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EDITED BY
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University College Cork, Ireland

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Panteion Panepistemio Koinonikon kai Politikon Epistemon Tmema Oikonomikes kai Periphereiakes Anaptyxes, Greece

*CORRESPONDENCE
Martina Bocci
martina.bocci@t-elika.eu
Emiliano Ramieri
emiliano.ramieri@cnr.it

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Disentangle the skein: a nomenclature framework to assess the contribution of Maritime Spatial Plans to the European Green Deal

Martina Bocci[1,2]*, Alexandre Cornet[3], Vesa Arki[4], Folco Soffietti[5], Adeline Bas[6], Daniele Brigolin[5], Mónica Campillos-Llanos[7], Pierpaolo Campostrini[2], Fabio Carella[5], Cristina Cervera-Núñez[7], Annija Danenberga[8,9], Katia Frangoudes[6], Kira Gee[10,11], Maria Gómez-Ballesteros[7], Eider Graner[6], Bettina Käppeler[11], Olivier Laroussinie[3], Laura Pietilä[4], Mari Pohja-Mykrä[12], Heikki Saarento[4], Hristo Stanchev[13], Margarita Stancheva[13], Marta Stube[9] and Emiliano Ramieri[14]*

[1]t-ELIKA, Venice, Italy, [2]Consortium for Coordination of Research Activities Concerning the Venice Lagoon System (CORILA), Venice, Italy, [3]Centre for Studies and Expertise on Risks, The Environment, Mobility and Urban Planning (CEREMA), Brest, France, [4]Regional Council of Southwest Finland, Turku, Finland, [5]Department of Architecture and Arts, IUAV University of Venice, Venice, Italy, [6]AMURE UBO Ifremer, Research Unit, European Institute for Marine Studies (IUEM), Plouzané, France, [7]Instituto Español de Oceanografía (IEO, CSIC), Madrid, Spain, [8]Baltic Studies Centre, Riga, Latvia, [9]Ministry of Smart Administration and Regional Development, Riga, Latvia, [10]Helmholtz Zentrum Hereon, Geesthacht, Germany, [11]Federal Maritime and Hydrographic Agency, Hamburg, Germany, [12]Ministry of Environment, Helsinki, Finland, [13]Center for Coastal and Marine Studies (CCMS), Varna, Bulgaria, [14]National Research Council, Venice, Italy

The European Green Deal (EGD) sets an ambitious, cross-sectoral agenda with direct implications for the sea. Yet methods to systematically assess how national Maritime Spatial Plans contribute to EGD objectives remain scarce. The article proposes an EGD–MSP nomenclature that translates the EGD's complexity into a practical, adaptable framework for practical application in Maritime Spatial Planning. The framework clusters EGD ambitions into seven topics—climate change mitigation, climate change adaptation, sustainable seafood production, biodiversity and ecosystem protection and restoration, blue circular economy, zero pollution, and fair and just transition—and organises them hierarchically into sub-topics and operational elements. The nomenclature was tested across seven EU countries (Bulgaria, Finland, France, Germany, Italy, Latvia, Spain) using desk analysis of MSP plans and related documents, targeted interviews, and a workshop to examine aspects common to the participating countries. A semi-quantitative synthesis (YES/PARTIALLY/NO) enabled consistent comparison of how EGD elements appear in MSP visions, objectives, and measures. Results show that climate change mitigation is widely and explicitly addressed—primarily via offshore renewable energy—while adaptation is present but often indirect. Biodiversity protection is common, whereas restoration remains limited. Blue circular economy and zero-pollution objectives are referenced more often in objectives than in concrete measures. Approaches to a fair and just transition are emerging, with participation and transparency improving, yet institutional, financial and technical knowledge capacities remain uneven. The nomenclature

balances harmonisation and interpretative flexibility, enabling robust cross-national comparisons without imposing uniformity. Beyond analysis, it provides a practical scaffold for implementation, monitoring, and iterative plan revision, and can be extended into an indicator-based system to track MSP contributions to the EGD over time.

KEYWORDS

assessment framework, cross-country comparison, European Green Deal, Maritime Spatial Planning, nomenclature, ecological transition

1 Introduction

In December 2019, the European Commission launched the European Green Deal (EGD), a set of policy initiatives with the overarching aim to make Europe the first climate neutral continent in the world (European Commission, 2019). The EGD constitutes an ambitious environmental, social, and economic transformation agenda. It brings together climate neutrality, biodiversity conservation, circular economy, sustainable food systems, and just transition under one framework, with direct implications for marine and coastal systems. The EGD was followed by numerous policy and legislative acts, such as the European Climate Law (European Union, 2021), detailing the objective of climate neutrality by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, and the Fit for 55 package, revising, i.a, the European emissions trading system, gradually extending carbon pricing to new sectors, including e.g., shipping.

