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Toward downscaling maritime spatial planning: a regional framework for tailoring actions to local needs

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Now that most national maritime spatial plans have been prepared in accordance with Directive 2014/89/EU, challenges and uncertainties persist regarding flexibility to address socio-economic, environmental, and governance specificities at regional and local levels. This study proposes a methodological framework for integrating regional needs into national maritime spatial planning (MSP) processes, thereby enhancing the role of sub-national actors in MSP and the effective implementation of actions. The research employs a comparative analysis of eight case study regions from five European countries carried out within the REGINA-MSP (Regions to boost National maritime spatial planning) project. These were selected to encompass diverse governance structures, competent authorities, procedural approaches (from strategic to more detailed plans), and stages of MSP implementation (including recently adopted, long-established, and plans pending adoption). The findings highlight persistent challenges in regional and sub-regional integration, including gaps in stakeholder participation, data fragmentation and limited coherence between national strategies and regional and local needs. The proposed framework provides a structured, participatory approach to identifying regional needs, translating them into actionable measures, and prioritizing interventions based on their strategic relevance and urgency. This study contributes to improving the adaptability of MSP to different governance settings and provides a replicable methodology for enhancing regional engagement in MSP.

KEYWORDS
management actions, maritime spatial planning, multi-level governance, participatory process, regional MSP framework

1 Introduction

Maritime Spatial Planning (MSP) is valued both as a strategic tool and as a participatory process for promoting the sustainable use of marine resources while addressing competing priorities such as environmental protection, economic growth, and social equity (Kirkfeldt and Frazão Santos, 2021; Alder and Castaño-Isaza, 2022; Reimer et al., 2023).

Some of the earliest maritime spatial planning initiatives emerged at regional and local scales. Notable examples include the zoning system introduced within the Great Barrier Reef Marine Park in Australia, which provided important lessons for the subsequent development of formal MSP frameworks (Day, 2002; Kenchington and Day, 2011; Day et al., 2019; Carella et al., 2025). Despite the origins, MSP is now most commonly led by central government, and its management and planning provisions are usually designed to serve national priorities, needs and trends. As a result, maritime spatial plans can lack flexibility and the level of detail to account for the coastal administrative regions' ecological, socio-economic, and cultural characteristics (Guerreiro, 2021; Zuercher et al., 2022b; Bellanger et al., 2020; Gambino et al., 2024). Whilst the guidelines and provisions included in most maritime spatial plans usually have a strategic nature—which allows the plan to be applied across multiple and diverse decision-making processes used to manage the wide variety of marine activities they address—this approach can raise questions about the scalability and adaptability to regional contexts (Ashworth, 2023; Reimer et al., 2023; Kidd et al., 2020). A further challenge concerns the distribution of responsibilities among different government levels, and more specifically at the regional EU NUTS 2 level. For example, in some countries, regional/local authorities have formal legal and/or administrative competencies over specific maritime sectors (e.g., Finland), while in others, responsibilities are either shared (e.g., Italy, Spain, and Ireland) or fully centralized and lie mainly with the national authorities/government (e.g., Greece). This variation leads to differences in both the level of involvement of regions within the MSP process and how effectively regional needs are integrated into maritime spatial plans (Flannery et al., 2019; Walsh et al., 2024; Zuercher et al., 2022a).

Evidence from recent studies suggests that the implementation of MSP at regional and local levels remains uneven, depending on institutional capacities, planning traditions and local political commitment (Fabbri et al., 2025). This highlights the need for mechanisms capable of bridging national MSP objectives with regional and place-based priorities. In this context, the principle of spatial subsidiarity has emerged as a key component of multilevel MSP governance, whereby spatial challenges should be addressed at the lowest appropriate territorial level while remaining aligned with broader national and transnational objectives (Matczak et al., 2014; Zaucha, 2014; Riddervold, 2023). This principle underscores the importance of strengthening the role of regional and local actors in translating strategic MSP objectives into place-based planning solutions and implementation measures.

These challenges are further exacerbated by insufficient participation and lack of inclusiveness of regional stakeholders in the MSP process (Wilke, 2023; Papageorgiou et al., 2024), which undermines the integration of local perspectives into planning (Eger et al., 2021; Gonçalves and Pinho, 2024; Lukambagire et al., 2024). In such a situation, MSP strategies and decisions made through implementation of the MS plan may be inadequate to local contexts (van den Burg et al., 2023).

Addressing these gaps—such as limited consideration for regional decisions, the complex integration of local socio-economic and ecological characteristics, and inadequate stakeholder participation—requires innovative governance models to bridge the gaps between national strategies and local implementation, emphasizing flexibility, inclusivity and adaptability to align MSP objectives with local realities (Zaucha and Kreiner, 2021; Bonnevie et al., 2023; Reimer et al., 2023; Stalmokaitė et al., 2023; de Vries et al., 2024; Stelzenmüller et al., 2021).

The overall goal of this research paper is to propose a methodology supporting the design and upgrading of sound MSP frameworks that enable the integration of regional perspectives into overarching nationally driven MSP process. In this article, the term "MSP framework" refers to the combination of institutional, legal, and procedural arrangements—whether formal or informal—that support the design, implementation, and/or adaptation of MSP at the regional governance level. Additionally, in some contexts where MSP is not yet in place, such a framework can serve as a strategic instrument to foster regional engagement from the early stages of the process and drive more inclusive MSP.

Building upon the overall objective, the study:

i) Identifies regional and local needs and priorities related to marine planning and management within eight case studies through the application of a standardized analytical framework.
ii) Defines tailored actions that translate regional and local needs into applicable measures, ensuring their coherence with MSP processes through stakeholder input.

The methodology proposed in this study to structure the regional framework for MSP processes was designed to be easily transferable across countries, facilitating the implementation of current national maritime spatial plans while strengthening the role of regions in the definition of national plans.

2 Methods

2.1 Regional case studies and institutional responsibilities

Eight case studies across two sea basins—the Atlantic and the Mediterranean—were selected, as part of the REGINA-MSP project, funded by the European Maritime, Fisheries and Aquaculture Fund (EMFAF) (2022–2024). The case study regions (NUTS 2 level) are Murcia and Galicia in Spain, Northern Sardinia in Italy, Provence-Alpes-Côte d'Azur and Pays de la Loire in France, Crete and Central Macedonia in Greece and County Mayo in Ireland (see Figure 1; Appendix 1). All these present a diverse range of socio-economic and environmental contexts across the Mediterranean and Atlantic basins. The selection reflects a range of MSP implementation stages, encompassing established plans, recently adopted plans and plans still in the process of

