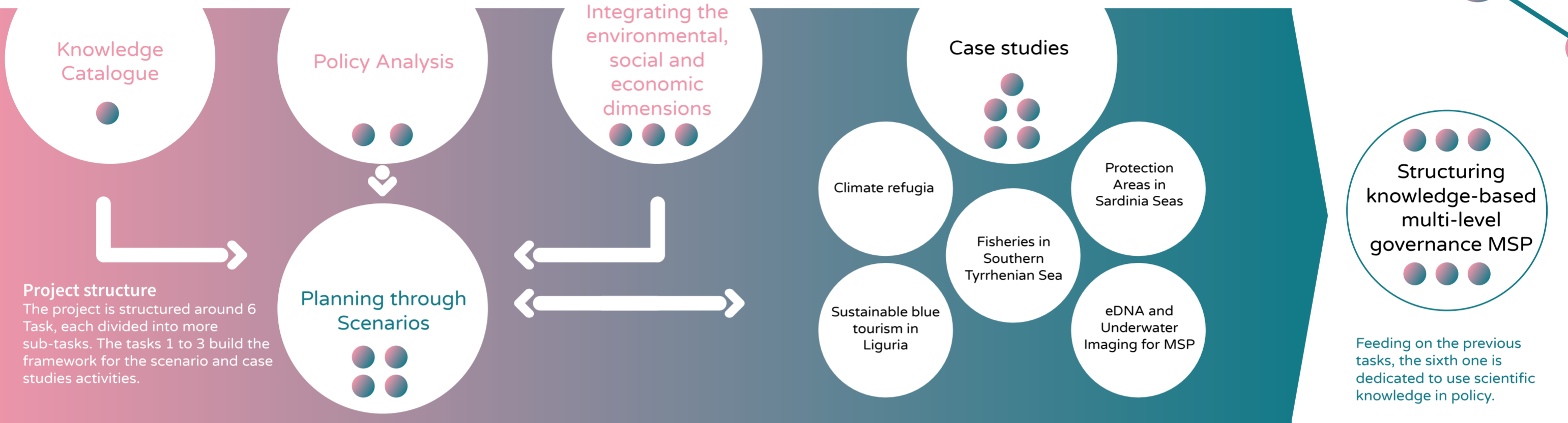


The loss of biodiversity is significant in Italy, this translates into a call to the scientific community with the goal of developing knowledge and innovative technologies to meet the challenge and protect our country's natural resources. And it is precisely with this ambitious goal that the National Biodiversity Future Center - NBFC was born, which aims to establish a permanent multidisciplinary community at the national level. The Center is coordinated by the National Research Council (CNR) and involves a network of 48 partners. Under Spoke 2 of NBFC "Solutions to reverse marine biodiversity loss and manage marine resources sustainably", aimed at implementing concrete actions to reduce anthropogenic pressure on Mediterranean marine biodiversity by developing

and testing solutions to reverse biodiversity loss due to activities such as fishing, shipping, and tourism, the MSP4BIODIVERSITY project "Biodiversity mainstreaming in Maritime Spatial Planning" aims, through Maritime Spatial Planning (MSP), to foster sustainable and lasting development of the marine economy, while safeguarding marine biodiversity and ecosystems. Research activities intend to directly inform the MSP process and Plans in Italy. Therefore, the study area extends to the whole Italian marine waters and considers when needed transboundary aspects.