In this frame, a specific agenda for the green transition of maritime sectors was defined (European Commission, 2021a), emphasising the needed transformation of all blue economy sectors—such as fisheries, aquaculture, coastal tourism, maritime transport, and marine renewable energy—toward the objectives of the EGD. This renewed approach for a sustainable blue economy (Karuppiah et al., 2025; Elston et al., 2024; Narwal et al., 2024) also highlights the need for knowledge, innovation, financing, and governance frameworks to ensure sustainability and resilience. Marine Spatial Planning (MSP)—named Maritime Spatial Planning in the European context—is identified as a key governance tool to balance competing maritime uses, integrate sustainability objectives, and provide spatial coherence for the transition to a sustainable blue economy.

The Ocean Pact (European Commission, 2025) has recently given additional momentum to several marine-related EGD objectives, particularly under the priority for protecting and restoring ocean health. This topic integrates the dimension of oceans as actors in climate change mitigation—through their carbon capture and storage potential and the opportunities offered by the development of offshore renewable energy. The need for acceleration toward the targets for biodiversity protection (30% of the European sea, 10% with strict protection—European Commission, 2020a) is highlighted. Given the evidence of largely unmanaged and ineffective Marine Protected Areas (MPAs) in Europe (Aminian-Biquet et al., 2024; Álvarez-Fernández et al., 2020; Fraschetti et al., 2018), the implementation of a management plan for each MPA is requested. The need for an ecosystem-based management of activities at sea, as well as those on land that affect the sea, is identified as crucial, as largely supported in the literature (Galparsoro et al., 2025; Zaucha et al., 2025; Kirkfeldt et al., 2021; Ansong et al., 2017; Katsanevakis et al., 2011; Douvere, 2008; Gilliland and Laffoley, 2008).

MSP is widely considered a strategic tool for managing ocean space through an integrated and forward-looking approach. It supports policymakers and stakeholders in organising marine areas under national jurisdiction according to ecological, social, and economic goals, enabling informed and coordinated decisions for the sustainable use of marine resources (IOC-UNESCO, 2021; Gissi et al., 2018; Jay et al., 2013; Qiu and Jones, 2013; Ehler and Douvere, 2009). Within this scope, the European MSP Directive (European Union, 2014) explicitly mention that healthy marine ecosystems and their multiple services, if integrated in planning decisions, can deliver substantial benefits, such as food production, recreation and tourism, climate change mitigation and adaptation, shoreline dynamics control, disaster prevention, just transition and fair distribution of benefits of sustainable blue economy.

While not originally conceived as an EGD tool, MSP's cross-sectoral scope makes it a natural platform to align sectoral developments with sustainability goals. MSP has been recognised as an enabler for the EGD in the marine realm (European Commission, 2022a). However, clearer guidance to strengthen the MSP–EGD linkage is needed (Wageningen Research et al., 2022). Integration with the EGD was found to be limited with core challenges including balancing renewable energy expansion with biodiversity protection, mitigating uneven zoning effects, and resolving sectoral conflicts (ibid).

The EGD adds further complexity to MSP as an umbrella framework that integrates diverse sectoral policies and initiatives, but with limited coherence and weak connections to preceding strategies (Sikora and Kawka, 2024; Hereu-Morales et al., 2024). Extracting its key objectives for the marine domain and translating them into operational terms remains difficult. Multiple aims and instruments overlap and at times conflict, creating an entangled policy landscape where priorities are interconnected but not consistently aligned (Stockmann, 2024). To date, no systematic method exists to assess how national MSP plans contribute to the EGD.

This paper addresses this gap by defining and critically reflecting on an EGD–MSP nomenclature: a structured taxonomy designed to disentangle the policy skein of the EGD and make its relevance for MSP explicit. The nomenclature enables harmonised

analysis of national plans, underpins monitoring and revision cycles, and offers potential integration with measurable targets and indicators. Its novelty lies in combining analytical clarity with operational utility, bridging scientific inquiry and planning. Accordingly, our research investigates: (1) how can the EGD's complexity be translated into a practical and operational framework for MSP; (2) to what extent does such a framework allow consistent evaluation across national contexts; (3) looking at the results from the application, what commonalities and differences in terms of EGD incorporation in MSP can be highlighted among the countries analysed; and, (4) how can such a framework support monitoring, revision, and the development of indicators to track MSP contributions to the EGD.

