



Designing and implementing a multi-scalar approach to Maritime Spatial Planning: The case study of Italy

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ABSTRACT

The Italian coastal and marine space includes areas with remarkable differences in terms of oceanographic characteristics, maritime uses, natural habitats, species distribution, landscape and cultural heritage. In Italy, coastal and marine management competencies are shared among national, regional, and for some aspects even local authorities. This geographic heterogeneity and governance complexity required the adoption of a multi-scalar approach to Maritime Spatial Planning (MSP). Such an approach aims at implementing decision-making and spatial planning at multiple and nested scales. In the case of Italy, the multi-scalar approach included the definition of national guidelines and the development of three maritime spatial (MS) plans, one for each maritime area (Adriatic, Ionian and Central Mediterranean, and Tyrrhenian and Western Mediterranean), including subareas and nested planning units. The development of the MS plans involved competent Ministries, the coastal Regions and several researchers. Based on the description of the adopted six-phase methodology and the exemplification of results of the Italian MSP process, this paper discusses the most relevant features and common challenges of multi-scalar MSP (i.e. co-planning, vertical and horizontal integration, multi-level governance, scalability, flexibility, integration of data and knowledge with different resolution, multi-scalar stakeholder engagement). Finally, the paper reflects on some novel aspects of the adopted multi-scalar approach and identifies actions to grant efficacy to this approach during the next phases of the Italian MSP process.

1. Introduction

In the 2021 Communication on a new approach for a sustainable blue economy in the EU [1], the European Commission recalled the central role of Maritime Spatial Planning (MSP) as an essential tool to achieve sustainable blue economy objectives. According to the MSP Framework Directive 2014/89/EC (MSPD), Member States were required to develop spatial plans for their national maritime waters in conformity with the objectives and guidelines set therein. In the transposition of the

Directive, Member States determined the format and content of plans in accordance with their institutional and governance levels, giving room for adaptation to national contexts [2,3]. In countries where competencies on marine issues are distributed among different governance levels, MSP can be applied across different scales. In the Mediterranean, the Conceptual Framework for MSP - a policy document adopted in December 2017 by the contracting parties of the Barcelona Convention [4] - recommends the application of a multi-scalar approach to MSP. This guiding document aims at providing a common reference for the

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MSP implementation to all Mediterranean countries. It links MSP to the binding Protocol on Integrated Coastal Zone Management (ICZM) in the Mediterranean [5], considering MSP as the main tool/process for the implementation of ICZM in the marine part of the coastal zone [6].

A multi-scalar approach to MSP pursues decision-making about planning and management of the marine space at multiple and nested scales [7–9]. Multi-scalar and nested are two complementary concepts: with multi-scalar we refer to the multiple geographical and institutional levels involved in MSP [10,11]; with nested we refer to the reciprocal influence across biological, social, economic and institutional processes at multiple geographical and institutional scales [12,13]. Adopting a multi-scalar and nested approach – referred hereafter as multi-scalar – allows that MSP is undertaken at the appropriate spatial and temporal scales in all its phases – i.e. planning, implementation, monitoring, evaluation, revision and adaptation [9,14] – in line with the Ecosystem-Based Approach, a pillar of the MSPD [15]. This enables MSP to define objectives, zoning options and measures at different resolutions and details – where needed – based on local environmental and socio-economic characteristics. The decentralisation of planning and management to the lowest appropriate level can strengthen coherence across the governance actors and among the different sectors. The improvement in the structured interactions with local communities and stakeholders reinforces awareness on and co-creation of the MS plan, improving the effectiveness of the overall process [15,16].

The choice of scale decides the degrees of detail in management [17], while the structure of the administrative levels has implications on how management - and MSP - is performed [18]. The governance system and the distribution of coastal and marine planning competencies strongly influence the way MSP is implemented and the different levels involved [19]. For instance, in the Baltic Region MSP governance has taken quite different forms: the involvement of the municipal level in Latvia and Sweden, an important regional/federal perspective in Finland and in the German territorial sea, and a more national perspective in Poland and Estonia, however including the subdivision of marine waters into smaller plan areas [17]. The interplay of responsible institutions across multiple levels is essential to allow effective and coherent management [20]. The multi-scalar approach operationalizes principles of integration and coherence among visions and objectives at different spatial scales, integrating regulatory functions, community values and aspirations across sectors and scales [7]. Analysing the geographic scale and management levels considered for MSP implementation by Member States of the Baltic Region, Westholm [17] highlighted that “a number of local and regional actors (...) influence how planning is performed. Such actors may have different interests and perspectives in their planning than national or international actors” (p. 268). A multi-scalar approach to MSP is particularly appropriate to address claims at different scales, of different typologies and intensity [21].

Multi-scalar MSP has implications in how data and knowledge are produced or used to inform the decision-making process. Institutions and stakeholders engaged in the process influence the capacity of accessing and organising data on temporal and spatial dynamics at multiple scales [22]. Data collected from different sources have different quality, accuracy and resolutions [11] that need to be managed within spatial data infrastructures, while the way data are published can influence the users’ and stakeholders’ perspective on the MS plan [23]. Data can be used to feed decision support tools (such as tools for the assessment of cumulative impacts or for conflict analysis). When tools are coherently applied across scales, they allow for a consistent and transparent comparison of multi-scalar assessments to support MSP [24–26].

The heterogenous geographic and governance characteristics of the Italian sea space, led Italy to adopt a multi-scalar approach to MSP. With this paper we aim at presenting the novel aspects of this approach, related to the multi-level governance structure established for MSP in Italy (Section 2) and to the adopted methodology (Section 3). We use examples of practical results (about the Tyrrhenian and Western

Mediterranean maritime area; Section 4) to illustrate how the multi-scalar approach was applied and to underpin the discussion, in Section 5, of some of its most relevant features and challenges. The conclusions provide recommendations for an effective implementation of the multi-scalar approach in the next phases of the Italian MSP process.

2. Multi-level governance in place supporting MSP implementation in Italy

The statutory Italian MSP process dates back to the transposition of the MSPD through the Italian legislative decree 201/2016 [27]. This decree identifies the MSP competent authority in the Ministry of Infrastructure and Transport and defines some fundamental aspects of MSP in the country, including coordination mechanisms. It refers to supplementary guidelines (hereafter “MSP guidelines”) [28] to provide common principles for the MS plans and to regulate their detailed elaboration. The MSP guidelines were adopted by an Inter-Ministerial Coordination Table on MSP, which is also in charge of checking the correspondence of the MS plans with such guidelines. The legislative decree 201/2016 recognises that competencies relevant to MSP in Italy are shared among the State and sub-national administrative bodies. The development of the MS plans has therefore been appointed to a Technical Committee, coordinated by the MSP competent authority and composed of several Ministries (i.e. Ministry of the Environment and Energy Security; Ministry of Agriculture, Food Sovereignty and Forestry; Ministry of Enterprises and Made in Italy; Ministry of Culture and Ministry of Tourism) and the coastal Regions.

The composition of the MSP Technical Committee reflects the distribution of legislative powers on coastal and marine issues among the Italian State and the coastal Regions. The State has a transversal legislative power on environmental protection, landscape and cultural heritage preservation. It shares legislative power with the Regions over ports, maritime transport, production and distribution of energy, spatial planning, enhancement of cultural and environmental goods, health protection, job protection and safety, foreign trade, scientific and technological research and support to business innovation. The Regions have legislative power over fishery, aquaculture, coastal defence and tourism. The State may also regulate these sectors to ensure uniformity and implement obligations imposed by European and international laws.

Administrative competencies on the regulation, planning and authorization of human activities at sea are shared among several institutions at different levels: national, regional, and for some aspects even local (provinces and municipalities). Examples of the distribution of coastal and marine competencies are presented in Table 1.

For the purpose of MSP, the Italian sea space was divided in three maritime areas, coherently with those identified in the implementation process of the Marine Strategy Framework Directive (2008/56/EC) according to their biogeographical and environmental characteristics (e.g. depth, morphology, sea current, habitat distribution, etc.): the Adriatic, the Ionian and Central Mediterranean, and the Tyrrhenian and Western Mediterranean (Fig. 1). A plan proposal was developed for each maritime area, in line with the criteria set by the Italian MSP guidelines. The Italian MS plans apply to the marine space under the country’s sovereignty, including:

- territorial sea up to the external limit of 12 nautical miles (NM) from the baseline (also including coastal waters as defined by the Water Framework Directive 2000/60/EC);
- the continental shelf, extending beyond 12 NM;
- the ecological protection zone of the north-western Mediterranean, the Ligurian Sea and the Tyrrhenian Sea, established by the decree of the President of the Republic no. 209/2011 according to the Law no. 61/2006.