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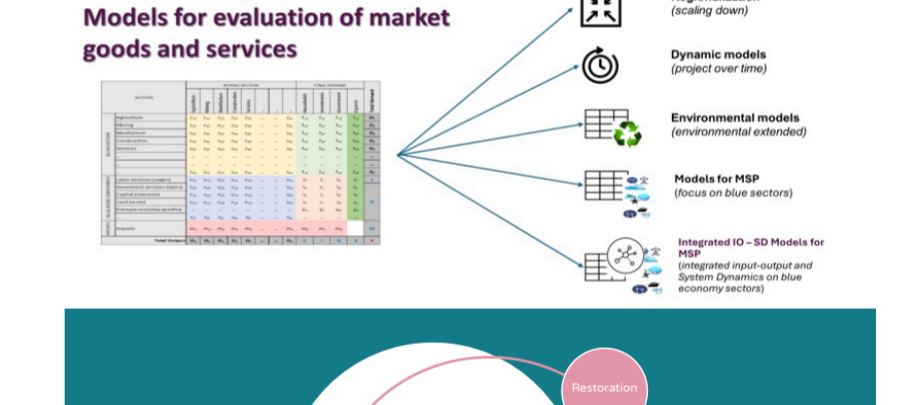
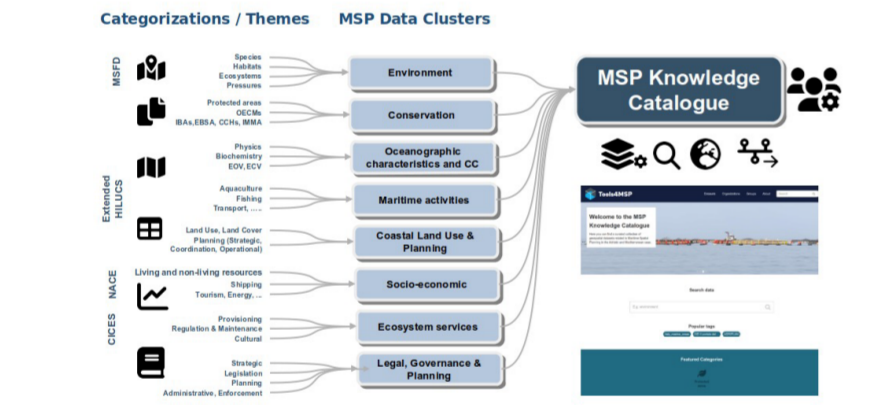
Mainstreaming Biodiversity while Planning Sea Uses



The Knowledge Catalogue represents a dynamic and interdisciplinary framework of knowledge functional to support national MSP processes based on the protection of biodiversity and the integration of ecological, economic and social dimensions.

Policy coherence and cross-compliance will allow for the reconstruction of the regulatory and institutional framework relevant to the protection of biodiversity in the Mediterranean marine spaces, and Italian in particular. Issues specifically investigated: mapping international instruments dealing with biodiversity conservation and recovery; mapping the European context; mapping the regulatory framework relevant to the protection of biodiversity in areas under Italian sovereignty or jurisdiction reports studying: relevant binding laws and regulations strategies, standards, objectives and guidelines institutional competencies (provided by law and judicial decisions) quantitative objectives.

Social Sciences and Humanities (SSH) and Economy will aim at the development & application of indicators, innovative analysis and evaluation methodologies to integrate socio-economic aspects with physical/environmental variables and measure socio-economic impacts of MSP. Specific indicators will be considered.



8 MSP Data Clusters

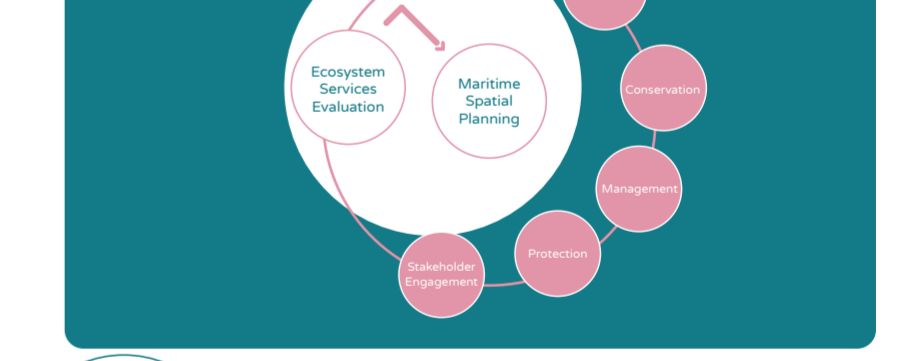
- Geospatial layers, reports, documents, statistic datasets, laws, etc.
- Multi-scalar coverage: International, national, regional, local
- Multi-temporal: current conditions, future scenarios, trends

(Adapted from MSP Data Framework TEG on Data for MSP, Abramic et al. 2023)

5 case studies are developed on selected key topics and study areas.