2 Materials and methods

2.1 Definition of an EGD-MSP nomenclature

A list of EGD core elements (e.g., keywords, subjects) was prepared, analysing the policy documents related to EGD (i.e., those indicated in Table 1). Six main thematic categories were extracted from this analysis and named *EGD topics*: (A) Climate change mitigation; (B) Climate change adaptation; (C) Sustainable seafood production; (D) Biodiversity and ecosystem protection and restoration; (E) Blue circular economy; and (F) Zero pollution. The principle of a (G) Fair and just transition was added as a transversal dimension (the seventh EGD topic).

A hierarchical structure is defined: each *topic* is subdivided into *sub-topics* and *operational elements*, also derived from the analysis of the policy documents, capturing progressively greater detail. This hierarchical articulation provides three levels of granularity and is associated with an alphanumeric code:

Level 1: topics (e.g., A. Climate change mitigation)

Level 2: sub-topics (e.g., A.1 Renewable energy production, storage and transportation)

Level 3: operational elements (e.g., A.1.5 Development of grid infrastructure).

In total, the nomenclature systematises over 60 elements across the seven EGD topics. Table 2 shows an extract of the nomenclature, relative to "Topic D. Biodiversity and ecosystem protection and restoration". The full nomenclature is presented in the Supplementary materials SM1.

TABLE 1 Policy documents considered to define the EGD-MSP nomenclature.

Short title	Reference
A clean planet for all—a European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy	European Commission, 2018
The European Green Deal	European Commission, 2019
EU biodiversity strategy for 2030—bringing nature back into our lives	European Commission, 2020a
A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system	European Commission, 2020b
A new circular economy action plan—for a cleaner and more competitive Europe	European Commission, 2020c
An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future	European Commission, 2020d
A new approach for a sustainable blue economy in the EU—transforming the EU's blue economy for a sustainable future	European Commission, 2021a
Pathway to a healthy planet for all—EU action plan: toward zero pollution for air, water and soil	European Commission, 2021b
Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030	European Commission, 2021c
REPowerEU Plan	European Commission, 2022b

2.2 Testing the nomenclature

The nomenclature was tested by analysing the MSP plans of seven European countries: Bulgaria, Finland, France, Germany, Italy, Latvia, and Spain. With these countries considered, experience from all the European sea-basins was included in the analysis. The methodology to assess the occurrence of EGD elements in the plans was based on three components: (1) desk-based analysis; (2) interviews; and (3) cross-country discussion within a workshop.

The desk-based analysis considered the national MSP plans, which are indicated in Table 3 as the primary source of information. Document consultation was not limited to plans: other sources were considered, such as MSP strategies, Strategic Environmental Assessments, communication documents, and websites. The different sections of the plans, namely *vision*, *objective* and *measures*—wherever available—were scanned to identify EGD-related elements, by using the nomenclature. To organize and standardize the analysis, summarising essential elements and allowing comparison across countries, a series of factsheets was compiled: (1) General features of MSP plans; (2) Operational elements; (3) Policy context; (4) Vision; (5) Objectives; (6) Measures; (7) Fair and just transition; (8) Cross-cutting elements supporting EGD (research and innovation; cross-border cooperation); (9) Zoning. The templates of the fact sheets are presented in the Supplementary materials SM2.

In order to ensure replicability, a step-by-step procedure for desk analysis is provided in the Supplementary materials SM3.

After the finalisation of the desk-based analysis, focused interviews were conducted to complement and contextualise the results. The purpose of the interviews was not to achieve statistical representativeness, but to address specific knowledge gaps identified during the document review. Guiding interview questions were defined in advance and are presented in the Supplementary materials SM4. Interviewees were selected through

TABLE 2 EGD-MSP nomenclature—extract related to topic D—biodiversity and ecosystem protection and restoration.

