMAR, IRBIM, IAS, IRPI, ISMED, ISGI, IRISS), OGS, UNIBO, Corila, CIMA and IMC.

Project's activity is structured in 5 main tasks (Figure 1):

- 4.1 Implementing the MSP Knowledge Catalogue,
- 4.2 Analysis of coherence and cross-compliance of the system of regulations, policies and strategies in the marine-maritime domain,
- 4.3 Methodologies and socio-economic analyses for the definition of a 'just and safe maritime space',
- 4.4 Biodiversity mainstreaming in MSP through scenario building and scenario analysis,
- 4.6 Analysis, tools and proposals for structuring a knowledge-based MSP process,

and five Case Studies (4.5):

- 4.5.1 Conceptualization and identification of "climate refugia" and their inclusion in the MSP process,

4.5.2 Socio-ecological approach to identify conservation priorities and implement the 2030 Biodiversity Strategy in the territorial waters of Sardinia within a MSP framework,

4.5.3 Operation of innovative eDNA-based monitoring techniques in marine spatial planning decisions and adaptation,

4.5.4 Socio-ecological approach to sustainable fishing in an MSP framework in the coastal waters of the central Tyrrhenian Sea,

4.5.5 Evaluations and proposals for the sustainable development of blue tourism in the territorial waters of Liguria and surrounding areas).

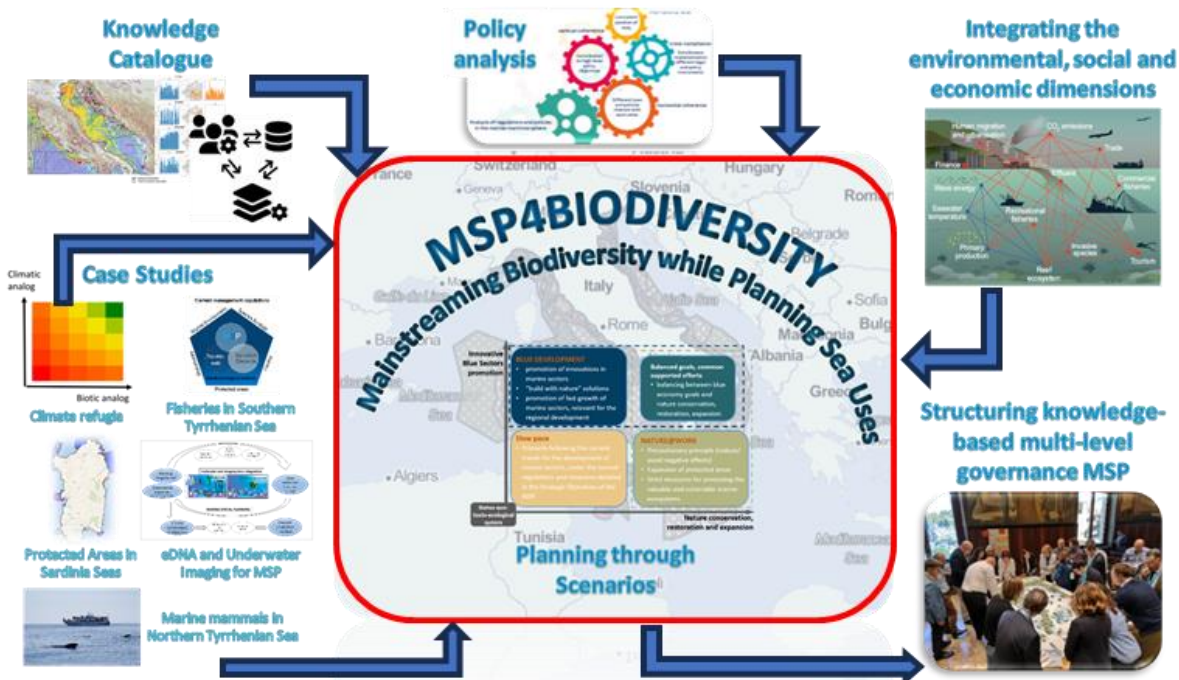


Figure 1 Structure and tasks of the MSP4BIODIVERSITY project.

Task 4.4 (Biodiversity mainstreaming in MSP through scenario building and scenario analysis) is the core task of the project, to which most of the other tasks provide their contribution, and aims to build and analyse, from an environmental, climatic, socio-economic and policy and governance point of view, a series of possible scenarios for the year 2040 of the sea uses and environmental protection measures, to guide planning and management options. This task is subdivided in three important steps: preparatory actions, scenario building and scenario analysis (see figure 2).