Through Law no. 91/2021, Italy declared its Exclusive Economic Zones still to be formally agreed with bordering countries. Once

Table 1

Examples of distribution of coastal and marine competencies among national and regional authorities (shown in italics).

Topic	National level	Sub-national level
Environmental protection	<i>Ministry of the environment and energy security</i> Establishment of national parks, national nature reserves, and Marine Protected Areas: (art. 35, D. Lgs. 300/1999; art. 2, 18, Law 394/1991) Authorization for discharges into sea waters by ships and aircraft (art. 80, D. Lgs. 112/1998)	<i>Regions</i> Establishment of parks and natural reserves of regional and local interest, which can include the sea facing the coast (art. 2, Law 394/1991)
Landscape conservation	<i>Ministry of culture</i> Imposition of landscape restrictions, and powers to replace the Regions (artt. 141, 141 bis, 146, D. Lgs. 42/2004)	<i>Regions</i> Imposition of landscape restrictions, adoption of landscape plans, and landscape authorizations (artt. 135, 140, 146, D. Lgs. 42/2004)
Conservation of cultural goods	<i>Ministry of culture</i> Imposition of cultural constraints, and authorization of interventions on cultural heritage (artt. 12–14, 21–22, D. Lgs. 42/2004)	
Coastal defence	<i>Ministry of the environment and energy security</i> Guidelines and criteria for coastal defence (art. 88, D. Lgs. 112/1998)	<i>Regions, Provinces, Municipalities</i> Protection and monitoring of coastal zones (art. 70, D. Lgs. 112/1998) Programming, planning and integrated management of coastal defence interventions and coastal settlements (art. 89, D. Lgs. 112/1998)
Maritime transport	<i>Ministry of infrastructure and transport</i> Regulation and safety of maritime and recreational navigation, management of the maritime traffic system (VTS) (art. 104, D. Lgs. 112/1998; art. 42, D. Lgs. 300/1999)	
Energy	<i>Ministry of environment and energy security</i> Exploration and exploitation of hydrocarbons; reconversion, closing and decommissioning of offshore infrastructures, safe restoration of sites (art. 35, D. Lgs. 300/1999) Authorization of State-owned power generation plants located at sea, including those using renewable sources (art. 35, D. Lgs. 300/1999) Authorization of offshore electricity production plants powered by renewable sources (art. 12, D. Lgs. 387/2003) Use of public maritime property and areas of the territorial sea for the purpose of supplying energy sources (art. 104, D. Lgs. 112/1998)	
Fishery and aquaculture	<i>Ministry of agriculture, food sovereignty and forestry</i> General regulation and coordination of policies relating to fishing and	<i>Regions</i> Updating the list of waters intended for shellfish farming (art. 81, D. Lgs. 112/1998)

Table 1 (continued)

Topic	National level	Sub-national level
	aquaculture (art. 33, D. Lgs. 300/1999)	Concessions of maritime State property and areas of the territorial sea for purposes other than those of supplying energy sources (art. 105, D. Lgs. 112/1998)

finalised, this process will have profound implications for the future update of the Italian MS plans beyond 12 NM.

The MS plans' proposals were submitted to public consultation, together with the documents drafted by the Strategic Environmental Assessment (SEA) process. The plans have a prevalent strategic nature and are legally binding; they aim at integrating and harmonizing existing and future cross-cutting and sectoral plans. According to art.5, c.3 of Italian legislative decree 201/2016, the MS plans have the nature of a first-level planning instrument, which is superordinate to the other plans and programs having effects on the MSP application area.

3. Methodology for the multi-scalar approach to the Italian MSP

The methodological approach applied across the Italian MSP process was developed capitalising on several EU and nationally funded projects (ADRIPLAN, 2013–2015 [29–31]; Ritmare, 2012–2017 [32–34]; SUPREME, 2017–2018 [35,36]; SIMWESTMED, 2017–2018 [37–39]; MSPMED, 2020–2022 [40]), involving research centres, academia, and national and regional institutions. These were capital project to collect spatial data, develop reliable tools, test the approach, and pave the way for the methodology employed in the statutory MSP process in Italy.

3.1. Six-phase methodology for strategic MSP

Each maritime area was subdivided in maritime subareas (SAs), which in turn include planning units (PUs). The latter represent the spatial elements considered for zoning, as further described in Section 3.3. The delimitation of maritime subareas was based on a mixed set of criteria: (i) governance spatial features (i.e. extension into the sea of administrative borders between coastal Regions, limit of the territorial sea and delimitation of the continental shelf), (ii) borders set in the frame of international agreements (e.g., FAO Geographical subareas - GSAs [41]), (iii) zoning schemes already defined for specific management purposes (e.g. exploration and exploitation of offshore hydrocarbon deposits), (iv) morphological, oceanographic and ecological characteristics of the maritime area, and (v) distribution of existing coastal and maritime uses. The distribution of maritime uses, environmental components (habitats and protected areas), landscape, and cultural values was considered for the PUs' delimitation, too, as detailed in Section 3.3. The MSP guidelines, the three maritime areas, the maritime subareas and the planning units form a unitary multi-scalar approach to MSP in Italy, enabling to zoom-in along the planning process. The overall MSP process followed a six-phase methodology, consistently applied to the three plans:

Phase 1. *Current status and future trends*; analysis of the current status of maritime sectors and their future trends, analysis of the status of marine habitats and their current and expected future level of protection, and evaluation of major land-sea interactions. This analytical phase included data collection, structuring and mapping.

Phase 2. *Analysis of interactions* (conflicts and synergies) among the different maritime uses and between these uses and the environmental components (habitats and priority species).

Phase 3. *Vision and strategic objectives*; definition of a common vision (10-years horizon) and related strategic objectives for the entire Italian sea space, based on a comprehensive review of existing policies, strategies, plans, and standards at the international, EU and national levels.