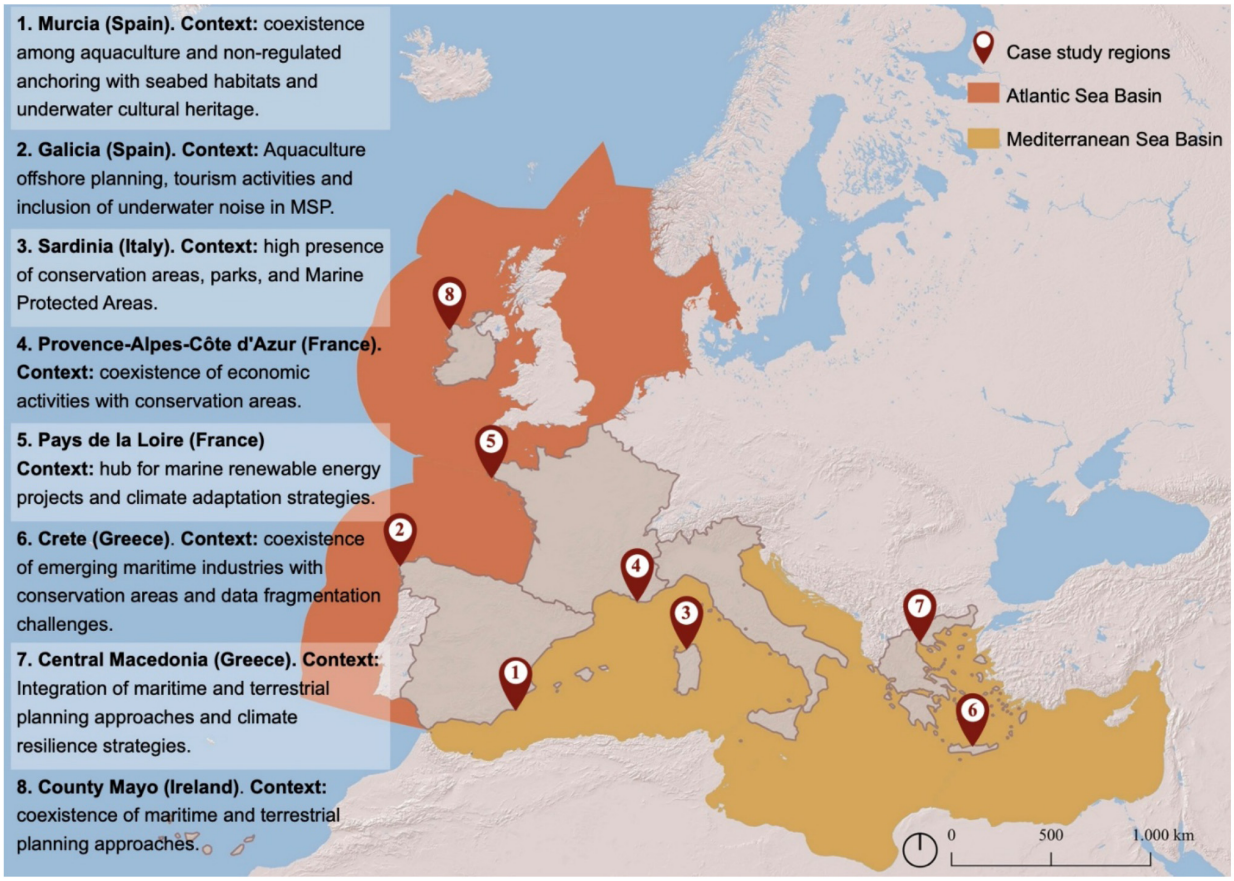


FIGURE 1
Distribution of the eight regional case studies within the two basins. Highlights of the case studies are provided on the left.

formal adoption. Governance structures vary significantly among case studies, with some regions following centralized national guidance and others holding sectoral planning competencies that enable them to align local priorities with national and EU strategies (see Table 1). Finally, selected regions shown an active involvement in MSP, demonstrating a strong commitment to regional MSP development.

2.2 Methodological approach

The methodological approach comprises three sequential phases (see Figure 2), ensuring a structured and evidence-based process for developing targeted actions to address regional MSP needs. The first phase focuses on identifying regional priorities through a systematic review of spatial plans, policies and datasets, complemented by stakeholder contribution to enrich and validate the findings. Building on this assessment, the second phase translates the identified needs into concrete actions, ensuring that they effectively address regional specificities. The final phase prioritizes these actions based on their strategic relevance, potential impact and ability to address multiple needs simultaneously, creating a coherent framework for implementation. In line with the principle of spatial subsidiarity (Matczak et al., 2014; Zaucha, 2014), the process integrates regional knowledge, expert input and literature review, stressing the importance of knowledge systems and stakeholder engagement as key sources of information for the analysis. The design of the process was influenced by the work by Axon and Collier (2023) and Flannery (2019), and by recent regional studies carried out in the Baltic and Black Sea (Stancheva et al., 2022; Stalmokaitė et al., 2023).

The expert knowledge is drawn from the study authors, who are affiliated with project partners, including research institutes, universities and national ministries, and is further strengthened by an extensive literature review, including scientific findings and management policies. This basis ensures scientific validity and alignment with established policy frameworks and MS planning. In parallel, local and regional knowledge is gathered from representatives of regional authorities and sector-specific stakeholders, providing practical insights that reflect territorial dynamics. Targeted interviews and dedicated workshops facilitate a structured dialogue, ensuring that proposed actions are evidence-based, contextually relevant and widely supported. An overview of the stakeholder categories involved across the different case studies is provided in Appendix 1.

2.2.1 Phase 1. Identification of needs and gaps in the case study regions

The first phase focused on identifying regional needs and knowledge gaps in marine planning and management through a

TABLE 1 Overview of planning competences and MSP state of play in the eight case study regions considered.

Region	Competent MSP authorities	MSP implementation status	National competences	Regional competences	Shared competences
Murcia (Spain) Galicia (Spain)	Directorate-General for the Coast and Sea (DGCM) under the Ministry for the Ecological Transition and Demographic Challenge (MITECO).	Adopted (2023) National plans developed for the five Spanish maritime zones, defined for the implementation of the Marine Strategy Framework Directive	Fishing, state-owned ports, maritime transport, sand extraction, military training areas, coastal surveillance, research, marine renewable energies, submarine cables and pipelines, and underwater cultural heritage.	Aquaculture, shellfisheries, regional fishing and recreational ports, tourism, land-sea discharge permits, coastal planning and management (the authorization of occupation of the maritime-terrestrial public domain must always be granted by the general government).	Environmental protection. Fisheries is a shared competence between the EU and national government.
Sardinia (Italy)	Ministry of Infrastructure and Transport (MIT).	Adopted (2024) Three national plans developed for each of the three maritime areas.	Renewable energy, maritime transport, sand extraction, military training areas, research, submarine cable and pipeline, underwater cultural heritage.	Aquaculture, tourism	Environmental protection, landscape conservation, coastal defense, and fisheries. Fisheries is a shared competence between the EU and national government.
Provence-Alpes-Côte d'Azur (France) Pays de la Loire (France)	Interregional Directorate for the Sea (DIRM).	Adopted (2022) (under revision) In metropolitan France, the ≪Façade Strategy Documents≫ (DSF) are the regional translation of the National Strategy for the Sea and Coasto, adopted in 2017 and updated in 2024). There are four DSF, each one corresponding to a French maritime sea basin.	Environment, fisheries, renewable energy, maritime transport, sand extraction, military training areas, research, submarine cable and pipeline, underwater cultural heritage	Economy, Land planning, Ports, and Coastal defense	Fisheries is a shared competence between the EU and national government.
Crete (Greece) Central Macedonia (Greece)	Ministry of Environment and Energy. General Secretariat of Spatial Planning and Urban Environment	National Spatial Strategy for the Marine Space (approved by Ministerial Council in 2025). MSP Framework (meaning Maritime Spatial Plan according to the MSPD) for the North Aegean Sea (draft)	All maritime industries, traditional and emerging—underwater cultural heritage	Water quality monitoring (MSFD)	None, the Regions have only advisory competences and approve the Strategic Environmental Assessment when assessing a plan or program. Fisheries is a shared competence between the EU and national government.

(Continued)

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TABLE 1 (Continued)

Region	Competent MSP authorities	MSP implementation status	National competences	Regional competences	Shared competences
County Mayo (Ireland)	Department of Climate, Energy and the Environment.	Adopted (2021) One national plan, the "National Marine Planning Framework" developed. Adopted (2024) One sub-national plan for Offshore Renewable Energy (ORE) "South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP)" developed.	Ireland's National Marine Planning Framework (NMPF) applies to all marine sectors and there is a duty on all public authorities to comply with its objectives.	Coastal Planning Authorities have certain competencies in the nearshore (terrestrial planning, climate adaptation, biodiversity, public amenities etc.) but these must align with the over-arching NMPF. While not a requirement, regional public bodies can be designated as competent authorities for the purposes of preparing a Designated Maritime Area Plan (DMAP). A DMAP must contribute to the objectives of the national marine plan and would typically focus on a particular sector and/or part of the national maritime area. The topics of a DMAP are set out in a proposal that is approved at the national level. To date, one DMAP has been approved: the South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP).	Different sectors are the responsibility of different institutions, but they must all comply with the NMPF. Fisheries is a shared competence between the EU and national government.

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systematic review of maritime and coastal strategies and spatial plans (Ramieri et al., 2024). This identification of regional/local priorities was then discussed with experts from each case study region in a dedicated workshop and through bilateral meetings (Gutiérrez-Ruiz et al., 2024).