Climate refugia in MSP

1. Define climate refugia in MSP context
2. Identify potential areas as climate refugia for Italy and the Mediterranean Sea by means of combined analysis of climate indices (climate analogs) and biotic indices (biotic analogs) Control anthropogenic pressures over refugia through MSP. Development of a coupled Cumulative Effect Assessment (CEA) Climate Change (CC) tool on the Tools4MSP Geoplatform



Building and analysing scenarios is the approach used to explore possible future and implement biodiversity mainstreaming in MSP. Exploratory scenarios are developed in three Pilot Areas (Northern Adriatic, Northern Tyrrhenian, Strait of Sicily) according with different visions (Slow Pace, Nature @ Work, Blue Development). Their analysis integrates different elements: conservation, blue economy sectors, climate change, policies.

Social-ecological approach to identify conservation priorities and implement in a MSP framework the Biodiversity Strategy 2030 in the Sardinia territorial waters, Actions:

- Database (MSP Knowledge Catalogue)
- Ecological connectivity among protected areas
- Multi-use synergy analysis
- Ecosystem services assessment
- Stakeholders involvement
- Planning of new protected areas
- New data acquisition

Operationalization of innovative monitoring techniques in marine spatial planning decisions and adaptation will foster the development and practical application of enabling technologies in the planning and monitoring and adaptation phases of plans by integrating eDNA and Underwater Imaging techniques combined with machine learning.

Social-ecological approach to sustainable fisheries in a MSP framework: Central Tyrrhenian coastal areas as a case study Objectives:

Identification of spatial management measures minimizing impacts on food web structure to promote maintenance and restoration of biodiversity levels.

Actions:

- Integrating fishery-dependent and independent data (scientific surveys, logbook data etc.)
- Sampling on board of commercial fishing vessel
- Gathering social and economic information on fishing activity
- Stable Isotopes on fish species

Modular assessments for sustainable development of blue tourism: Ligurian territorial waters as a case study - Information (socio-economic value and hotspot of area) about whale-watching

- Database of thematic maps
- Questionnaires for a socio-economic assessment
- Reinforcement the HQWW® network
- Mapping of collected data from whale-watching Recommendations for MSP

Promoting the establishment of multi-level governance (MLG) to support and facilitate the achievement of the Italian Maritime Spatial Plans' objectives, the development of the sustainable blue economy and the conservation of biodiversity. With the overall purpose of implementing the Directive (2008/56/EU), MLG implements collective actions involving various actors and institutions through informal and formal activities at different administrative and sectoral levels. The core activity aims to develop a stable knowledge infrastructure, centralising the management of Italian MSP processes and creating an effective science-to-policy activity that permeates the institutional barriers and brings together different disciplines to mediate, co-produce and transfer scientifically sound transdisciplinary information to the decision-making process.