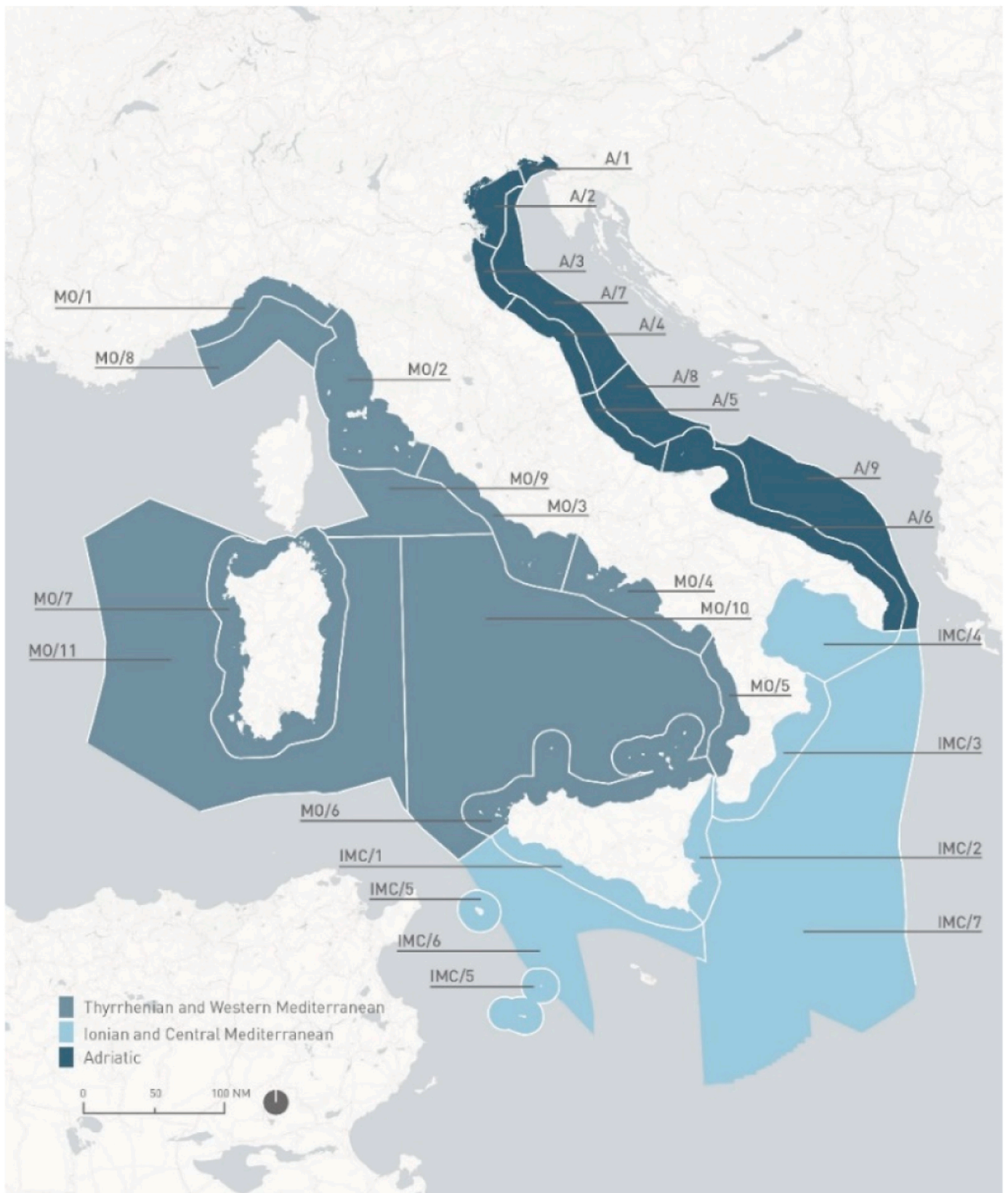


Fig. 1. Italian MSP maritime areas. Each maritime area is divided in subareas, identified with a code (MO = Tyrrhenian and Western Mediterranean, IMC = Ionian and Central Mediterranean, A = Adriatic).

Phase 4. *Strategic planning of subareas*; consistently with the common vision and strategic objectives set in phase 3, a detailed vision and related specific objectives were defined for each SA. The cognitive framework built in phase 1, the outcome of the analysis of use-use and use-environment interactions (Phase 2) and more detailed information gathered in this specific phase were used to delimitate the planning units of each SA (zoning), as described in more detailed in Section 3.3. For each PU, priorities for specific uses (vocations of use) were defined, along with related relevant elements (landscape preservation, environmental protection and interactions among uses) to be taken into consideration. Eventually, measures were identified at the national and sub-national scales, to support the operational implementation of identified vocations of use.

Phase 5. *Monitoring, evaluation and adaptation*; definition of an indicator-based methodology for the MS plans monitoring, evaluation and adaptation, allowing to progressively tailor the plans to future needs (e.g. entirely reviewing the plan, detailing the plan for a specific zone, improving linkages with evolving sector plans, etc.).

Phase 6. *Setting the ground for MSP implementation*; identification of actions for the implementation of the MS plans and for their future consolidation and updating.

Table 2 summarises the levels of application of each phase. Phases 1 and 2 conceptually and operationally interlinked with SEA, which was formally developed in parallel with the MSP process, providing specific inputs, also thanks to the SEA formal consultation process.

3.2. Coordination and operational mechanisms for the MSP methodology implementation

The Technical Committee had the responsibility of ensuring the coherent application of the MSP guidelines and of the six-phase methodology throughout the three plans. This body played a guiding role, relying on the MSP Core Team for operational aspects. The latter was appointed by the Technical Committee and included representatives from some Ministries and the coastal Regions. The overall governance of the MSP process was completed by a Scientific Team, that provided multidisciplinary scientific and technical support to the overall MSP process.

The Scientific Team, Ministries, coastal Regions, and superintendence regional offices of the Ministry of Culture provided data, knowledge and planning inputs along the entire process. These inputs were integrated in the three MS plans by the Scientific Team and checked for coherence and adequacy by the Technical Committee (Fig. 2), thus operationalising co-planning. Most of the coastal Regions set up internal MSP working groups involving different regional departments and having diverse levels of formalisation, giving voice to sectors, local administrations and the civil society. These groups fed the process (with

Table 2

Levels of application of the six-phase methodology for MSP in Italy at the scale of the maritime area, maritime subarea and planning unit.

Phase	Maritime area	Maritime subarea	Planning Unit
1. Current status and future trends	X	X	
2. Analysis of interactions	X	X	
3. Vision and strategic objectives	X		
4. Strategic planning of subareas			
4a. Detailed visions and specific objectives		X	
4b. Zoning		X	X
4c. Plan's measures	X	X	
5. Monitoring, evaluation and adaptation	X	X	
6. Setting the ground for MSP implementation	X		

data and knowledge) and agreed on key planning decisions at the regional level.

3.3. Zoning: delimitation and characterisation of PUs

Phase 4 of the methodology represented the core planning activity of the MSP process. In particular, coastal Regions proposed zoning for the coastal SAs (up to the limit of the territorial sea: 12 NM from the baseline) in close collaboration with the Scientific Team. The latter also developed initial zoning proposals for the offshore SAs (from 12 NM to the continental shelf delimitation). Both coastal and offshore zoning proposals were discussed and agreed upon by the members of the Technical Committee.

For each SA, several PUs were identified; these are homogenous areas for which vocations of use are assigned, aiming to regulate the current and future uses of these areas. PUs were designed considering the following criteria:

- intensity of existing maritime uses and on-going trends of their future evolution;
- envisioned evolution of existing and new uses (e.g. offshore renewable energy, allocated zone for aquaculture, etc.);
- distribution of main environmental components (in line with the SEA analysis), as key habitats (e.g. seagrass meadows, coral reefs, rocky outcrops), Marine Protected Areas (MPAs), Natura 2000 sites and other forms of nature, biodiversity and resources protection (including area-based conservation measures, such as the GFCM Fisheries Restricted Areas and Biological Protection Zones defined at the national level);
- presence of landscape and cultural heritage of significant value, including underwater cultural heritage sites;
- conflicts and synergies among different uses and between uses and the environment and the landscape, detailing at the level of SA the analysis performed in Phase 2 and that part of the SEA process.
- areas with intense land-sea interactions (e.g. major ports, coastal wetlands, river deltas and estuaries, etc.) identified in Phase 1.

Each PU was assigned to one of the following categories, providing an increasing level of exclusive use of the area:

- generic PU: areas where all maritime uses are equally considered, with specific regulation mechanisms aiming to guarantee safety, reduce environmental impacts and favour coexistence between uses. For this typology of planning units, vocations of use are not defined.
- priority PU: areas for which the MS plans identify priorities for existing or developing uses, also indicating the other uses to be guaranteed through specific regulation mechanisms.
- limited PU: areas where a prevalent use is indicated and where other uses may be present - with or without specific limitations - if compatible with the prevalent one.
- reserved PU: areas reserved for a specific use. Other uses are permitted exclusively for the needs of the reserved use or in case of specific concessions provided by the manager of the reserved use.

Priority, limited, and reserved uses represent the vocations of use in the different PUs. They were defined considering the following sea uses: landscape and cultural heritage, environmental protection and natural resources, coastal and maritime tourism, aquaculture, fishery, military defence, energy (including both offshore oil and gas and renewable energy), sand extraction, sediment dumping, maritime safety and security, maritime transport, and research and innovation. Attribute tables were developed, detailing for each PU the following information: category of the PU (generic, priority, limited or reserved); prioritised, limited or reserved uses (i.e. the vocations of use); reasons for the category attribution; other allowed uses and related considerations on uses' regulation; relevant environmental, landscape and cultural