A typology of regional needs was developed, based on conventional strategic planning process theories, which refer to frameworks developed over time to guide organizations in defining and achieving long-term goals. These frameworks generally revolve around the importance of defining a vision and objectives, assessing the existing knowledge base, considering and understanding sectoral interactions, and improving governance mechanisms. Thus, the following four key categories of regional needs were identified:

1. Strategic orientation: in several regions, MSP processes are hindered by the absence or inadequacy of clearly defined long-term visions and strategic objectives. Yet, these elements are essential for providing a coherent direction to planning, guiding decision-making, and ensuring continuity across planning cycles (Hammar et al., 2020; Friess and Grémaud-Colombier, 2021).
2. Data information: this category refers to gaps in both the availability and quality of data needed to support evidence-based decision-making (Erkkilä-Välimäki et al., 2022; Davret et al., 2024), as well as in processed information derived from spatial, economic, or cumulative impact analyses. Limitations in geospatial resolution also constrain the ability to produce detailed maps and advanced spatial analyses, which are essential for effective maritime planning, particularly at the local level where a high level of detail is required (Furlan et al., 2020; Basirati et al., 2021; Stancheva et al., 2022).
3. Sectoral spatial coexistence: this category refers to the difficulties in identifying and managing interactions—both conflicts and synergies—among maritime sectors, particularly between established uses and emerging activities (Boussarie et al., 2023).
4. Governance and institutional coherence: this category refers to difficulties in coordination across governance levels, institutional fragmentation, and limited stakeholder engagement, which can undermine the implementation of planning actions. These difficulties highlight the need to improve cooperation mechanisms and enhance policy coherence within the MSP process (van der Wel et al., 2025; Tafon et al., 2023; Olaniyi et al., 2024).

The completion of this phase laid the groundwork for the subsequent steps, establishing a baseline of regional MSP gaps and needs that were consistent with the regional and local realities.

2.2.2 Phase 2. Identification of actions

Building on the findings of the first phase, the second phase involved a participatory approach to identify targeted actions addressing regional MSP needs. These actions were grouped into four main typologies, which reflect the different phases of plan development:

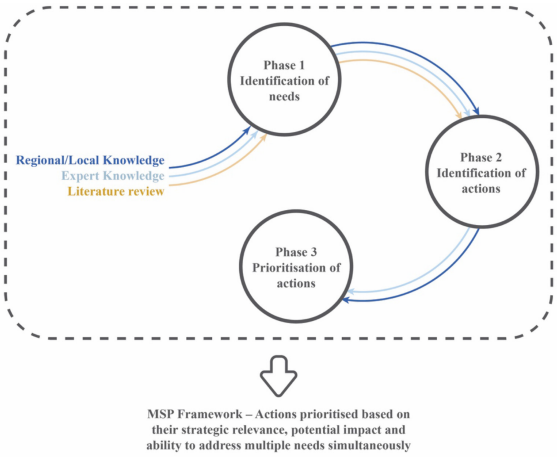


FIGURE 2
Steps of the approach adopted in the study and related sources of information.

1. Strategic and specific objectives: actions defining new objectives aimed at aligning the overarching MSP goals with the region's specificities. This typology of actions can address all four categories of needs defined in Phase 1, and the governance coherence across different levels.
2. Knowledge base: actions improving the collection, management and use of data to support evidence-based decision-making. This category intends to respond to the knowledge base and sector coexistence needs.
3. Zoning: spatial actions aimed at allocating marine space efficiently, preventing sectoral conflicts, improving coexistence, and promoting sustainable resource use.
4. Management measures: actions defining provisions to regulate resource use, mitigate sectoral conflicts, and establish robust governance mechanisms for sustainable management of marine areas. This typology encompasses sector coexistence and governance needs and includes innovative approaches to improve stakeholder engagement and policy harmonization.

Within this phase, each action co-proposed by case study leaders in collaboration with local actors such as authorities, practitioners and civil society was reviewed by experts from research institutes, universities, and national ministries involved in the project, to confirm its coherence with the challenges identified in Phase 1.

2.2.3 Phase 3. Prioritization of selected actions

In the last phase, the analysis highlighted cross-cutting approaches and common challenges across the eight case studies, compared and prioritizing actions (responses to challenges) based upon their strategic relevance. In particular, the prioritization process was directly informed by the previous phases, ensuring a structured evaluation of the identified actions based on their capacity to address interlinked challenges, feasibility within

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governance frameworks, synergies between regional and national MSP objectives, and expert validation.

Prioritization followed a three-stage approach:

- Multi-need assessment: actions were first assessed for their ability to simultaneously address multiple regional needs identified in Phase 1, ensuring that the prioritized interventions had the highest potential impact.
- Expert and regional validation: the proposed ranking was then reviewed by case study leaders, regional authorities and sector experts who assessed the practical feasibility of leveraging existing resources to achieve significant, measurable outcomes.
- Final prioritization: the refined list was finalized through an iterative validation process, ensuring consistency with national and regional MSP frameworks while maintaining adaptability to local contexts.

By structuring prioritization around the existing knowledge of regional stakeholders and expert reviews, this approach ensured that the selected actions are both strategically relevant and practically implementable within ongoing MSP processes.

3 Results

This section presents the regional needs identified across the eight case studies (sub-section 3.1), the corresponding actions to address these needs (sub-section 3.2) and the outcomes of the actions' prioritization exercise (sub-section 3.3).

3.1 Identification of needs

The comprehensive results of regional needs emerging from environmental, socio-economic, and governance dynamics in the eight case studies are summarized in Figure 3 and Table 2. In Murcia, key needs focus on mitigating the environmental impacts of aquaculture and anchoring in areas characterized by highly sensitive habitats and valuable underwater cultural heritage assets. Challenges include the lack of high-resolution maps, the lack of carrying capacity studies, and limited stakeholder engagement to integrate local perspectives into planning processes. Galicia faces the challenge of managing traditional sectors, such as fisheries and aquaculture, alongside emerging industries such as offshore wind energy. Moreover, assessing cumulative pressures, integrating the evaluation of underwater noise impacts, and developing climate adaptation strategies are considered relevant needs, also to resolve sectoral conflicts. In Sardinia, major challenges arise from spatial and management conflicts between tourism (leisure boating in particular), maritime transport, fisheries and nature conservation. These challenges are also fuelled by gaps in data collection and availability (e.g., concerning the distribution of tourism and fisheries environmental pressure and valuable benthic habitats). Enhanced monitoring systems and strengthened governance mechanisms are needed to support the sustainable management of the maritime space. Provence-Alpes-Côte d'Azur (PACA) requires improved multi-level governance to effectively manage competing interests (port activities, tourism, and environmental protection

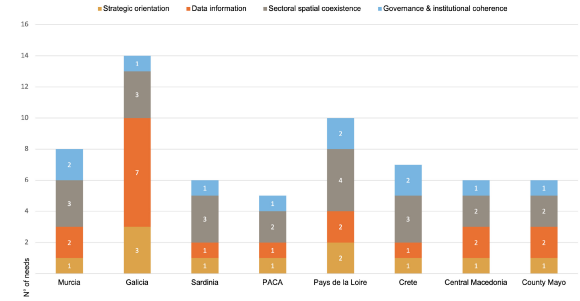


FIGURE 3
Comparative distribution of identified regional needs by thematic category across the eight case studies.

in particular). To address the insufficient alignment between regional/local plans and the *DSF Mediterranean* (which constitutes the regional MSP document translating the national MSP strategy at the sea basin level, considering regional specificities), coupled with climate pressures, it is necessary to strengthen collaboration between stakeholders and improve spatial tools (data sharing and higher data resolution). Similarly, in Pays de la Loire, aligning the *DSF Pays de la Loire* with other regional/local plans remains a key challenge. Within maritime spatial plans small-scale fisheries are under-represented, and greater cooperation between authorities is needed to refine marine use plans and improve climate adaptation measures. Crete's MSP shift toward a blue economy is driving the need for updated spatial plans for the single sectors and improved data systems due also to its strategic location in the Eastern Mediterranean. Integrating emerging industries, such as offshore wind farms (OWFs) or hydrocarbon extraction with traditional sectors, such as tourism or fisheries, while addressing fragmented data is essential to resolve sectoral conflicts and ensure the integration of land-sea interactions into plans. In Central Macedonia, there is a need to address complex governance and planning challenges that surpass the region (which is located in the north Aegean Sea, that is one out of the four marine spatial units in Greece). The region also needs to adopt a region-wise MSP vision and planning objectives to address the blue growth trends as well as climate resilience. Knowledge gaps and data fragmentation is another important aspect toward regional MSP. County Mayo recognizes the importance of harmonizing marine and terrestrial planning. Tailored sectoral policies and enhanced governance mechanisms are needed to manage land-sea interactions and support sustainable development.