These scenarios are co-developed with multidisciplinary experts and stakeholders in three pilot areas: Northern Adriatic, Ligurian Sea and Northern Tyrrhenian and Strait of Sicily.

In each pilot area three spatially explicit scenarios are developed, according to different visions and narratives:

- 1) Slow Pace: the development of each Study Area follows the current trends, with a slow development of emerging sectors, slow adoption of innovative solutions and technologies and a low emphasis on the protection and conservation of the marine ecosystem (under current regulations);
- 2) Nature@Work: the focus on a precautionary principle, translated in a lower risk acceptance of interaction between activities, and with the aim to reduce /avoid the negative effects on the marine ecosystem, the existing nature protected areas are expanded and strict measures are put in place for protecting, conserving and restoring valuable and vulnerable marine habitats;
- 3) Blue Development: due to a fast development of innovative solutions in blue economy sectors, a higher risk acceptance of interaction between activities, a synergetic interaction between blue economy activities and valuable protected habitats is allowed and promoted (see [Figure 3](#)).

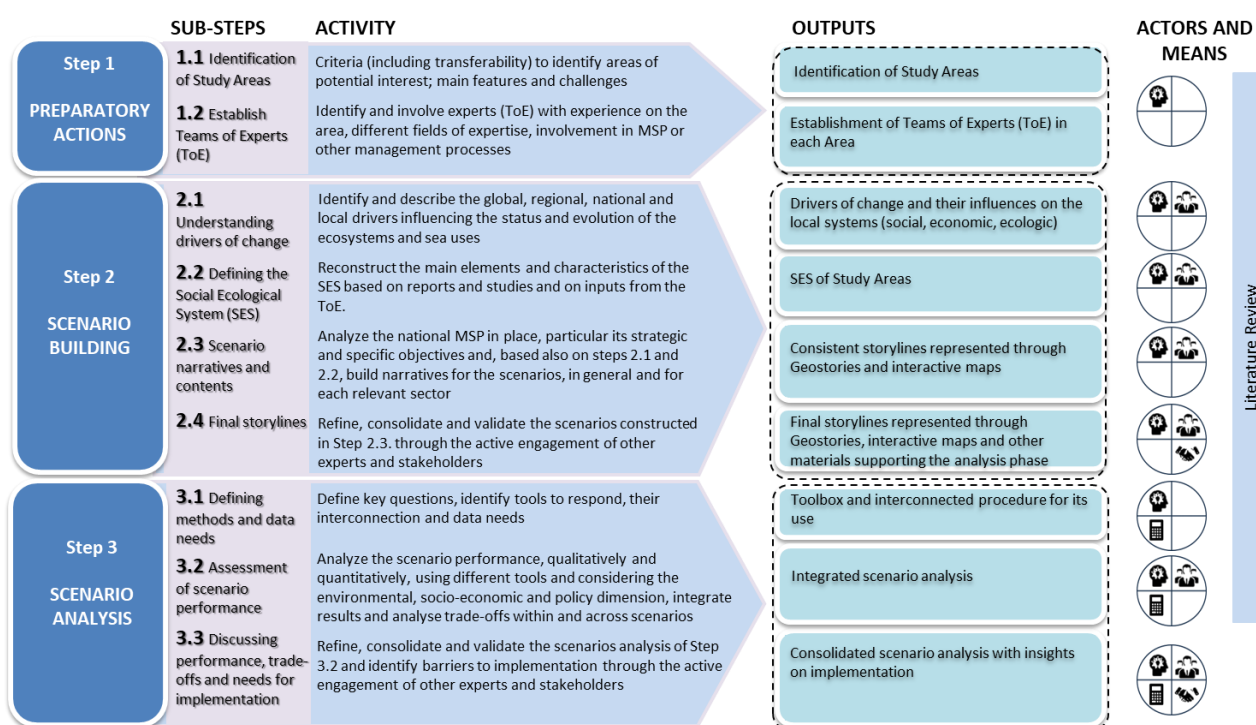


Figure 2 The three-steps process for scenario building and analysis adopted for Task 4.4 (Biodiversity mainstreaming in MSP through scenario building and scenario analysis).

The scenarios are built integrating the available knowledge on the socio-ecological state in place and on existing and expected drivers of change (environmental, climatic, socio-economic, policy-related).

These future scenarios are analysed (“what if” analysis) by using a set of customised quantitative and spatially explicit modules and models, followed by an integration of the different lines of evidence obtained (see Table 1 and Figure 5).