THE GEARS AND WORKFLOW OF THE ITALIAN MSP

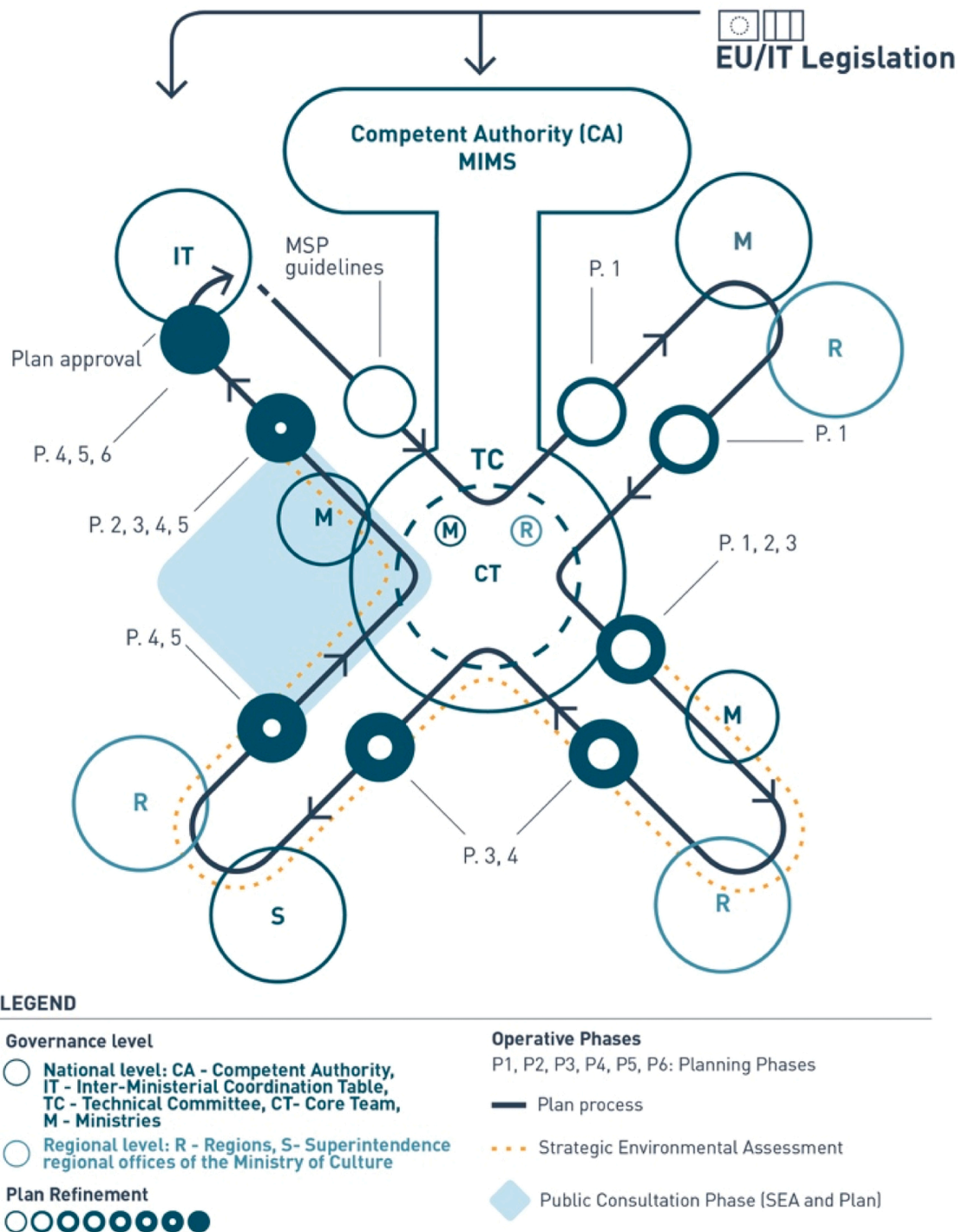


Fig. 2. Coordination and operational mechanisms for the MSP methodology implementation: data, knowledge and planning input were exchanged among the different bodies involved, under the coordination of the MSP Technical Committee.

elements present in the areas and considerations for their protection. In Appendix A, we provide some examples about how above criteria were applied for the identification and spatial delimitation of PUs.

4. Multi-scalar approach to zoning: examples from the Tyrrhenian and Western Mediterranean maritime area

The three MSP maritime areas were divided into 27 subareas (Fig. 1): 9 in the Adriatic (6 coastal and 3 offshore SAs), 7 in the Ionian and Central Mediterranean (5 coastal and 2 offshore SAs) and 11 in the

Tyrrhenian and Western Mediterranean (7 coastal and 4 offshore SAs). We illustrate hereafter how the MSP multi-scalar approach was applied, downscaling from the national level to the detailed zoning of planning units for the case of the Tyrrhenian and Western Mediterranean maritime area. Such results refer to the plans' proposals developed up to September 2022. 178 PUs were identified in the 11 SAs of the Tyrrhenian and Western Mediterranean maritime area: 17 generic, 137 priority, 18 limited and 6 reserved PUs (Fig. 3).

The high concentration of maritime uses, the relatively high number of protected areas and the importance of landscape and cultural assets required a more detailed zoning in the proximity of the coastline, where also data availability is greater than in offshore areas. This determined a number of PUs (165) in the subareas within the 12 NM (represented in orange and indicated as coastal PUs in the upper panel of Fig. 3) much higher than those (13) part of offshore subareas (represented in blue and indicated as offshore PUs in the upper panel of Fig. 3). Offshore PUs are larger than coastal ones.

A significant fraction of the maritime area (40.7%) was assigned to PUs with combined vocations of uses (from 2 to 4 uses). The most frequent combination (in terms of number of PUs) is between "coastal and maritime tourism" and "landscape and cultural heritage", which characterises relatively small PUs close to the coastline (57 PUs, covering only 2.1% of the total surface). These vocations are also combined with "fishery" and "environmental protection and natural resources" in several coastal PUs (17 PUs). The combination involving "environmental protection and natural resources" and "maritime transportation" is particularly relevant for the offshore PUs (4 PUs, corresponding to the 13.5% of the subarea surface), given the presence

of the Pelagos Sanctuary for marine mammals in the northern Tyrrhenian sea, an area of key importance for maritime traffic as well (to this regard it is worth mentioning that a Particularly Sensitive Sea Area was created in the North-western Mediterranean Sea in July 2023, including the entire Pelagos Sanctuary). Single vocations of use are relatively less frequent, with the notable exception of "environmental protection and natural resources" (33 PUs, 34.7%). This single vocation is associated with a high number of small coastal PUs (i.e. overlapping with MPAs, Natura 2000 sites and other forms of protected areas). It also characterises two large offshore PUs. It shall be remarked that in addition to the priority use, several other uses are guaranteed by the MS plan in these two PUs (e.g. maritime transport, maritime safety and security, energy, fishery, research and innovation) through proper measures and regulation mechanisms.

The case of Sardinia exemplifies planning undertaken at the level of a single subarea (MO/7), thus further zooming in along the MSP multi-scalar approach to zoning. The vision defined for the future evolution of this subarea was articulated in 32 specific objectives, referring to a wide range of sectors and cross-cutting issues (Table 3). These objectives were discussed at the regional level with the actors involved in the regional MSP working group and agreed upon with the Technical Committee. They were coherently defined in line with the 44 national-level strategic objectives, integrating and detailing aspects relevant for this subarea. Strategic objectives were defined by the members of the Technical Committee, referring to the targets set by international, European and national policies and to the related Italian pledges.

The vision and specific objectives developed for the Sardinia subarea and the distribution of uses and environmental, landscape and cultural