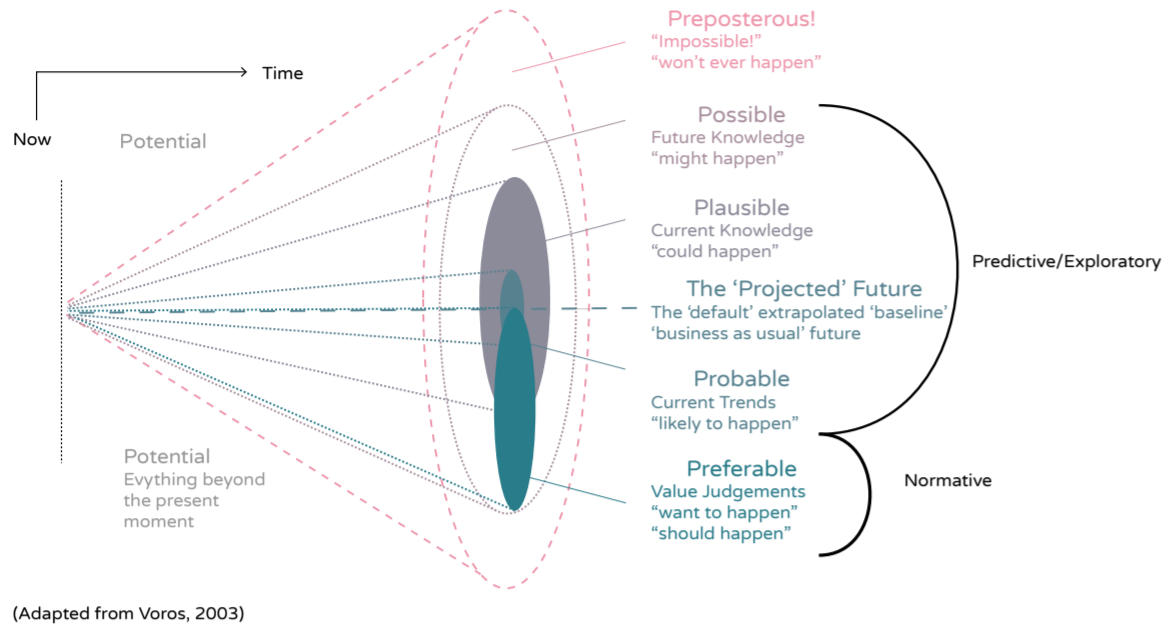
Conceptual diagram depicting the four primary models enhancing knowledge exchange between scientists and decision-makers (from Citanovic et al. 2015).

- Scientist
- Intermediary
- Decision-maker
- Co-production
- Embedding
- Knowledge broker
- Boundary organisation

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Mainstreaming Biodiversity while Planning Sea Uses

Scenario building and scenario analysis are the key conceptual and operational tools used to explore and implement biodiversity mainstreaming in MSP.



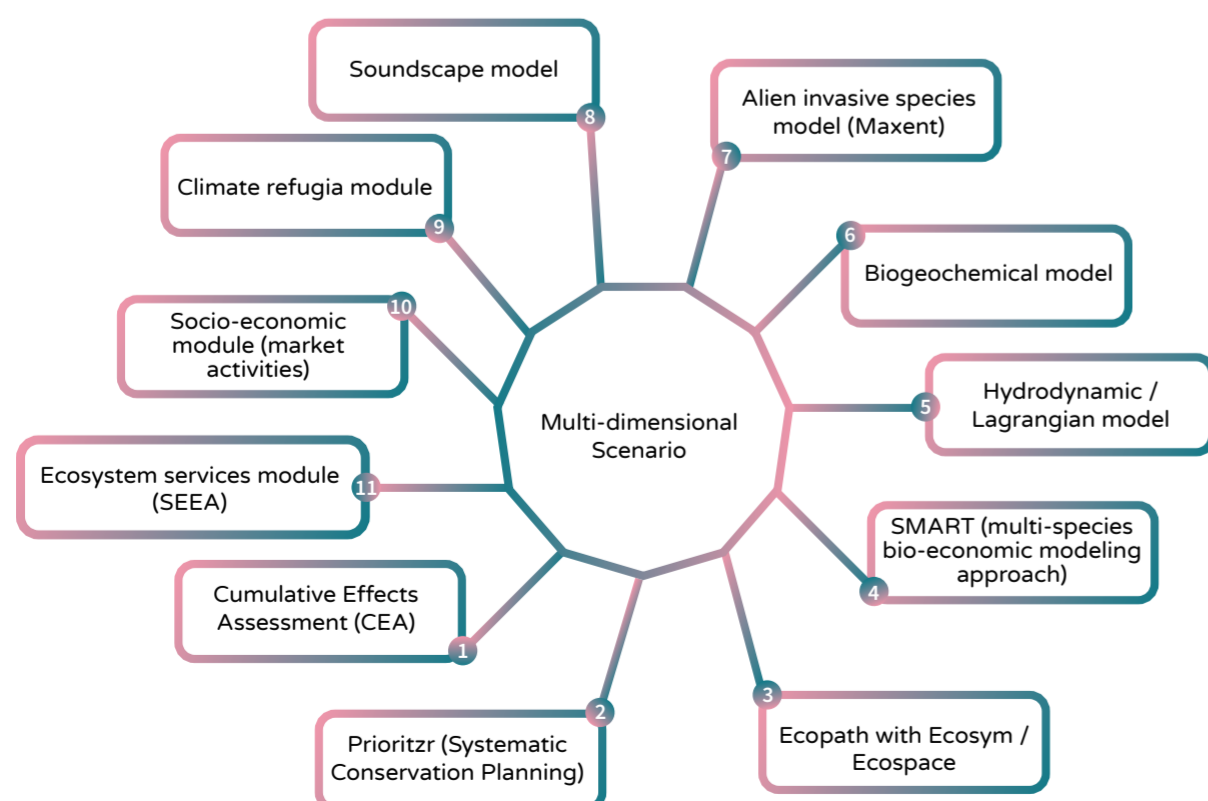
(Adapted from Voros, 2003)