3.2 Identification of actions

Actions identified across the regions address strategic objectives, knowledge development, zoning, and management measures, tackling different MSP challenges (see Table 3). In Murcia, efforts are focused on the management of unregulated anchorages mainly through the development of a regional strategy and high-resolution cartography. Carrying capacity studies for seagrass meadows and quantitative monitoring of maërl beds are significant actions, complemented by the essential

TABLE 2 Typologies of needs identified and summarized per case study region.

Regions	Strategic orientation	Data information	Sectoral spatial coexistence	Governance and institutional coherence
Murcia	- Develop specific objectives targeting aquaculture, nautical activities, underwater cultural heritage and marine habitats analysis.	- Assess non-regulated anchoring impacts on seagrass meadows and underwater cultural heritage. - Study impacts of aquaculture on mäerl habitats.	- Address conflicts and synergies between recreational activities, marine ecosystems, and the underwater cultural heritage, mainly through the study and regulation of unregulated anchoring impacts. - Evaluate the cumulative impacts in terms of magnitude and extension of aquaculture on mäerl and benthic habitats at a suitable scale. - Develop vocation maps for maritime activities and uses at the regional scale.	- Improve governance of maritime sectors throughout all public administrative scales (national and regional). - Enhance stakeholder engagement and communication throughout the entire MSP process.
Galicia	- Advance in data and knowledge to facilitate the planning of offshore aquaculture. - Integration of underwater noise in the maritime planning process. - Identification of blue tourism activities along with their characterization in socioeconomic terms.	- Collect and evaluate oceanic parameters influencing aquaculture offshore establishment as well as state of technology development - Advance in the knowledge of the optimal thresholds for the culture of the selected species - Conduct underwater noise analyses and integrate AIS data and georeferenced activity-specific noise studies. - Generate data and knowledge on the economic value of maritime uses. - Enhance resolution of cumulative pressure studies for spatial use optimisation. - Increase precise local information on species optimal growth values at regional level. - Identify sensitive areas and species impacted by underwater noise.	- Evaluate potential overlapping and conflicts of aquaculture and fisheries with wind farms activities - Incorporate climate change into MSP. - Integrate noise analysis in MSP.	- Foster collaboration between regional and national authorities and participation of all social actors involved in MSP from the very beginning of the processes.
Sardinia	- Manage conflicts between different uses of the sea at the regional and local level, based on an evidence-based approach.	- Collect data on surveillance and security, fisheries, and recreational boating.	- Analyse conflicts between aquaculture, fisheries, and tourism. - Conduct environmental impact assessments for key areas. - Develop zoning for higher-resolution spatial planning units.	- Promote stakeholder collaboration to address sectoral conflicts.
PACA	- Enhance alignment between the regional and local plans (including coastal urban plans) and the Sea Basin Plan -*Façade Strategic Document* (DSF) guidelines and objectives.	- Use the regional geoplatform ≪Monlittoral≫ for data sharing, in particular regarding tourism and recreational activities.	- Create governance measures to align seaport plans and environmental MSP objectives. - Adapt the Façade Strategic Document (DSF) vocation maps for local implementation.	- Enhance stakeholder engagement at local and regional levels.

(Continued)

TABLE 2 (Continued)

Regions	Strategic orientation	Data information	Sectoral spatial coexistence	Governance and institutional coherence
Pays de la Loire	- Enhance alignment between regional and local plans (including coastal urban plans) and the DSF guidelines and objectives. - Strengthen maritime-environment integration.	- Develop climate adaptation knowledge and monitor water quality and pollution to better identify pollution sources. - Improve the monitoring of the coastal small-scale fishing fleet.	- Combine the objectives of ORE development with the consequences on local economy, fisheries and MPAs, while ensuring that the interests of the different stakeholders are adequately considered - Incorporate marine activities related issues (e.g., coastal fisheries) into land-use plans. - Integrate local and DSF vocation maps. - Increase stakeholder cooperation in integrating DSF maps into local plans.	- Address stakeholder gaps in MSP processes. - Ensure integration of actions carried out by regional/local authorities and those carried out by State services for effective governance.
Crete	- Ensure ecosystem-based MSP that incorporates blue economy and climate considerations.	- Organize and address fragmented MSP data at regional level.	- Explore decentralized MSP decision-making. - Analyse conflicts in coastal/marine zones (agriculture, tourism, near-shore wind farms, hydrocarbon extraction platforms etc.). - Update sectoral spatial plans (Terrestrial Spatial Planning) and coordinate them with upcoming maritime spatial plans, to identify conflicts and create synergies between them.	- Foster national and regional MSP collaboration and multi-level marine governance. - Create local networks for MSP, for example, "Communities of Practice and Innovation."
Central Macedonia	- Implement integrated spatial planning for marine and coastal areas, addressing blue growth and climate impacts.	- Fill data gaps and address data fragmentation, critical for comprehensive analysis across the four Gulfs of the region. - Conduct detailed maritime spatial plans in each of the four Gulfs of Central Macedonia Region.	- Promote synergies among maritime sectors while addressing needs for hosting investments for critical sectors. - Ensure sustainability of marine resources and ecosystems.	- Foster trans-regional collaboration and multi-level governance.
County Mayo	- Develop regional objectives for maritime policies, incorporating spatial considerations (e.g., ports, habitats).	- Analyse impacts of economic activities at the regional level. - Develop data on renewable energy and marine biodiversity.	- Ensure policy coherence between marine activities and land dependencies, particularly in coastal and estuarine areas. - Tailor local spatial policies for aquaculture and renewable energy.	- Strengthen governance at sub-national and regional levels.

collaboration with the private sectors and the establishment of coordination mechanisms to improve sustainability, governance and engagement. In Galicia, three maritime issues were addressed. Socioeconomic relevance of coastal tourism and recreational activities was assessed in the South of the region, and high potential areas for the development of offshore aquaculture were characterized by collecting and analyzing met-ocean and biogeochemical historical data. This information was displayed as layers using Geographic Information Systems (GIS). Underwater noise analysis on the Galician coast was carried out by integrating AIS data analysis of the maritime traffic and noise recorded by a hydrophone. Sardinia focuses on establishing a UNESCO Biosphere Reserve in the Strait of Bonifacio, integrating transboundary cooperation, and collecting data on boating impacts to support the management of the Archipelago of La Maddalena, significantly impacted by leisure boating. Identified actions include a Traffic Separation Scheme in the Gulf of Asinara and technical coordination tables for shellfish farming and port activities (specifically in Olbia) to manage conflicts through improved locally based governance. In Provence-Alpes-Côte d'Azur, the integration of the Façade Strategic Document (DSF) into local plans is the main implementation item, with practical guidelines developed to support local authorities. Regional inventories of the blue economy and ecological data will support planning, while maps of maritime

TABLE 3 Actions identified per typology of actions.