Topic	Biodiversity and ecosystem protection and restoration
D.1	**A coherent network of marine protected areas**
D.1.1	Establishment of new or enlargement of strictly marine protected areas (10% target) and definition of strict protection
D.1.2	Establishment of new or enlargement of Natura 2000 and OECMs (30% target)
D.1.3	Identification of ecological "blue" corridors
D.1.4	Elements that improve marine connectivity (i.e., submarine canyons, artificial reefs, etc.)
D.1.5	Multi-use of the sea space: combination including biodiversity and ecosystem protection
D.1.6	Coordinated, transboundary initiatives
D.2	**Restoring marine and coastal ecosystems**
D.2.1	Remediation of contaminated marine and/or coastal sites
D.2.2	Restoring of marine degraded ecosystems
D.3	**Knowledge-related measures**
D.4	**Governance-related measures**

Sub-topics are identified in bold. Operational elements are in normal text.

purposive sampling based on their direct involvement in, or detailed knowledge of, the MSP plans. Given the diversity in MSP plan preparation processes across countries, interviewees included planners, officials from competent MSP authorities, representatives of other public authorities involved in the MSP process, and key stakeholders participating. This selection logic aimed to balance institutional perspectives rather than to represent all stakeholder groups exhaustively in the planning process. Table 4 reports the number of interviews conducted per country. While this approach may introduce a degree of expert and institutional bias, it was considered appropriate for the exploratory and interpretative nature of the study, and the interview results were used to corroborate, clarify, or nuance findings from the desk analysis rather than to generate independent evidence.

Preliminary results from the assessment were subsequently discussed among the authors of this manuscript in a dedicated workshop, held in Turku (Finland) in June 2023 (Arki et al., 2023). The workshop served as a structured validation and synthesis exercise, supporting cross-country comparison and collective interpretation of results. Participants were directly involved in the MSP analysis for their respective countries, ensuring a high level of contextual knowledge while also implying a potential risk of shared analytical perspectives. To mitigate this, workshop design explicitly encouraged critical reflection, comparison across national contexts, and identification of both convergences and divergences. The workshop methodology comprised three complementary steps. First, participants presented concise, visually oriented summaries of their national MSP analysis using a Pecha Kucha format (Widyaningrum, 2016). Second, cross-cutting observations relevant to multiple countries were identified, discussed in small groups and consolidated in plenary sessions to highlight recurring patterns and emerging themes. Third, a World Café session facilitated focused dialogue on the seven EGD thematic areas in MSP with rotating working groups, while discussing success factors, gaps, and institutional constraints under the guidance of facilitators. Finally, participants worked in national groups, using a schematic 3D mapping exercise to spatially represent EGD-related activities and interactions along the land–sea continuum. Inspired by the Social–Ecological Systems (SES) approach (Nagel and Partelow, 2022; Colding and Barthel, 2019), this exercise supported systems thinking and visualisation of linkages between marine uses, ecological processes, and governance mechanisms.

2.3 Assessment of MSP plans

Results from the desk analysis, the interviews and the workshop were used to prepare seven EGD-MSP assessments, one for each country (Cornet et al., 2023). Finally, country-level assessments were used to prepare the cross-country EGD-MSP assessment, described in the results section of this article.

With the aim of complementing the findings described in this narrative assessment, a synthetic overview of the results from the country analysis was also prepared, using a semi-quantitative approach. The synthesis was based on the six EGD topics (thus excluding Fair and Just transition) and their respective sub-topics, with reference to the defined nomenclature. Inclusion of EGD elements in MSP objectives and measures was assessed at the sub-topic level, based on the screening of the plans reported in the country assessments. The occurrence of such elements was classified in three categories: (1) YES; (2) PARTIALLY; and (3) NO. The category (1) YES was applied in the cases where a clear and precise reference to the EGD elements was found in the plan. The category (2) PARTIALLY was interpreted as "to some extent". It was used in the cases where the elements found in the plan were partially or indirectly linked to the EGD elements. For example, in the case of Finland, sub-topic *A.1 Renewable energy production, storage and transportation* was classified as YES, because the plan identifies potential areas for energy production by offshore wind farms as a central measure for climate change mitigation. Sub-topic *A.2 Clean energy transition in maritime sectors* was classified as PARTIALLY, as the Finnish plan identifies objectives that can indirectly support emission reduction, such as electrification, digitalisation, and automatisation, but does not set any quantitative emission reduction targets for the maritime sectors. After having undertaken the analysis at the sub-topic level, results were aggregated, and the six considered topics were assigned to the classes (YES, PARTIALLY, NO), based on the occurrence of EGD elements in at least one of their sub-topics. An example of the application of this method is provided in Table 5.