Steps	Outputs	Who
1. PREPARATORY ACTIONS	1.1 Identification of areas (3)	Project Partners
	1.2 Establishment of a Team of Experts (ToE) in each Area	Team of Experts
2. SCENARIO BUILDING	2.1 In-depth knowledge of the current and projected drivers and trends of the marine sectors, and their influences of the local systems (social, economic, ecologic) of the 3 selected areas	Project Partners, Team of Experts
	2.2 The analysis and characterisation of the socio-economic and ecologic dimensions of the local context for the 3 analysed areas (SES), described through topics of the 10-tenets of sustainable development.	Project Partners, Team of Experts
	2.3 Initial scenario narrative, specific Strategic Objectives and maps for 3 scenarios based on the local SES and the national MSP.	Project Partners, Team of Experts
	2.4 Final version of the scenarios (SMART Strategic Objectives) and related maps, based on consensus between stakeholders and experts.	Project Partners, Team of Experts, Stakeholders
3. SCENARIO ANALYSIS AND EVALUATION	3.1 List of valuable tools and methods for scenario analysis and evaluation. Results of scenario analysis.	Project Partners, Team of Experts
	3.2 assessment and comparison of scenario performance in relation to the status-quo, the strategic Objectives and the 10 tenets.	Project Partners, Team of Experts
	3.3 Discussion and refinement of the scenarios.	Project Partners, Team of Experts, Stakeholders
4. TRANSFERABILITY	4.1 Final results and transferability analysis.	Project Partners, Team of Experts

The starting point of the scenarios to be developed and evaluated are the National MSP Plans in the three maritime areas (Adriatic, Tyrrhenian-Western Mediterranean, Ionian-Central Mediterranean) under finalization and approval. We consider 3 Pilot Areas from the marine waters under the National Maritime Spatial Plans. The scenarios qualify, quantify and spatialise the different sea uses, focusing on the ones identified as the most relevant.

Sea uses	Scenario Options
Protected Areas	New Natura 2000 or National MPAs, enlarged Natura 2000 or National MPAs, OECMs, restoration actions, MAB Unesco
Maritime Transport	New PSSAs, new ATBAs, voluntary or mandatory speed limitation, traffic increase, vessels with reduced URN
Fisheries	Decrease of fishing effort, new FRAs and other areas with permanent or temporary trawling ban, promotion of SSF, better regulation of recreational fisheries
Aquaculture	New shellfish and finfish farms, new species, IMTA, multi-use with OWF
Oil & Gas	New gas exploitation, O&G decommissioning
Offshore Renewables	New OWFs, wave energy generators in port areas, LNG terminals
Coastal Defense	Measures against flooding and erosion, mapping and strategic use of marine aggregates, NBS
Coastal & Maritime Tourism	Increase of tourism pressure, improved sustainability, experiential tourism, improved leisure boating regulation
Landscape & UCH	Protection of coastal landscapes, protection and valorisation of UCH sites

The evaluation of scenario performance, the comparison among scenarios and the adjustment of expert-based scenarios is carried out through a customised toolbox, with modules and models selected and developed to respond to specific scenario-related questions. Results will allow an integrated, quantitative and spatially-explicit environmental and socio-economic analysis of the scenarios, which will be then further integrated and synthesized by using the 10-tenets of adaptive management and sustainability approach (Barnard & Elliott, 2015).