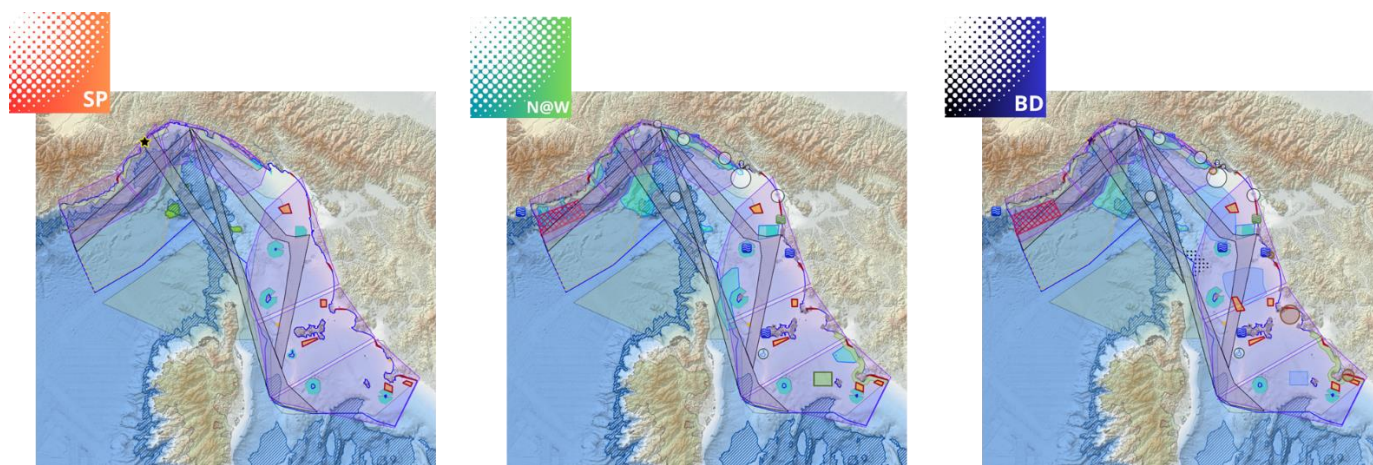


Figure 3 Visualization of the three scenarios (Slow Pace, Nature @ Work, Blue Development) in the Ligurian Sea and Northern Tyrrhenian pilot area.

The modules utilise as input data the information gathered within step 2, therefore including the components of the Social Ecological System (SES), i.e Drivers, Pressures, Biophysical components, Ecosystem services and the relations among them. (see 2.2 in figure 2). *The data provided to MSP4Biodiversity by the Secretariat of the Pelagos Agreement contribute to define the SES of the Pilot Area Ligurian Sea and Northern Tyrrhenian and feed the modules: 1) Risk-based Cumulative Effects Assessment (RB-CEA); 2) Systematic Conservation Planning, using Prioritizr-R; 3) Underwater soundscapes and related risks, using Ocean Planner.*

Table 1 Key questions and tools for the “what if” scenario analysis. *The modules marked with an asterisk are the ones that will use the data by the Secretariat of the Pelagos Agreement.*

Key question	Scenario Analysis Tool
Sectors creating main impacts, areas and aspects impacted, useful indicators, MSFD relationships	Risk-based Cumulative Effects Assessment (RB-CEA)*
Environmental performance for conservation features, optimal areas, optimization of zonation of sea uses.	Systematic Conservation Planning (Prioritizr-R, Marxan)*
Effects of management areas on fish stocks. Effects of variation in fishing efforts. Climate change impacts on fisheries	Trophic network models (Ecopath with Ecosym / Ecospace)
Effects on fish stocks and benthic biocenosis. Socio-economic effects on the fishery sector	Multi-species bio-economic modeling approach (SMART)
Connectivity analysis, Oil spill and other risks, spatialization of pressures.	Lagrangian models
Water quality and oceanographic parameters in relation to anthropogenic pressures and climate scenarios.	Biogeochemical models
Scenarios affecting and being affected by alien species distribution	Alien invasive species model (Maxent)
Sound maps and related risks to target species, GES according to MSFD-D11 thresholds, delays and fuel savings/over-consumption	Soundscape model (Ocean Planner)*
Identification of climate refugia and evaluation of climate-smartness of scenarios	Climate refugia module
Evaluation of economic impacts ad cost-benefits for uses	Socio-economic module (input-output model)
Identification, qualification and evaluation of ecosystem services	Ecosystem services module