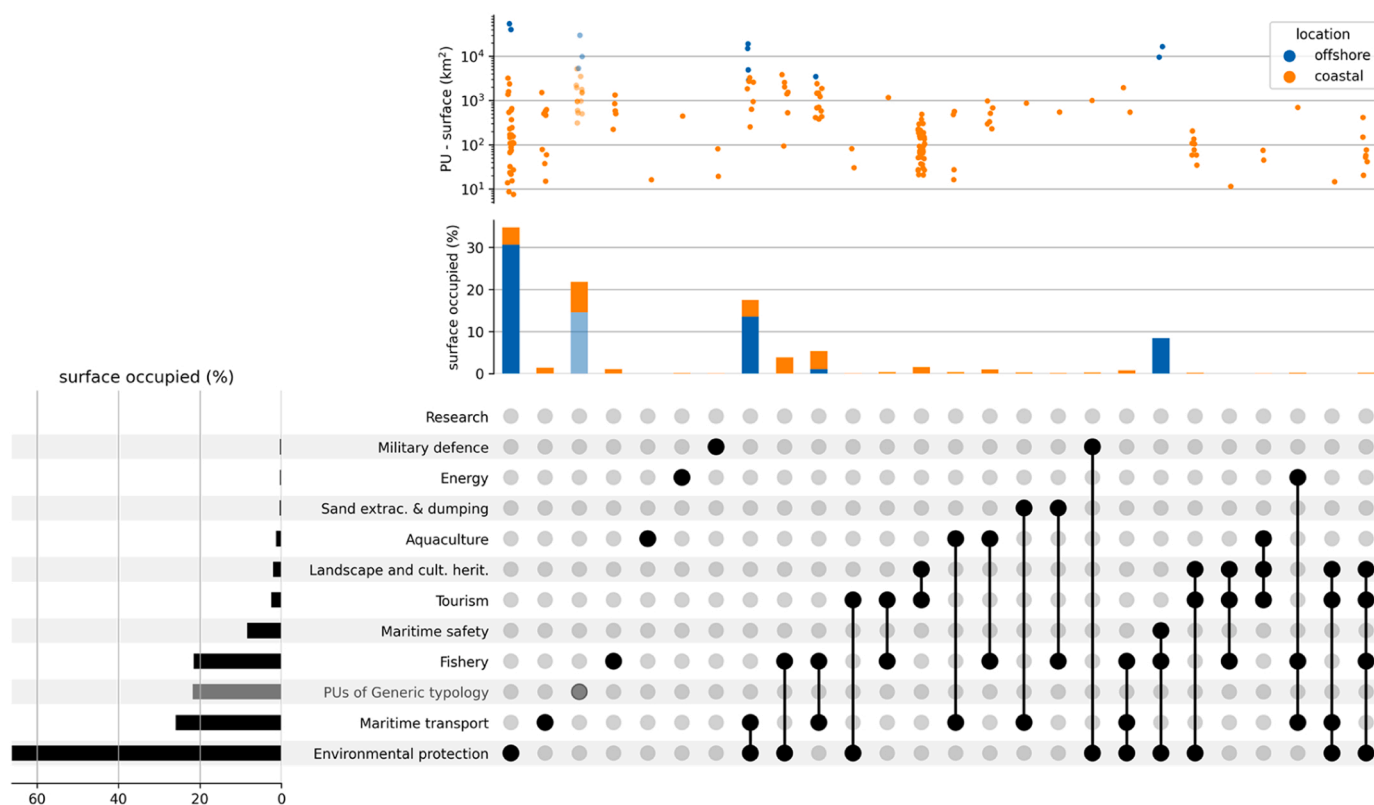


Fig. 3. Characterisation of PUs of the Tyrrhenian and Western Mediterranean maritime area in terms of number, size and assigned vocations of use. The bottom panel provides a common legend for the other three panels: single black dots refer to PUs (of priority, limited and reserved typology) with a single vocation of use, the darker grey dot to PUs of generic typology (where all maritime uses are equally considered), and connected dots to PUs (of priority, limited and reserved typology) with coexisting vocations (of 2–4 uses). The upper panel illustrates the number (each orange dot represents a coastal PU, while each blue dot represents an offshore PU) and size (in km²) of PUs with single and coexisting vocations as well as of those categorised as generic. The panel in the middle shows the surface assigned to a single vocation of use, to combinations of different vocations and to the PUs of generic typology, expressed as percentage of the total surface of the maritime area. Finally, the panel at the bottom left shows the surface (still expressed as percentage of the total surface of the maritime area) assigned to each vocation of use, independently whether this is combined or not with others. PU = planning units.

Table 3

Number of strategic objectives (national level) and specific objectives defined for the Sardinia subarea (MO/7) for cross-cutting (CC) issues and sectors (S).

Sectors (S) and cross-cutting issues (CC)	Strategic objectives	Specific objectives
CC - Sustainable development	4	1
CC - Environmental protection and natural resources	5	4
CC - Landscape and cultural heritage	6	3
S - Maritime safety and security	2	2
S - Fishery	6	2
S - Aquaculture	2	3
S - Maritime transport	5	3
S - Energy	5	3
S - Coastal defence	3	2
S - Coastal and maritime tourism	3	4
S - Research and innovation	3	5

heritage informed the delimitation of PUs (Fig. 4). These planning elements were defined to be coherent with the zoning of the entire Tyrrhenian and Western Mediterranean maritime area. They were discussed at the regional level and agreed upon with the Technical Committee to be then finally included in the overall plan.

A total of 40 PUs were identified, including 3 generic, 28 priority, 7 limited, and 2 reserved ones. The preservation of the high-quality coastal and marine environment is particularly important for Sardinia, also due to its relevance for tourism. A high number of PUs include priority or limited vocations for “environmental protection and natural resources” due to the presence of 6 MPAs, one national park (the Asinara island in the northwest), several coastal and marine Natura 2000 sites and areas where environmental protection is further pursued through planned actions (e.g. proposals for new Natura 2000 sites). 20 PUs of priority type consider a multiple vocation. One of the most relevant combinations involves “coastal and maritime tourism” and “landscape and cultural heritage”, which characterises several PUs extending along the coastline. The “maritime transport” priority is in some cases associated with those of aquaculture (PUs 04 and 23) and fishery (PU 15). Important traffic corridors (to the Olbia port) were considered to delimit a PU with priority vocation for “maritime transport” (PU 12), located between others focusing on “environmental protection and natural resources”. Restricted uses were assigned only to areas affected by frequent Navy operations (PUs 29 and 34). Based on the Region’s definition of Allocated Zones for Aquaculture, the envisioned extension of aquaculture brought the allocation of 8 PUs for this use (in combination either with “fishery” or “maritime transport”).

5. Implementing a multi-scalar approach to MSP: key features and challenges

The need for a multi-scalar approach to MSP in Italy is driven by the geographic, environmental and socio-economic heterogeneity of the Italian coastal and marine space. Equally, the articulated distribution of competencies on coastal and marine resources has required the planning process to act at different governance levels. This section discusses how the Italian process addressed some of the typical components of a multi-scalar approach to MSP, reflecting on challenges and persisting obstacles.

5.1. Combining nationally and sub-nationally driven approaches

The Italian multi-scalar MS plans can be considered the results of a co-creation process moving into two parallel directions across different levels. A prevalent nationally-driven approach was applied to build a common knowledge framework on the state of the marine environment and seas uses (Phases 1 and 2; in line with SEA), draft a shared vision and develop strategic objectives (Phase 3). A parallel approach mainly driven by the sub-national level, enabled the identification of a specific

vision and objectives for each SA, the delimitation of PUs and the definition of related vocations of use (Phase 4; as exemplified in the cases of Fig. 4). This second approach relied on the key contribution of coastal Regions as far as subareas within the territorial sea are concerned. In a multi-level perspective, the two approaches are expected to integrate [42–45]. In the case of Italy, the two streams haven’t been working in silos, but have fed each other by vertical integration across levels throughout the entire process (Fig. 2). The involved coastal Regions contributed to data and knowledge collection. Together with national authorities and the Scientific Team, they co-created the common vision and strategic objectives orienting the MS plans. These were then translated and detailed into specific visions and objectives as well as in zoning options. Zoning performed at the subarea level generated feedback for the refinement of the strategic components of the MS plans, pertaining to the entire maritime area.

Open challenges still remain in transforming general national strategic inputs in specific provisions and measures at the sub-national and local level. On the other hand, regionally-driven approaches demonstrated to have different levels of maturity, depending on several factors, such as knowledge gaps, lack of awareness or political will, fragmentation among interests at the local level, etc. Improvements are expected through monitoring and adaptation, building on the framework now set in place, in particular referring to some specific measures (i.e. to develop guidelines on specific issues, fill knowledge gaps, establish permanent working groups on key MSP-related challenges, etc.) established in the MS plans for a more robust multi-level decision-making.

5.2. Operational integration across scales and sectors

Co-planning through a multi-scalar approach implies vertical and horizontal integration [46–48]. Integration is strictly related to the ability of MSP to enable the sustainable management of use and marine resources across scales [49]. The adopted multi-scalar approach aimed at developing coherent plans for the three maritime areas, resulting from the integration of local and regional planning proposals developed for each subarea. MSP was undertaken at the lowest appropriate level (that of PUs), coherently with the common principles, vision and strategic objectives set for the entire national level. Integration and coherence have been sought also horizontally: (i) at the national level involving (through the Technical Committee) all Ministries with competencies on the marine space, and (ii) at the regional level merging competencies of different regional departments and those of regional offices of some national Ministries (i.e. superintendence regional offices of the Ministry of Culture). The existence of previous MSP experiences supported these mechanisms, while the availability of MSP-related data, knowledge and skills (also acquired through EU or nationally co-funded projects) facilitated the work and acted as a catalyst for the creation of some of the regional MSP working groups (see for example [50,51]). The great majority of coastal Regions sought a policy endorsement of the working groups’ results. The vision, specific objectives, zoning options and measures proposed by the regional administrations have been often formalised through regional resolutions.