Regions	Strategic and specific objectives	Knowledge base	Zoning	Management measures
Murcia	Design a regional strategy for the management of unregulated anchorages.	Build carrying capacity studies, based on monitoring plans for seagrass meadows and other sensitive ecosystems.	Display enough anchoring areas throughout the coastal sheltered areas to avoid the anchoring in sensitive areas with the presence of seagrass meadows and underwater cultural heritage assets.	Create a working group for unregulated anchorages at the regional level.
	Develop the mäerl habitat cartography of the potential area of distribution for this habitat, to properly establish the zoning of aquaculture areas.	Design quantitative methodologies for monitoring mäerl beds, equipped with a system of indicators based on scientific knowledge.	Include mäerl habitats in the Marine Strategy and MSP geoportal (INFOMAR) and count on them in the designation of Priority Use and High Potential Areas for biodiversity protection.	Collaboration with private sectors (aquaculture, tourism operators, diving centers, etc.) to implement measures that improve sustainability and to enhance knowledge-sharing.
	Create a common database with all the cartographic information of the sea space of the Region obtained through different projects and other works. This information shall be included as part of the cartography used for the implementation of the Marine Strategy Framework Directive.	Develop high-resolution cartography and characterization of the marine ecosystems throughout the entire marine space.	Improve zoning counting on regional and sectorial knowledge and based on the best information available.	Establish and improve the coordination and communication mechanisms within public administrations and sectors.
Galicia	Spatial analysis of tourism and recreational activities in the Southern area of Galician Coast, considering socioeconomic impact and potential conflict with other human activities.	Estimation and visualization of the value of marine-related tourism activities of the southern areas of the Galician Coast, measured by socioeconomic indicators. Knowledge about the impact of this sector on the regional economy.	Display socio economic information useful for planning purposes, to manage potential conflicts and overlapping uses, as well as reflecting the increase of anthropogenic pressures.	Improve knowledge of the added value and employment potential of the maritime tourism sector to inform evidence-based management measures, particularly in areas with limited regulatory challenges.
	Identify the most suitable offshore areas to establishing aquaculture systems, considering physical, chemical and biological parameters.	Compilation, processing and analysis of meteorological and oceanographic, biochemical and biological data from areas of high potential for aquaculture in the territorial sea, out of internal waters.	Display Geographic Information Systems (GIS) to integrate and visualize multiple environmental data layers relevant to the planning of marine activities in offshore areas.	Establishment of oceanographic, biological and technological parameters, technical requirements and limitations to be considered for the development of offshore aquaculture in the territorial sea of Galicia.
	Include underwater noise in the MSP process.	Analyse existent underwater noise information in Galicia, extending experimental monitoring.	Contribute to the characterization of pressures in coastal areas with anthropogenic activities and facilitate its inclusion in underwater noise maps.	Delimitation of sensitive areas, species and potential measures based on the information about the pressure exerted by underwater noise.
Sardinia	Establish a UNESCO MAB Reserve in the Strait of Bonifacio with cross-border involvement.	Collect data on boating and its impact on the marine environment to support the management of the archipelago of La Maddalena.	Establish a Traffic Separation of Scheme (TSS) in the Gulf of Asinara.	Establish a Nautical-Port Table in the Archipelago of La Maddalena.
				Establish a permanent technical coordination Table for shellfish farming in the Gulf of Olbia.
PACA	Clarify the legal scope of the DSF.	Draw regional inventory of blue economy data and maritime ecological data and reinforce the role of the regional geoplatform ≪Monlittoral,≫	Examine the possibility of adapting the vocation map of the DSF at the local level, based on the strategies for public maritime domain	Better involve local authorities in the elaboration and implementation phases of the DSF.

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TABLE 3 (Continued)

Regions	Strategic and specific objectives	Knowledge base	Zoning	Management measures
		through strengthening its animation and sharing the data necessary for the elaboration of urban plans (e.g., data on coastal erosion). In addition, supply ≪Monlittoral≫ with operational data for the territories, including notably (i) regional inventory and data collection on the blue economy, particularly concerning tourism, recreational activities, artisanal fishing, and recreational boating, (ii) data on coastal erosion, and (iii) data on marine ecology with the Regional Agency for Biodiversity and the Environment.	management developed by State services at the departmental level.	
	Design practical guidance to help regional and local authorities to take into account the DSF objectives in their local plans.		Precise the role that can play the territorial Coherence Scheme (SCoT) regarding maritime and coastal issues, and design guidance on how to draw a consistent sea and coastal chapter in the SCoT.	Strengthen the level of involvement of sub-regional authorities in the development of sectoral projects impacting them or requiring their subsequent action, within the steering committees (DIRM/Region).
	Clarify the role of the state services, the tools and documents to be used to ensure the homogeneous operationalisation of the objectives of the DSF applicable to local authorities and quantify the resulting human resources requirements accordingly.	Ensure consistent monitoring and evaluation of the plans at different levels to ensure alignment with national and regional priorities and include indicators grids for environmental, social, and economic monitoring.	Include the development of submarine cables in the DSF.	Reflect on how to improve the MSP governance in the long term.
	Seize the opportunity of upcoming revisions of local planning documents to remind local authorities of the guidelines of the DSF, the Regional Scheme for the Planning, the Sustainable Development, and Equality of the Territories (SRADDET) and the Water Planning and Management Master Scheme (SDAGE) to be taken into account for their territory, through official guidelines provided by State services during the revision process of local documents ("porter à connaissance").		Study the advisability of adding prescriptive rules on certain maritime and coastal issues in the SRADDET.	Encourage regional, departmental, and local stakeholders to include the State Services in the elaboration process of their coastal strategies or plans, establishing shared framework.
	Strengthen the role of the Region in MSP by including sea and coastal orientations in its legally binding documents and by animating MSP network at regional level.			Encourage the development of reference guides and documents and experience-sharing networks on how existing tools available to local authorities can contribute to achieving the objectives for maritime issues.

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TABLE 3 (Continued)

Regions	Strategic and specific objectives	Knowledge base	Zoning	Management measures
				Study the allocation of resources dedicated to MSP in regional and infra-regional authorities to draw recommendations on how to develop human resources on that topic.
				Develop human resources in the marine field within the technical departments of regional and subregional authorities through training course on MSP.
Pays de la Loire	Examine the possibility of precising the regional guidelines of the DSF at the local level through the strategies for public maritime domain management developed by State services at the departmental level.	Discuss the sharing of responsibilities between the Region and State services to improve data collection and sharing.	Examine the possibility of adapting the vocation map of the DSF at the local level, based on the strategies for public maritime domain management developed by State services at the departmental level.	Raise awareness among local authorities of their role in implementing the DSF and facilitate their appropriation of the documents. This could be achieved by (i) involving local authorities more closely in the revision of the DSF, and (ii) improving the communication strategy aimed at local authorities, combining interactive maps, webinars and workshops.
	Seize the opportunity of upcoming revisions of local planning documents to remind local authorities of the guidelines of the DSF, SRADDET, and the SDAGE to be considered for their territory, through official guidelines provided by State services during the revision process of local documents.		Study the advisability of adding prescriptive rules on certain maritime and coastal issues in the regional scheme SRADDET.	Encourage local authorities to build a network of already existing regional and local commissions and concertation bodies to address maritime issues.
				Rely on the Regional Assembly for the sea and coast (ARML) to strengthen coordination among public stakeholders.
				Promote the development of guidance materials and peer-learning networks to support local authorities in leveraging existing tools for the achievement of maritime-related objectives.
				Examine the possibility of using the local development mechanisms of the European structural and investment funds to strengthen the leadership capacities of local authorities.

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TABLE 3 (Continued)

Regions	Strategic and specific objectives	Knowledge base	Zoning	Management measures
				Examine the possibility of using existing contracts between the State and local authorities to establish a shared framework for action on maritime and coastal issues.
				Precise the role that the Territorial Coherence scheme (SCoT) can play in tackling maritime issues.
Crete	Design a (sub)regional strategy on offshore renewable energy, considering the National Plan for the allocation of OWFs and the results of the relevant consultation processes.	Implement a capacity study on climate-smart MSP.	Establish new Marine Protected Areas (MPAs) and define protection measures.	Establish a Community of Practice and Innovation (CoPI).
	Build a multi-use strategy for the harmonious co-existence between tourism and the other Blue Economy sectors and industries.	Implement a capacity study on Land-Sea Interactions, mostly related to tourism.	Identify test sites with limited administrative burdens.	Establish a regional structure to coordinate units between different authorities (sectors).
		Work on harmonized MSP data collection under a regional or national observatory.	Identify the most appropriate zones for deep-sea hydrocarbons extraction, based on relevant industrial research and in a multi-use perspective. Delimitation of EEZ between Greece and Libya according to UNCLOS is considered crucial to this end.	Workshops to foster collaboration of the Region with the private sectors and research institutes/academia for planning and implementing innovative actions on MSP.
		At the regional level, study and promote state-of-the-art knowledge and proposed solutions to address the pressures caused by underwater noise in the territorial waters surrounding Crete.		
Central Macedonia Region	Develop the Central Macedonia Region (CMR) Marine Strategy.	Perform analysis regarding the economic value and potential of each marine sector in CMR.	Identify priority zones for the spatial growth of existing and new sectors, also considering the possibility of co-existence.	Establish a cross-regional governance scheme to promote interaction between the five (5) neighboring regions sharing the North Aegean Sea.
	Draft more detailed plans for each one of the four Gulfs of CMR.	Perform LSI analysis for each one of the four gulfs of CMR.	Perform sustainable sea-use planning within MPAs.	Establish a governance scheme at the regional level (of Central Macedonia Region).