Barnard, Steve & Elliott, Michael. (2015). The 10-tenets of adaptive management and sustainability: An holistic framework for understanding and managing the socio-ecological system. Environmental Science & Policy. 51. 10.1016/j.envsci.2015.04.008.
 Borjeson, Lena & Höjer, Mattias & Dreborg, Karl-Henrik & Ekvall, Tomas & Finnveden, Göran. (2006). Scenario Types and Techniques: Towards a User's Guide. Futures. 38. 723-739. 10.1016/j.futures.2005.12.002.
 Voros, J. (2003). A generic foresight process framework. Foresight, 5(3):10-21. doi:10.1108/14636680310698379.

Planning through Scenarios

This task of MSP4BIODIVERSITY is conceived to formulate analysis and proposals for strengthening the contents and provisions of the National MSP Plans aimed at preserving and increasing biodiversity, fully using Ecosystem-Based approaches. Planning Scenario describing future states at 2040-2050 of our Pilot Areas are shaped according to 3 different visions (Slow Pace, Nature@Work, Blue Development).

Innovative Blue Sectors promotion

BLUE DEVELOPMENT
 promotion of innovations in marine sectors
 "build with nature! solutions promotion of fast growth of marine sectors, relevant for the regional development

Balanced goals, common supported efforts
 Balancing between blue economy goals and nature conservation, restoration, expansion

NATURE@WORK
 Precautionary principle (reduce/avoid negative effects)
 Expansion of protected areas
 Strict measures for protecting the valuable and vulnerable marine ecosystems

Slow pace primarily following the current trends for the development of marine sectors, under the current regulations and measure detailed in the Strategic Objectives of the MSP

Status-quo: Socio-ecological system

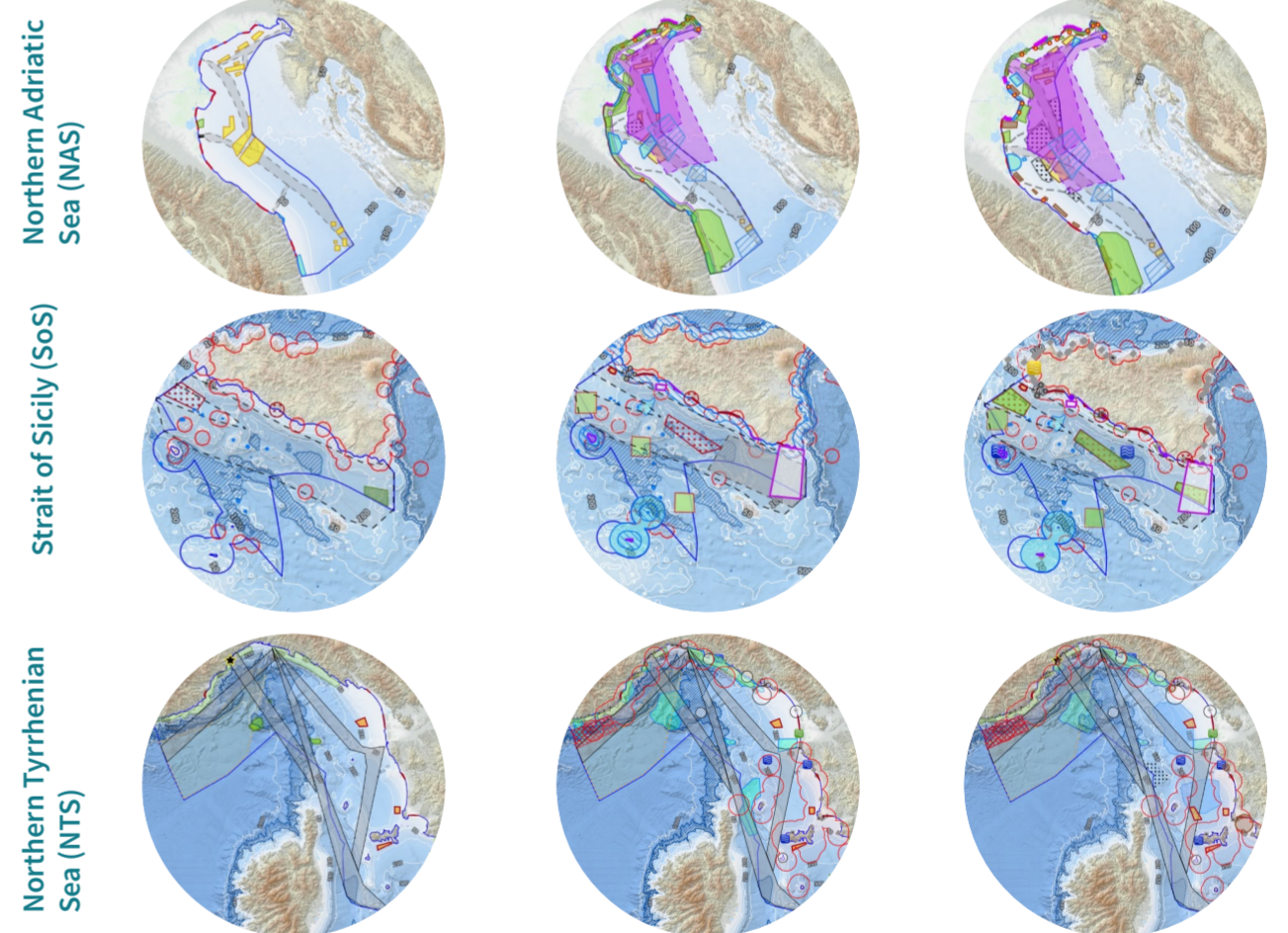
Nature conservation, restoration and expansion