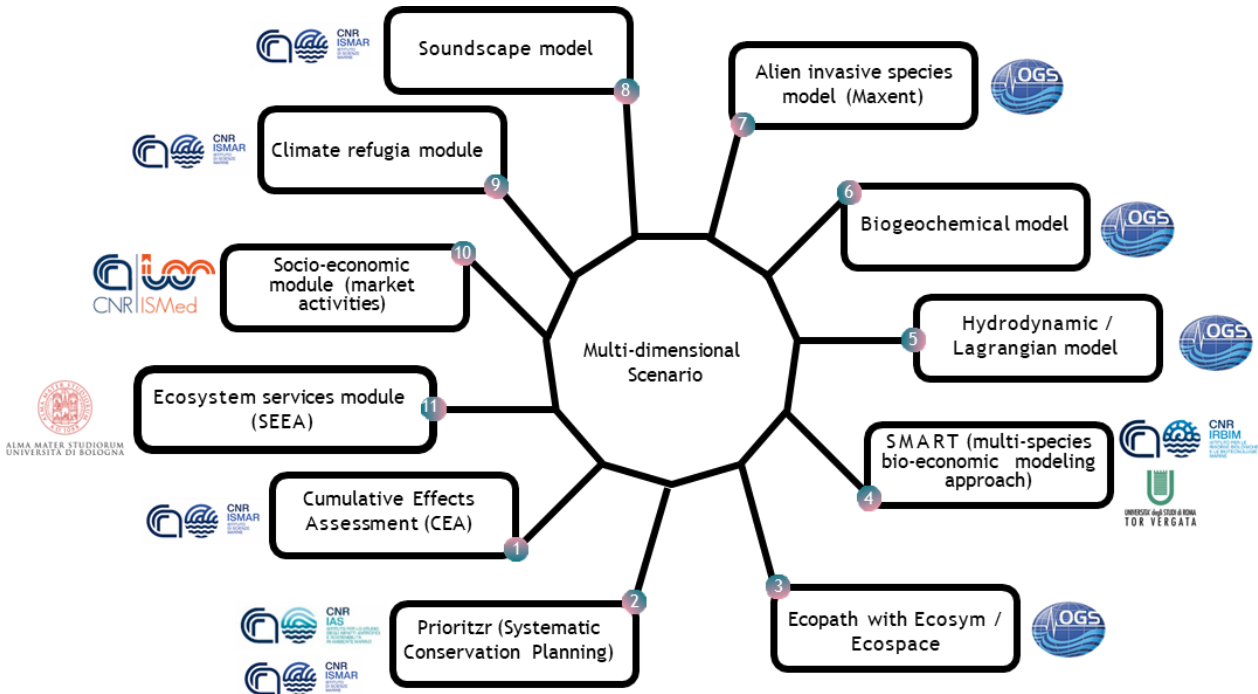


Figure 45 Visualization of the toolbox under use in Step 3 (Scenario analysis) of Task 4.4 and the partners in charge of developing and using the different tools/models.

Besides the specific answers provided by each tool, the multiple lines of evidence obtained, including inputs from stakeholders, will be integrated through the conceptual scheme proposed by Barnard & Elliott (2015): the 10-tenets of adaptive management and sustainability. The conceptual framework allows to assess the performance of the scenarios according to 10 different and complementary criteria: socially desirable/tolerable, ecologically sustainable, economically viable, technologically feasible, legally permissible, administratively achievable, politically expedient, culturally inclusive, ethically defensible, effectively communicable.

The results of the analysis of scenarios using the different modules / models will be discussed in a series of interactive workshops with the Team of Experts, other experts and stakeholders. Key elements of this final discussion will be the analysis of trade-offs between scenarios, the weighting of the 10-tenets, how we take into account uncertainties, intangible results and values behind the scenarios in a post-normal science perspective (Funtowicz and Ravetz, 1993), the multi-dimensional barriers and enablers (e.g. environmental, economical, societal, technological, governance, communication) towards the implementation of the scenarios.

More information on the participatory side of the project is available on the web page:

<https://marefuturoismar.isiq.it/>

Geo-story describing the scenarios build for the Pilot Area Ligurian Sea and Northen Tyrrhenian:

<https://geoplatform.tools4msp.eu/apps/1856/embed#/>

The second interactive workshop for the pilot area Ligurian Sea and Northen Tyrrhenian is foreseen in Genova on 15-16th September 2025.