Considering general public interests expressed mainly through the strategic objectives, potential tensions among sectors were addressed balancing their different power according to vocations of use attributed to the different PUs. This allowed going beyond “strategic sectoral planning” [45]. A similar approach was applied to balance the tension between blue economy and environmental and biodiversity values. For several cases, more in-depth analyses were identified as plans’ measures, to further improve coherence among uses and between uses and environmental protection.

5.3. Implementing a structured multi-level governance for MSP

Integration across scales and sectors should involve different national, regional and even local authorities, requiring the planning

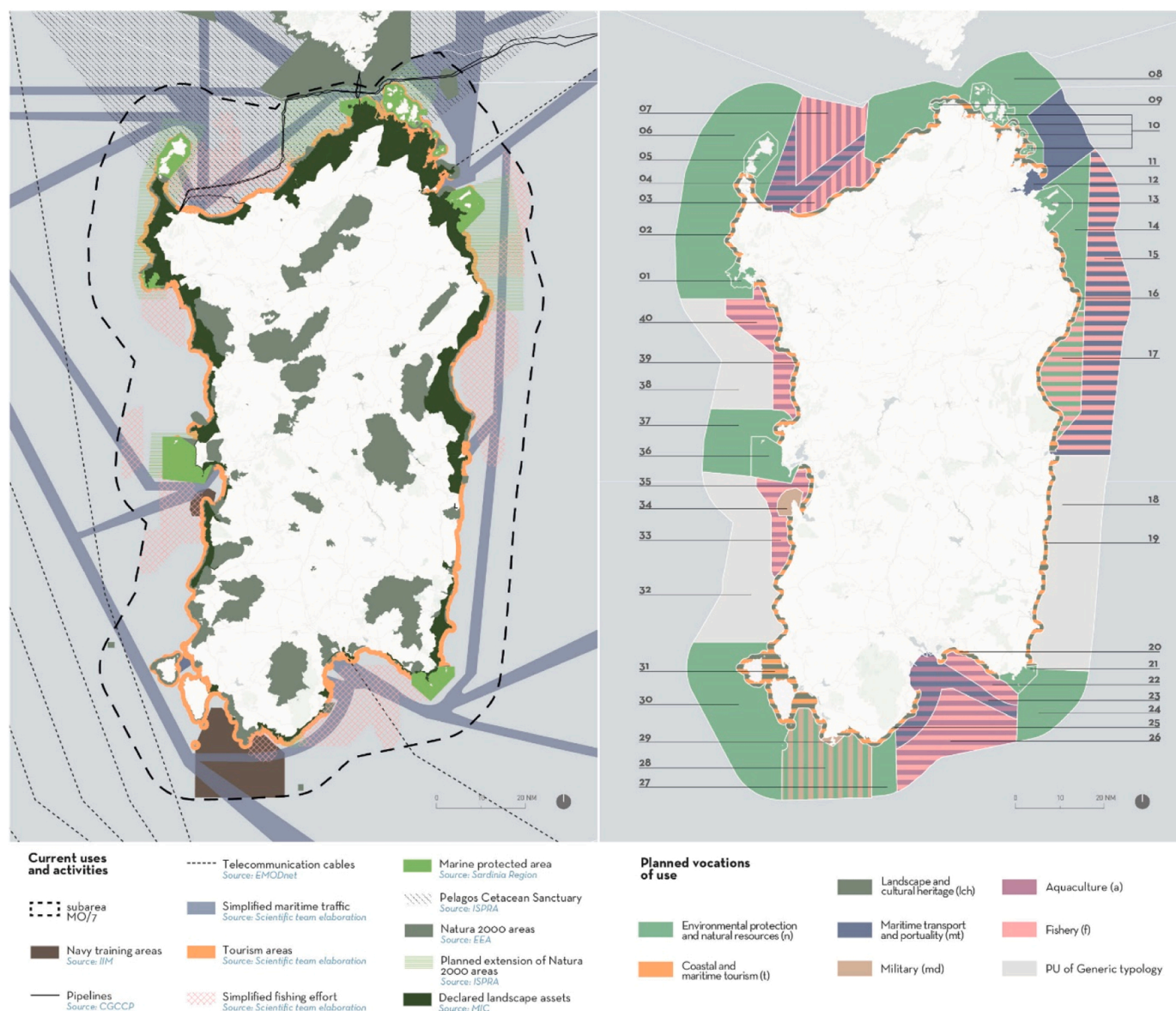


Fig. 4. Sardinia maritime subarea MO/7: existing maritime uses and activities (left) and defined planning units and related vocations of use (right). PUs present the following feature (the capital letter refers to the PU typology, while the letter in brackets to the planned priority, limited or reserved uses): 01|L (n), 02|P (f, a), 04|P (mt, a), 05|L (n), 06|P (n), 07|P (f, a), 08|P (n), 09|L (n), 10|L (n), 11|P (lch, t), 12|P (mt), 13|L (n), 14|P (n), 15|P (mt, f), 16|P (lch, t), 17|P (f, n), 18|G, 19|P (lch, t), 20|P (lch, t), 21|L (n), 22|P (f, a), 23|P (mt, a), 24|P (n), 25|P (lch, t), 26|P (f, a), 27|P (n), 28|P (n, md), 29|R (md), 30|P (n), 31|P (lch, t), 32|G, 33|P (f, a), 34|R (md), 35|P (lch, t), 36|L (n), 37|P (n), 38|G, 39|P (lch, t), 40|P (f, a). Acronyms about PU typology: G = generic use, P = priority use, L = limited use, R = reserved use. Acronyms about use types: landscape and cultural heritage (lch), environmental protection and natural resources (n), coastal and maritime tourism (t), aquaculture (a), fishery (f), military defence (md), and maritime transport (mt).

process to act at different governance levels. The Italian MSP process provides a great opportunity to progress further in this direction by consolidating a structured multi-level governance for MSP, around and beyond the present governance mechanisms (i.e. the Inter-Ministerial Coordination Table on MSP, the MSP Technical Committee, the MSP Scientific Team, and the regional working groups on MSP). In Italy, this process has just begun to move in this direction. It is still coping with obstacles and challenges related to the institutional set-up: bureaucratic fragmentation, unclear overlapping of competencies, sometimes limited willingness to collaborate between public entities, and the lack of full empowerment of some coordination mechanisms set at the national and regional levels [48,49,52]. Lack or limited availability of skills and expertise was recognised as an additional constraint along the Italian MSP process. In some cases, the involvement of national and regional authorities in MSP required an initial effort of awareness raising, if not

of full capacity building. Lifelong learning and capacity building were recognised as fundamental in supporting multi-scalar MSP. Project-based experiences provide a key role in building a common ground of knowledge, principles and values, which can act as drivers for the statutory process of maritime spatial planning [53].

5.4. Scalability and flexibility

The Italian MS plans are strategic ones, providing binding directions for the management of the Italian sea space, rather than detailed and regulatory indications. Coherently with their strategic nature, MS plans were drafted through a scalable and flexible approach. This is reflected in three major components of the MS plans. First, a structure of nested planning objectives allowed for specific targets of each subarea to detail the strategic ones identified at the national level, ensuring mutual

coherence. Secondly, the scalability and flexibility of the adopted MSP methodology allowed to plan different areas with site-specific resolution. The number and size of the PUs vary (Fig. 3) according to the characteristics of the considered subarea, the ambition of the specific objectives set for each subarea and the data and knowledge availability. Equally, the zoning resolution also varies with a given subarea (as exemplified in Fig. 4) in consideration of local specificities. Thirdly, an integrated set of national and subarea level measures was defined (Phase 4) to implement the vocations of use set in the plans, improve the coexistence between uses, contribute to the good environmental status and ensure the compatibility of uses with the preservation of the landscape and cultural heritage. Subarea level measures integrate the overarching measures set at the national level.