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TABLE 3 (Continued)

Regions	Strategic and specific objectives	Knowledge base	Zoning	Management measures
		Perform analysis for the climate change threats/risks and hazards in CMR (and each Gulf).	Selection of the optimal location for the siting of the shipyard zone.	Draft Integrated Coastal Zone Management (ICZM) studies.
		Perform risk analysis for the natural disasters threatening the marine and terrestrial parts and the coastal zone of CMR (and of each Gulf).		
		Monitor the atmospheric and geophysical parameters (e.g., wind, waves, and solar radiation) in the marine parts of CMR.		
		Establish a comprehensive geospatial database for the coastal and marine areas of CMR.		
County Mayo	Appropriate public body(ies) to consider seeking designation as competent authorities for the purposes of preparing a Designated Maritime Area Plan (DMAP).	Establish and analyse the evidence base to inform the potential development of a DMAP—analysis of existing data and identification of gaps for activities around Mayo.	National MSP authorities should work with prospective sub-national public bodies, including Mayo County Council, to further develop marineplan.ie for use in sub-national DMAP development.	Examine the process of ensuring coherence between DMAPs and land planning (e.g., Regional Spatial and Economic Strategies, Local Plans) to enable shared objectives—including collaboration between planners to develop plans to enable common implementation.
	Support development and publication of national Designated Maritime Area Plan (DMAP) Guidelines.	Scope the potential for knowledge-building workshops (or other mechanisms) on local maritime activities for stakeholders.		Ensure national teams within DCEE, lead department for MSP, are appropriately structured to support sub-national marine planning, primarily by providing resources for DMAP development and implementation at the national level.
				Enhance stakeholder input to MSP governance nationally and locally, including through Project Ireland 2040; MSP Advisory Group, and scoping the need for a DMAP Governance Group.

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uses and legal tools will be adapted to improve operationalisation. Governance measures aim to strengthen the involvement of local stakeholders and the monitoring of planning outcomes through environmental, social and economic indicators. Pays de la Loire builds on the regional guidelines of the DSF, aiming to integrate them into local processes. Awareness-raising initiatives would involve local authorities, while revisions to planning documents align them with regional strategies. Coordination needs to be strengthened through mechanisms like the Regional Assembly for Sea and Coast, and resources for MSP need to be explored to ensure effective governance. Crete is developing a sub-regional strategy for offshore renewable energy, aligning with national frameworks that emphasize climate-smart MSP and land-sea interactions. Carrying capacity studies help address pressures from tourism and underwater noise, while newly established marine protected areas include clear protective measures. Harmonized MSP data collection and stakeholder collaboration, including academia, foster innovative MSP initiatives. Additionally, these efforts consider the interests of U.S. hydrocarbon industries in deep-sea extraction, South of Crete. In Central Macedonia, there is a need to ensure coherence of MSP at the north Aegean Sea level, through cross-regional cooperation and the establishment of a (multi-level) governance scheme. The focus should also be on drafting a regional marine strategy and detailed plans for each one of the four gulfs, identifying (exclusive or multi-use) zones for the critical marine sectors of the region (e.g., aquaculture) and ensuring sustainability of the marine resources and the ecosystems. The knowledge base should be enriched with data allowing a set of spatial and other analysis (related to the economic valuation of key sectors, the land-sea interactions, environmental impacts, the marine risks and hazards, etc). Another important need is to address the fragmentation and the lack in high-resolution geo-spatial data. To progress implementation of MSP at county-level in Mayo, the local authority would need to be designated as a competent authority for the purpose of preparing a Designated Maritime Area Plan (DMAP). Ireland's DMAP process allows for production of a sub-national—and/or sectorally focused—marine plan that sets out specific objectives while supporting the broad aims of the national marine plan. Evidence-based analyses might inform activity gaps, while workshops may foster stakeholder engagement. Coherence between marine and terrestrial planning must be ensured through increased collaboration between planners and alignment with national plans.

The study identified 93 actions which were grouped into the four typologies defined in phase 2 of the methodology (see Figure 4), reflecting the multi-dimensional nature of the challenges and opportunities within MSP processes. Twenty actions fall under the *Strategic and specific objectives* typology and focus on aligning regional strategies with overarching MSP goals. For instance, in the PACA region, the development of guidelines to harmonize regional MSP processes with the Mediterranean DSF (which translates the national MSP guidelines into the specific context of the Mediterranean region of France), is an example of strategic alignment. In Central Macedonia, the development of a regional Marine Strategy and of integrated spatial plans for each one of the four gulfs (focusing on sustainable blue growth while addressing the environmental and socio-economic dynamics of the region)

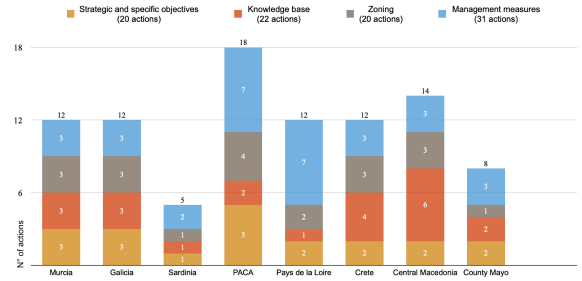


FIGURE 4
Number of actions per typology considered in phase 2 of the study.

is considered particularly relevant. Similarly, Pays de la Loire emphasizes improving local planning systems to ensure coherence between regional activities and the sea basin framework (DSF Pays de la Loire). The *knowledge base* typology, which includes 22 actions, reflects the key recognition of data gaps as a barrier to regional MSP implementation. Murcia's focus is on high-resolution cartography and carrying capacity studies, aiming to assess the environmental impacts of anchoring and aquaculture on sensitive marine habitats and underwater cultural heritage. Galicia's focus on cumulative impact analyses and underwater noise assessments illustrates how regions with high economic reliance on marine resources seek to solve conflicts and preserve ecosystems. Central Macedonia places emphasis on data that will allow detailed analysis for marine sectors, LSIs, risks and hazards. Similarly, Crete and PACA perceive as a priority the investment in geoportals and data sharing tools to address data fragmentation at the very local levels and facilitate coordinated decision-making. The 20 *zoning* actions reflect efforts to allocate marine space efficiently while minimizing inter-sectoral conflicts. For instance, PACA's adaptation of national vocation maps to better reflect local conditions highlights the importance of flexibility in zoning frameworks. In Crete, zoning strategies emphasize coexistence between tourism and emerging blue economy sectors through updated spatial planning processes. Drafting detailed plans for each of the four gulfs of Central Macedonia will address critical land-sea interactions and optimal allocation of sectors and activities, ensuring environmental protection and sustainability. The 31 actions of *management measures* focus on stakeholder engagement mechanisms to ensure MSP implementation. PACA demonstrates extensive initiatives in this area, including strengthening regional governance to resolve conflicts between maritime tourism, fisheries, and environmental conservation. County Mayo focuses on coherent marine-terrestrial planning frameworks to address specific regional challenges. Sardinia's emphasis on collaborative governance highlights how stakeholder-driven approaches can mediate conflicts in areas such as the Strait of Bonifacio or the Gulf of Olbia.

3.3 Prioritization of actions

Results of the prioritization exercise, carried out for each case study, are presented in Table 4. In Murcia, the development

of carrying capacity studies was prioritized for its dual role in managing the environmental impacts of mooring and aquaculture on sensitive habitats and the underwater cultural heritage. Similarly, the production of high-resolution cartography was identified as essential to improve the spatial resolution of available data, refine zoning processes and support multi-sectoral planning initiatives. In Galicia, priority was given to actions aimed at ensuring that cumulative pressures are fully integrated into zoning processes. For the inclusion of underwater noise into MSP, the main needs regard the identification of sensitive areas and species and potential adverse impact, the development of georeferenced activity-specific noise studies and the setting of targets and mechanisms for underwater noise reduction. In Sardinia, the prioritization led to a focus on collecting data on boating and its environmental impacts. This baseline data supports the development of conflict resolution mechanisms and strengthens environmental monitoring efforts, which are essential for balancing tourism and conservation objectives. The PACA region prioritized the development of practical guidance for local authorities to align local planning efforts with national and regional MSP objectives, thereby promoting a coherent and integrated planning framework. In Pays de la Loire, the development of guidelines and cooperation networks for local authorities to engage in MSP processes was prioritized. This action strengthens multi-level governance by integrating regional socio-economic priorities into broader MSP objectives, ensuring alignment between different levels of governance. Crete emphasized a multi-use strategy to balance tourism with other blue economy sectors and a capacity study on land-sea interactions. These actions were chosen for their potential to address knowledge gaps while improving the overall spatial planning system and the collaboration among stakeholders. In Central Macedonia, the development of a Marine Strategy and detailed spatial plans for the gulfs have been prioritized due to their cross-cutting importance. These actions facilitate inter-regional cooperation and address key challenges related to land-sea interactions and resource management. In County Mayo, the selected actions aim to enhance coherence between marine, and land-use planning and align spatial objectives and planning processes across governance levels. Particular attention is paid to the evolving Designated Maritime Area Plan (DMAP) process and how it might be used at more regional and local levels. The actions also address capacity-building needs by exploring ways to improve stakeholder understanding and support the coordinated implementation of the Plan.