The activity is carried out by applying in each pilot area a step-wise process: from Driver identification, to definition of Socio-Ecological Systems, to definition of three expert-based spatially explicit scenarios in line with the scenario narrative and within the boundaries of the national MSP Strategic Objectives, to and in depth multidimensional "what if" analysis through a customised toolbox. Key actors of the process are project Partners, Teams of Experts and Stakeholders.

Scenarios take into account aspects related to policies, to climate change and interactions (conflicts, coexistence, synergies) between the uses of the sea and the coast. Overall, our goal is to address, through the construction of qualitative (narrative) and quantitative / spatially explicit scenarios, further analyzed, Sustainable Blue Economy solutions, fully taking into account environmental and biodiversity protection objectives. For better grasping the environmental, legal and social-economic implications of different potential management strategies, with regards to the use of the offshore space, but also for quantifying the potential trade-offs between the different scenarios, we have selected the explorative strategic scenario typology (Borjeson et al., 2006). The key question is then: What can happen if we act in a certain way?

Since in some cases specific targets can be identified or set, mostly on the environment, during the process we tend sometimes to move towards normative scenarios, where the key question becomes: How can a specific target be reached? In fact, normative scenarios represent organized attempts at evaluating the feasibility to achieve certain desired outcomes or avoid the risk of undesirable ones.

Slow pace Nature Work Blue Development



Main questions and indicators per tool, applicable to one or more Area

- 1 Sectors creating main impacts, areas and aspects impacted, useful indicators, MSFD relationship.
- 2 Environmental performance for conservation features, optimal areas, optimization of zonation of sea uses.
- 3 Effects of management areas on fish stocks. Effects of variation in fishing efforts. Climate change impacts on fisheries.
- 4 Effects on fish stocks and benthic biocenosis. Socio-economic effects on the fishery sector.
- 5 Connectivity analysis, Oil spill and other risks, spatialization of pressures.
- 6 Water quality and oceanographic parameters in relation to anthropogenic pressures and climate scenarios.
- 7 Scenarios affecting and being affected by alien species distribution.
- 8 Sound maps and related risks to target species, GES according to MSFD-D11 thresholds, delays and fuel savings/over-consumption.
- 9 Identification of climate refugia and evaluation of climate-smartness of scenarios.
- 10 Evaluation of economic impacts ad cost-benefits for uses in the scenarios.
- 11 Individuation, qualification and evaluation of ecosystem services in the scenarios.