Scalability and flexibility are not only essential to take local specificities properly into consideration, but also to incorporate new knowledge and facilitate the work of progressive adaptation of the MS plans [46,54–56], including possible detailed zoning for specific areas or for specific sectoral aspects. Scalability and flexibility can also allow the transition from a strategic planning approach (as the one adopted by Italy) to more prescriptive planning [57], e.g. through change in zoning (e.g. exact allocation of areas to specific uses or introduction of use bans) or by new measures specifying how uses should be carried out. Open challenges in the full application of a scalable approach to MSP are mainly related to the difficulty of identifying multi-level SMART (Specific, Measurable, Achievable, Relevant and Time-bound) [9,55] indicators and targets, to be used in the monitoring and adaptation process (as defined in Phase 5). Such difficulties are well known and common to several MSP experiences [58–60].

5.5. Integration of data and knowledge at different resolution

The use of best available data and knowledge for science-based decision making is one of the key pillars of the EU approach to MSP (art. 10 of the MSPD). Under a multi-scalar approach, data with different characteristics (spatial domains, spatial and temporal resolution, uncertainty, completeness of description, etc.) are integrated to provide a coherent picture [8,61,62]. In the case of Italy, data were initially collected within Phase 1 to provide a common picture of the spatial and temporal distribution of uses and environmental components at the scale of the maritime area. Within Phase 4 local and higher resolution data were collected, also highlighting major existing gaps (e.g. about underwater cultural heritage, seabed habitats or small-scale fisheries). Main gathered data and metadata were structured in the National Portal of the Sea. The consolidation of this tool with other data is of key importance. It should progress hand in hand with the harmonisation of models for input and output data for MSP (as for example advanced by the Technical Expert Group on “Data for MSP” [63,64]) and their metadata (e.g. MSP Knowledge Catalogue - MSPKC [26]), as well as with its integration with geoportals and other data sharing infrastructures available at the European (e.g. EMODnet Human Activity [65]), transboundary (e.g. GAIR – PORTODIMARE for the Adriatic region [26]), and sub-national levels. Sharing should extend beyond data, and also deal with science-based tools for MSP (e.g. Tools4MSP geoplatform, including tools for cumulative effects assessment and marine use conflict analysis) [66,67].

5.6. Multi-level stakeholder engagement

Multi-scalar co-planning requires a diverse range of stakeholders – acting at different levels – involved and solicited to take part in MSP [8, 44,56,68], possibly with similar resources and capacity of influencing the process. Actually, multi-scalar approach is a powerful tool towards effective stakeholder involvement. National and regional authorities as well as academia and research institutions (i.e. the Scientific Team) have been full part of the Italian co-planning process. Up to now local authorities, representatives of the sectors and the civil society have not

been sufficiently involved, despite several local initiatives, bilateral or multilateral meetings, research and pilot projects, scientific workshops, and informative events. The public consultation on the MS plans and the SEA process has partially contributed to fill this gap.

As underlined by other experiences and analysis [45,48,49,56,69], this gap is the combined effect of several constraints, dealing with: time, resource availability, communication, awareness raising, full understanding of MSP, attitudes, responsibilities, interests, unequal power of the involved actors, and fragmented governance. The first Italian MS plans provide a starting point towards proper multi-level stakeholder engagement, to move away from project-based or circumstance-based consultations to more effective, formalised and institutionalised processes directly linked to MSP [69]. To this regard, the Italian plans include measures aiming at a long-term mechanism of multi-level engagement, to be strengthened in the next phases of the Italian MSP. Such mechanism has to be based on the well-known cornerstones of stakeholder participation: effective communication, trust building and transparency, inclusivity and empowerment of all stakeholders, merging of top-down and bottom-up approaches, integration across sectors and levels, and adaptation of the form of participation to the specific phase and context [56,70].

6. Conclusions

General principles and features of a multi-scalar approach to MSP were adapted and applied to prepare the national MS plans in Italy. This approach allowed to consider the diverse spatial scales pertaining to marine ecosystems, sea uses and anthropogenic pressures as well as the multi-levels administrative and governance system in place [11]. As in the case of other national MS plans (e.g. [71,72]), identified PUs vary in form and dimension, with a decrease in spatial resolution from coastal to offshore areas. A peculiarity of the multi-scalar approach adopted in Italy is that coastal Regions were directly involved in the planning process. They were responsible of proposing objectives, zoning, vocations of use and measures for the territorial sea facing their coasts. This is a novelty when compared to other national plans. Such an approach required a great effort on vertical and horizontal integration, which has been essential to build a common ownership on the Italian MS plans, improve their internal coherence and form the basis for future regular interactions with stakeholders across spatial scales. Based on the Italian experience, we can derive the following lessons learned about the application of a multi-scalar approach to MSP:

- Proper time and resources should be dedicated to the co-development and testing of the MSP methodology to improve its understanding and coherent application. This is not only important at the initial stage, but during the entire process, as it happened for example in the case of the zoning methodology applied specifically in Phase 4.
- All involved levels are expected to jointly contribute to data collection and knowledge creation. This is important to come to a shared agreement on the knowledge basis to be used for the plan development and overcome problems related to the merging of data with different resolutions. Proper integrated data management and shared access to data should be implemented.
- Spatial planning coherence between bordering areas is the essence of an MS plan addressing different geographic scales. Several aspects had to be considered in the case of Italy: coherence among planning units of the same subarea, coherence between bordering (coastal and offshore) maritime subareas, overall coherence at the level of the maritime area and among the three maritime areas, land-sea coherence, without forgetting coherence at the transboundary level non-specifically addressed in this paper. This is a complex and long-term process. It requires subsequent refinements, also beyond the first release of the MS plan. Multi-scalar coherent planning is a learning-by-doing exercise, which needs a long-term mandate and

empowerment, supported by adequate technical and long-term funding.

- Coherence at the strategic level is equally important. The Italian experience highlights that the co-creation of a common vision and of a nested system of objectives is of paramount importance. The integration into the plans of international, European, national and subnational commitments is essential to base the vision and objectives on a common ground and ensure that MS plans are coherent with other relevant policies, programmes and plans.

As pointed out by the EC COM (2022) 185 [73], “the implementation of maritime spatial planning in the EU will not end after the adoption of the first wave of plans” (p.15). In the coming years, countries are expected to continue working on MSP, also to better embed the goals of the European Green Deal and of the Sustainable Blue Economy Strategy [1] in their plans. While it is recognised that there is no best or single method for undertaking strategic MSP [9,57], in agreement with Lagabriele et al. [11], we sustain that the adoption of a multi-scalar approach to MSP since its beginning can improve the efficiency of the planning process at the later implementation stage. Among other benefits, this approach is expected to allow for the flexibility of monitoring and for the plan’s adaptation across scales and sectors.

To give real efficacy to its multi-scalar approach, Italy should work on several aspects in the next MSP phases. Among the others, it should progressively consolidate the multi-level governance set for the MS plans design. Around the core of the MSP Technical Committee and the (formal and informal) MSP working groups set at the sub-national level, a larger group of stakeholders (representing local administrations, marine sectors, NGOs, academia and research institutions, and civil society) should be structurally aggregated towards the establishment of an Italian MSP community of practice. The Scientific Team involved in the Italian MSP ensured continuous support to the process, under the responsibility of the competent authority. This experience should be scaled-up towards the establishment of a stable science-to-policy (and to society) interface aimed at applying scientific research results within the MSP process as well as at directing the marine and coastal research on MSP priority needs.

The future evolution of the Italian MSP process requires novel analysis and studies on specific aspects, e.g.: (i) climate proofing of the MS plans (considering effects on both maritime sectors and on ecosystems, habitats and species), (ii) detailed assessment of the contribution of the MS plans to climate neutrality, (iii) detailed analysis of land-sea interactions and coherent land and sea planning, (iv) integration of the spatial demand of emerging sectors of the blue economy (e.g. offshore renewable energy, new allocated zone for aquaculture, blue biotechnologies, etc.) within the MS plans, (v) preservation of landscape and (underwater) cultural heritage through MSP, and (vi) contribution of the MS plans to the targets set by the EU Biodiversity Strategy for 2030 on the marine environment. All these aspects have relevance across scales, confirming the importance of a multi-scalar approach to MSP for Italy. The implementation of the EU Green Deal and of the

National Recovery and Resilience Plan provides tremendous opportunities to make MSP a real game changer for the sustainable management of the Italian sea.