4 Discussion

4.1 Commonalities and differences: comparing local specificities

Emphasis on data-driven and evidence-based approaches is acknowledged as a common feature across all case studies. It enables regions to more actively contribute to MSP processes within their territories. Actions in Murcia, PACA and Galicia, such as the development of high-resolution cartography and cumulative impact assessments, demonstrate how knowledge generation can help planning future uses, addressing complex spatial conflicts and sectoral overlaps of maritime activities and uses. By embedding region-specific data into broader frameworks, the study highlights the importance of ensuring that regional realities inform national strategies. As highlighted by Hammar et al. (2020), cumulative impact assessments quantify the effects of overlapping marine activities and inform mitigation strategies, while Ansong et al. (2021) emphasize the necessity to build capacity through the integration of environmental and socio-economic data to achieve adaptive, region-specific MSP strategies. These approaches are consistent with the general objective of this study to bridge the gap between local features and national plans. The use of geospatial analysis in Galicia to assess the suitability of specific maritime areas for aquaculture and promote sectoral coexistence demonstrates this integration, supported by transparency and stakeholder engagement enabled by digital geoportals (Hietala et al., 2021; Davret et al., 2024).

Governance represents another important domain of common interest for several case studies. In PACA and Pays de la Loire, regional efforts to operationalise the Façade Strategic Documents show a strong vertical alignment between national and local priorities. Conversely, for County Mayo, Crete and Central Macedonia the flexibility of bottom-up mechanisms that prioritize local stakeholder engagement and empower regional decision-making were illustrated, reflecting Pennino et al. (2021), who emphasize the importance of socio-cultural values in fostering participatory approaches. These approaches are consistent with calls for adaptive governance models, combining multi-level collaboration with decentralized decision-making to address spatial and temporal variability in marine environments (Zuercher et al., 2022b; Howells and Ramirez-Monsalve, 2022; Rafael et al., 2024). Cross-regional comparisons highlight the importance of co-developing MSP frameworks with stakeholders, as such inclusiveness enhances the legitimacy and operational effectiveness of governance systems (Ashworth, 2023). Multi-level governance approaches emerge as relevant across several regions to further balance competing demands through adaptive spatial planning. Conversely, more sector-specific priorities, such as offshore renewable energy development and fisheries management, point to regional differences that require tailored actions within broader governance frameworks. These findings underscore the need to integrate cross-cutting and sector-specific strategies to ensure comprehensive MSP processes.

Environmental sustainability remains a common priority across regions, with multi-use strategies such as those in Crete and Sardinia balancing economic growth and environmental conservation, in line with ecosystem-based approaches, aiming at balancing marine resource use with conservation objectives (Podda and Porporato, 2023). Comparatively, the adaptive use maps in the plans of PACA and Central Macedonia exemplify the integration of ecosystem-based management principles, in line with Kirkfeldt and Frazão Santos's (2021) call to balance ecological resilience with socio-economic sustainability.

Multi-need strategies, such as the initiatives in Crete to balance tourism and other blue economy sectors and adaptation of vocation maps in PACA, illustrate the potential for strategic

TABLE 4 Actions meeting multiple needs.

Region	Identified actions (summarized)	Strategic orientation	Data information	Sectoral spatial coexistence	Governance and institutional coherence
Murcia	Build carrying capacity studies, based on monitoring plans for seagrass meadows and other sensitive ecosystems.		+	+	
	Develop the mäerl habitat cartography of the potential area of distribution for this habitat, to properly establish the zoning of aquaculture areas.		+	+	+
Galicia	Include underwater noise in the MSP process.		+	+	+
	Display Geographic Information Systems (GIS) to integrate and visualize multiple environmental data layers relevant to the planning of marine activities in offshore areas.	+	+	+	+
Sardinia	Collect data on boating and its impact on the marine environment to support the management of the archipelago of La Maddalena.		+		+
PACA	Design practical guidance to help regional and local authorities to take into account the DSF objectives in their local plans.	+			+
	Clarify the role of the state services, the tools and documents to be used to ensure the homogeneous operationalisation of the objectives of the DSF applicable to local authorities and quantify the resulting human resources requirements accordingly.	+			+
	Strengthen the role of the Region in MSP by including sea and coastal orientations in its legally binding documents and by animating MSP network at regional level.	+			+
Pays de la Loire	Study the advisability of adding prescriptive rules on certain maritime and coastal issues in the regional scheme SRADDET.	+	+		
	Promote the development of guidance materials and peer-learning networks to support local authorities in leveraging existing tools for the achievement of maritime-related objectives.		+		+
Crete	Build a multi-use strategy for the harmonious co-existence between tourism and the other Blue Economy sectors and industries		+	+	+
	Implement a capacity study on Land-Sea Interactions, mostly related to tourism.		+	+	
Central Macedonia	Develop the Central Macedonia Region (CMR) Marine Strategy	+	+		
	Draft more detailed plans for each one of the four Gulfs of CMR.	+	+	+	
	Draft Integrated Coastal Zone Management (ICZM) studies.		+	+	
County Mayo	Support development and publication of national Designated Maritime Area Plan (DMAP) Guidelines.	+			+

(Continued)

TABLE 4 (Continued)

Region	Identified actions (summarized)	Strategic orientation	Data information	Sectoral spatial coexistence	Governance and institutional coherence
	Examine the process of ensuring coherence between DMAPs and land planning (e.g., Regional Spatial and Economic Strategies, Local Plans) to enable shared objectives—including collaboration between planners to develop plans to enable common implementation.	+			+

prioritization to address environmental, socio-economic, and governance dimensions simultaneously. These approaches reflect the importance of aligning stakeholder priorities with the objectives to create adaptive, regionally responsive planning. The cross-case studies analysis also highlights the importance of aligning regional actions with transnational frameworks, as these can strengthen the coherence of national and international MSP processes. PACA and Pays de la Loire are highlighted as examples of how European MSP objectives, such as those set out in the EU's Maritime Spatial Planning Directive (MSPD), can be operationalised through locally relevant strategies. This multi-scalar approach ensures coherence between different levels of governance while allowing regions to shape their contributions to national and transnational plans, addressing criticisms of overly centralized plans that fail to take account of local realities (Clarke and Flannery, 2020; Trouillet, 2020).

The comparative analysis demonstrates that regions can play a critical role in translating strategic MSP objectives into operational actions tailored to local conditions, thereby strengthening the implementation of spatial subsidiarity within nationally led MSP processes (Matczak et al., 2014; Zaucha, 2014).

While common priorities are evident, regional MSP processes differ significantly in their focus, reflecting different governance, socio-economic and environmental contexts. Governance-driven actions in PACA, such as the elaboration of practical guidance for local authorities, demonstrate a mature MSP framework adapted to complex coastal dynamics, in line with Ashworth's (2023) recommendations, who highlights the influence of governance maturity in shaping adaptive strategies. In contrast, in Galicia the role of knowledge-building actions were emphasized- such as underwater noise studies and those designed to increase data and knowledge relevant to identifying suitable areas for offshore aquaculture and managing potential overlapping of uses—in addressing the need for capacity building in regions with emerging industries such as offshore wind and related planning (Ansong et al., 2021). In Greece, the identified needs emphasize the strengthening of institutional capacity and spatial planning tools to support ongoing MSP processes, thus ensuring alignment with national and EU frameworks. Zoning priorities also vary: the resolution of specific sectoral conflicts was prioritized in Murcia, such as those related to unregulated anchoring and aquaculture, while Crete emphasizes balancing tourism with other blue economy sectors. These regional differences show the importance of tailoring MSP to local contexts, where downscaling frameworks provide flexibility to address specific challenges and opportunities.