CRediT authorship contribution statement

Emiliano Ramieri: Conceptualization, Methodology, Investigation, writing. **Martina Bocci:** Methodology, Investigation. **Daniele Brigolin:** Methodology, Investigation, writing. **Pierpaolo Campostrini:** Methodology, Supervision. **Fabio Carella:** Methodology, Investigation, Writing, Visualization. **Amedeo Fadini:** Methodology, Investigation, Data curation. **Giulio Farella:** Methodology, Investigation. **Elena Gissi:** Methodology, Investigation, Writing. **Fabrizio Madeddu:** Investigation. **Stefano Menegon:** Methodology, Investigation, Data curation. **Micol Roversi Monaco:** Methodology, Investigation, writing. **Francesco Musco:** Methodology, Supervision. **Folco Soffietti:** Methodology, Investigation. **Laura Barberi:** Methodology, Supervision, **Andrea Barbanti:** Supervision, Conceptualization, Methodology, Investigation, Writing.

Declaration of Competing Interest

No conflict of interests to declare.

Data Availability

The data that has been used is confidential.

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Appendix A. Examples of identification and delimitation of PUs

Fig A1 provides examples about how criteria for the identification and spatial delimitation of PUs were operationally applied in cases of the Tyrrhenian and Western Mediterranean maritime area, considering in particular three typical situations.

The cases represented in Fig. A1a, b, c and d come from the Tuscany coastal subarea (MO/2) and provide examples of PU’s delimitation based on the analysis of the interactions between one principal use - “environmental protection and natural resources” - and others occurring in the same area. In the case of Fig. A1a, the boundaries of the existing MPAs were maintained to define three PUs with “environmental protection and natural resources” as prevalent vocation. The PUs labelled as 1 and 3 in Fig. A1a (Capraia and Secche della Meloria MPAs) were categorised as of limited typology, while that labelled as 2 (Gorgona MPA) was categorised as of reserved typology. A relevant fraction of the MO/2 subarea is of high relevance for the conservation of the bottlenose dolphin (Fig A1b). “Environmental protection and natural resources” was therefore prioritised also in other PUs, however taking in consideration other concomitant uses. In particular the traffic routes flowing into and from the Livorno harbour contributed to the delimitation of a PU where both “environmental protection and natural resources” and “maritime transport” were considered priority uses (Fig A1c).

For the two PUs located on the eastern and western sides (labelled as 1 and 2 in Fig. A1d) of this traffic corridor, priority was assigned to “environmental protection and natural resources” in combination with “fishery”.

The second set of cases (Fig. A1e and A1f) provide examples about the delimitation of PUs of generic category, where all maritime uses are equally important. In front of the northern part of the Lazio coastal subarea (MO/3), a generic PU (Fig. A1f) was identified due to the concomitant occurrence of multiple uses (fishery, military defence, sand extraction, sediment dumping, landscape and cultural heritage), all with similar priorities. A different situation characterises the PU of generic typology (Fig. A1e) located along the western coast of the Sardinia subarea (MO/7). Currently, this area does not host major uses and a clear pattern for its future utilisation is not defined yet. A generic PU was delimited to preserve this marine space for future evolution, including environmental protection and preservation of the landscape and seascape for the next generations.

The third case (Fig. A1g and A1h) provides examples about how the pre-existence of a specific use or relevant environmental characteristics was addressed in zoning. The example of Fig. A1g focuses on “military defence” (specifically Navy operation) and refers to an area located off the south-western coast of Sardinia, included in the subarea MO/7. Most of the area is used by the Navy only for a few days and is open to the public during the rest of the year. This led to the identification of a PU (delimited in blue in Fig. A1g) where “military defence” is a priority use, however in combination with “environmental protection and natural resources” to promote both nature protection and restoration. A smaller area is of exclusive military use and was therefore delimited as a reserved PU for “military defence” (small blue polygons in Fig. A1g). The analytical phase of the MSP process highlighted the importance of deep-sea habitats, both for biodiversity conservation and the sustainable management of fishery resources. In the case of the southern part of the Lazio coastal subarea (MO/3), the bathymetry provided by the Italian Navy Hydrographic Institute was used as a major criterion to delimit a PU deeper than 200 m (and including areas below 1000 m) where priority was assigned to “environmental protection and resource management” (Fig. A1h).

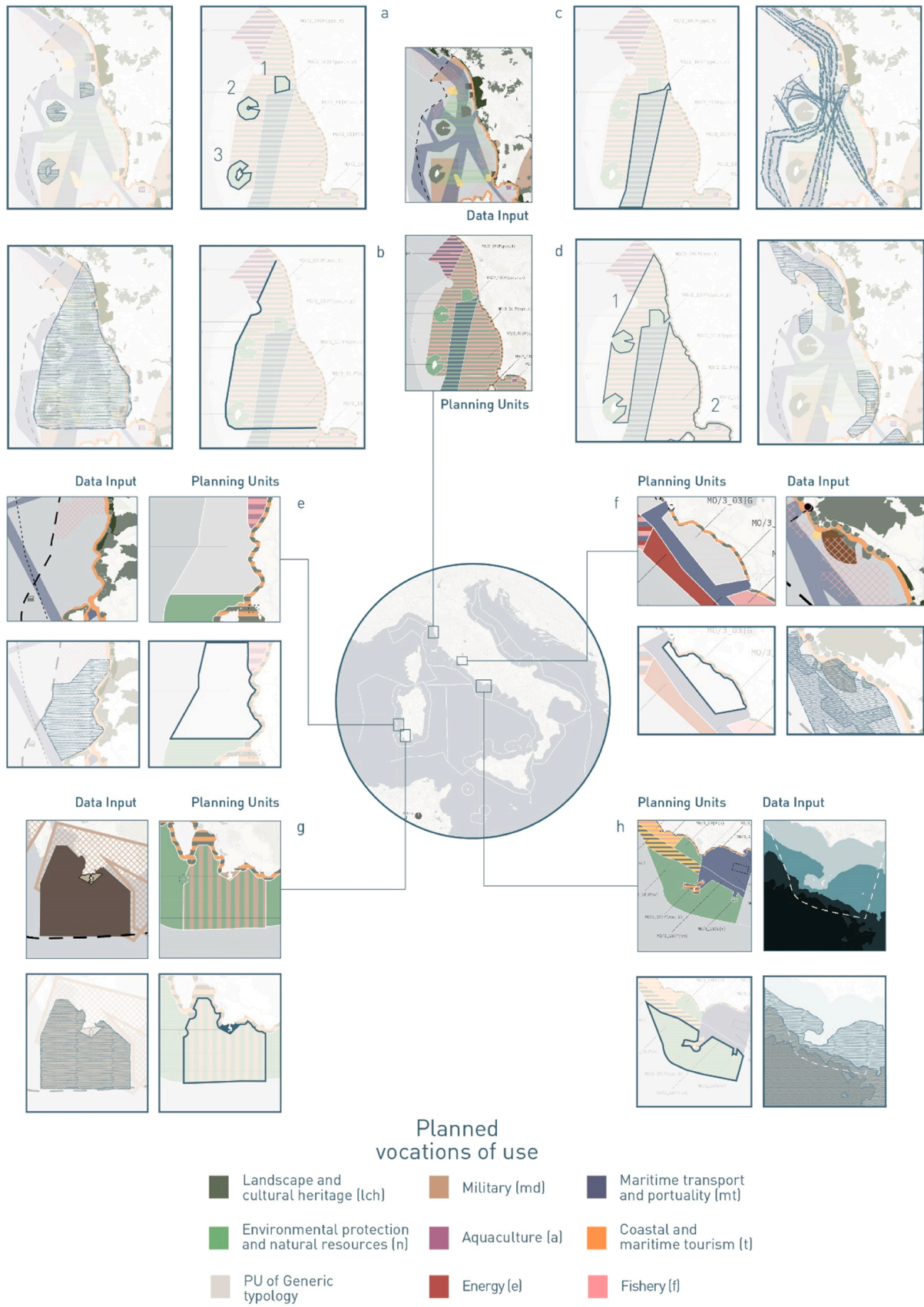


Fig. A1. Examples of detailed zoning (delimitation of planning units) in the Tyrrhenian and Western Mediterranean maritime.

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