The integration of digital tools and participatory mechanisms also proved decisive for effective MSP implementation in most case studies. As noted by Davret et al. (2024), geoportals and spatial decision-support systems enhance data transparency, enabling real-time feedback from stakeholders and strengthening collaborative decision-making. Moreover, incorporating automated data streams from marine sensors and regional geoportals could improve responsiveness and reduce delays in updating spatial plans, in line with calls for continuous monitoring and adaptive management (Flynn et al., 2023). However, maintaining data integrity and addressing knowledge gaps remain challenges, as noted by de Vries et al. (2024), who emphasize that robust knowledge-integration frameworks are essential for regions with limited data availability.

4.2 Tools and mechanisms to complement a framework approach

By emphasizing context-sensitive strategies, the study identifies and provides pathways to address gaps in the existing national maritime spatial plans. These plans often focus on general/strategic principles and guidelines without sufficient attention to their practical application at the regional and local levels. The analysis suggests that additional regional MSP objectives emerge most clearly in sectors where regions hold planning or management responsibilities, highlighting the importance of mechanisms capable of reconciling national strategic objectives with local needs.

A key aspect emerging from the comparative analysis is the different levels of institutional involvement and familiarity with MSP across the case study regions. While some regions have been actively involved in the development of MSP through national and regional frameworks, others are at an earlier stage of integrating MSP into their planning systems. This diversity influences both the prioritization of actions and the institutional mechanisms required for their implementation. In France, for example, the Facade Strategic Documents (DSF) provide a framework to guide regional engagement within a national MSP approach, ensuring alignment between local and national priorities. In other regions, such as Central Macedonia and Crete, MSP processes are still evolving, with regional authorities focusing primarily on spatial planning at the land-sea interface. These differences highlight the need for adaptive methodologies that can accommodate different governance realities while promoting coherence in MSP implementation.

Similar efforts can be observed in other ongoing MSP-related initiatives. In Ireland, the development of Designated Maritime Area Plans (DMAPs), particularly the South Coast DMAP (Department of the Environment Climate and Communications, 2024), represents an emerging sub-national mechanism through which regional and local actors can play a more active role in shaping maritime spatial planning decisions. At the same time, projects such as INCORE-MED Project (2025) are testing participatory and co-design approaches to strengthen stakeholder involvement and support the integration of local knowledge into MSP processes under conditions of environmental change and uncertainty (González-Domingo et al., 2026).

While the methodological approach proposed in this study effectively integrates stakeholder input and knowledge-based assessments across multiple stages, several areas for improvement emerge from the literature and on-field results. A potential improvement concerns the integration of dynamic data sources. Davret et al. (2024) emphasize that the rapid development of digital platforms, such as marine geoportals, supports adaptive governance by providing real-time feedback. In addition, improving the comparability of case studies through harmonized performance indicators would strengthen the comparative analysis phase. Rafael et al. (2024) argue that standardized indicators can improve the assessment of cross-regional synergies and gaps, enabling more precise identification of transferable practices and region-specific constraints. However, the applicability of such indicators may vary according to data availability and governance structures. Tailored approaches that take these contextual factors into account can improve the effectiveness of comparative assessments while maintaining methodological consistency.

The methodology could also benefit from a more structured approach to address governance asymmetries. Tafon et al. (2023) suggest that multi-scalar governance needs to explicitly address power imbalances to ensure equitable participation, particularly in regions where local actors have limited institutional capacity. Formally integrating the concerns of marginalized stakeholders into strategic prioritization could enhance both the legitimacy and impact of MSP actions (MacDonald et al., 2022).

Despite its strengths, the methodological framework presents certain limitations that should be acknowledged. Integrating regional MSP actions into existing institutional and regulatory frameworks could be difficult in those cases where centralized settings operate within rigid administrative structures that limit the feasibility of adopting new regionalised MSP processes. Similar challenges may arise when regional initiatives and national MSP processes follow different planning timelines, potentially affecting the integration and uptake of proposed actions. In some cases, the lack of dedicated legal instruments for MSP implementation results in fragmented or slow adoption, requiring additional institutional coordination mechanisms (Zaucha et al., 2025). For example, while some regions benefit from clear legal mandates that support MSP implementation, such as those in Italy and Ireland, others face challenges related to overlapping jurisdictions or the need for additional regulatory instruments. Improving institutional coordination, both horizontally across regional authorities and vertically with national institutions, can enhance the operational relevance of regional MSP efforts and support their effective integration into overarching planning frameworks. In addition, the results stressed the importance of adaptive governance in MSP, but the rigidity of certain planning frameworks may limit the ability to integrate rapidly evolving sectoral socio-economic and environmental needs. A more dynamic scenario-based approach could improve the adaptability of regional MSP processes, particularly in addressing emerging challenges such as climate change and economic shifts (Flynn et al., 2023). In parallel, lack of dedicated funding, human resources and political commitment can hinder the implementation of even well-prioritized actions, reducing the long-term impact of MSP frameworks. Future research should explore ways to strengthen the institutionalization of regional actions to ensure that they move from planning to implementation (de Vries et al., 2024). Finally, the study assumes a level of institutional and stakeholder readiness that may not always be present in different governance contexts. While participatory processes enhance legitimacy and inclusiveness, their effectiveness depends on the capacity of local actors to engage meaningfully in the process. In regions where MSP is still emerging, there may be limited expertise, insufficient stakeholder representation, conflicting sectoral interests, or broader geopolitical constraints, which may slow down the implementation effort. Where limitations are identified, capacity building initiatives and institutional alignment strategies could improve the replicability of the methodology in different regional contexts (Tafon et al., 2023).

5 Conclusion

This work proposed a structured methodology to support the design and upgrading of MSP frameworks that foster the integration of regional perspectives into nationally driven MSP processes. In doing so, through a combination of literature and plan analysis with regional and local actors, the methodology supported the identification of key MSP needs and of a set of actions required to address them.

The flexibility of this methodology enables regions with different governance models to design and upgrade MSP frameworks tailored to their specific contexts, whilst adhering to national and European strategies. However, its effectiveness can be limited by regulatory fragmentation, administrative rigidity and resource constraints, which may result in slow uptake and limit long-term impact. Institutional coordination and adaptive governance mechanisms can be used to overcome these challenges. Given the central role of regional actors in strategic planning, a stronger institutional mandate for regional authorities could enhance the legitimacy and efficiency of national MSP processes. This requires a more systematic integration of regional perspectives throughout the planning cycle, ensuring that national frameworks are not only aligned with overarching strategies, but also effectively incorporate local priorities. In addition, formal mechanisms for integrating stakeholder input, coupled with adequate technical and financial support, could strengthen adaptive governance and improve the implementation of MSP at multiple levels, fostering a more iterative and participatory decision-making process. The methodology can support both MSP implementation and plan

preparation by translating national objectives into regional actions and informing planning priorities from an early stage. In doing so, it highlights the need for a governance model that recognizes local stakeholders as active contributors rather than passive implementers of MSP.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

RD: Software, Data curation, Writing – review & editing, Investigation, Visualization, Formal analysis, Conceptualization, Writing – original draft, Methodology. FCa: Data curation, Methodology, Writing – review & editing, Conceptualization, Software, Investigation, Writing – original draft, Visualization, Formal analysis. MB: Investigation, Writing – review & editing, Supervision, Validation, Methodology. ED: Writing – review & editing, Methodology, Investigation, Validation. JLGG: Validation, Writing – review & editing, Methodology, Investigation. EG-R: Methodology, Writing – review & editing, Validation, Investigation. SK: Methodology, Validation, Investigation, Writing – review & editing. FCh: Validation, Writing – review & editing, Methodology, Investigation. FM: Validation, Supervision, Writing – review & editing, Methodology, Investigation. AMO'H: Methodology, Validation, Writing – review & editing, Supervision, Investigation. MP: Validation, Methodology, Investigation, Writing – review & editing. ER: Supervision, Validation, Methodology, Writing – review & editing, Investigation. TW: Writing – review & editing, Methodology, Validation, Investigation. DB: Project administration, Validation, Methodology, Supervision, Conceptualization, Writing – review & editing, Resources, Funding acquisition, Investigation.

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Conflict of interest

MB was employed by t-ELIKA.

The remaining author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/focsu.2026.1802042/full#supplementary-material

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