3 Results

Figures 1, 2 synthesise the occurrence of EGD elements—both topics and sub-topics—in the MSP plans of the analysed countries, in the objectives and measures, respectively (the German plan does not include measures, and is therefore excluded from Figure 2). Overall, the topics Climate change mitigation and Sustainable sea-food production are the most frequently

TABLE 3 MSP plans analysed.

Country	MSP plan documents	Date of adoption
Bulgaria	Maritime Spatial Plan of the Republic of Bulgaria 2021-2035 (The Black Sea—an open door to the world, the Bulgarian Black Sea coast—our responsibility and common heritage)	11 May 2023
Finland	The Maritime Spatial Plan for Finland 2030	15 December 2020
France	Façade Strategic Documents (Documents Stratégiques de Façade—DSF) for - MEMN: Eastern Channel—North Sea (Hauts-de-France and Normandy regions) - NAMO: Northern Atlantic—Western Channel (Brittany and Pays de la Loire regions) - SA: South Atlantic (Nouvelle-Aquitaine regions) - MED: Mediterranean (Occitanie, Provence-Alpes-Côte d'Azur regions and Corsica)	DSF NAMO: - Sea basin Strategy: 24 September 2019 - Monitoring mechanism: 18 November 2021 - Action Plan: 06 May 2022 DSF MEMN: - Sea basin Strategy: 25 September 2019 - Monitoring mechanism: 21 October 2021 - Action Plan: 12 May 2022 DSF SA: - Sea basin Strategy: 14 October 2019 - Monitoring mechanism: 28 October 2021 - Action Plan: 4 May 2022 DSM MED: - Sea Basin Strategy: 4 October 2019 - Monitoring Mechanism: 20 October 2021 - Action Plan: 28 April 2022
Germany	Spatial plan for the German Exclusive Economic Zone in the North Sea and in the Baltic Sea	1 September 2021
Italy	Italian Maritime Spatial Plan "Tyrrhenian—Western Mediterranean" maritime area Italian Maritime Spatial Plan "Ionian—Central Mediterranean" maritime area Italian Maritime Spatial Plan "Adriatic" maritime area	25 September 2024 At the time of preparation of this analysis, the draft plans available for public consultation and the Strategic Environmental Assessment consultation were considered. Then, the results of the analysis were revised based on the final plans.
Latvia	"The Maritime Spatial Plan for the Marine Inland Waters, Territorial Sea and Exclusive Economic Zone Waters of the Republic of Latvia"—Maritime Spatial Plan 2030: National level long-term spatial development planning document	21 May 2019
Spain	Planes de Ordenación del Espacio Marítimo (POEM): Royal Decree of the approval of the POEM and the assessment of the 5 marine demarcations: - North-Atlantic - South-Atlantic - Levantine-Balearic - The Strait and Alboran Sea - Canary	28 February 2023

represented topics in MSP objectives. At the sub-category level, Climate change mitigation is mainly reflected through objectives related to renewable energy production, storage and transport, while decarbonization of maritime sectors and ports plays a minor role. Blue carbon ecosystems are almost not mentioned. For Sustainable sea-food production, fisheries and aquaculture are addressed to a similar extent, whereas sustainable algae production is much less considered. Despite the strong emphasis on mitigation, Climate change adaptation is less visible in MSP objectives across all the analysed sub-topics (green infrastructures, sensitive habitats and species, anticipation of climate change effects). Biodiversity and ecosystem protection and restoration is explicitly mentioned in more than half of the plans and indirectly referenced in the others: none of the plans omit it entirely. However, marine restoration remains clearly under-represented. Direct references to the Blue circular economy and Zero pollution are limited, although indirect mentions, such as in the case of waste and pollution prevention, are more common.

When analysing MSP measures, similar patterns emerge, though overall occurrences of EGD elements are slightly lower, except for Biodiversity protection and Zero pollution, which are more prominent in measures than in objectives.

Applying the EGD–MSP nomenclature to the analysis of MSP plans of the seven countries reveals topic-specific patterns, summarised below. The compiled fact-sheets with the results of the assessment at the country level are included in the Supplementary materials SM5. A summary table with semi-quantitative results (raw data for Figures 1, 2) is also included. Country reports describing these results in a narrative form are provided in Cornet et al. (2023).

TABLE 4 Interviews.

Country	Number of interviews	Interviewees category
Bulgaria	3	2 representatives of the Competent MSP Authority 1 planner involved in MSP Plan development
Finland	11	10 MSP planners from coastal regional councils 1 representative from the Ministry of the Environment
France	9	1 representative of competent MSP authority, 2 national authorities involved in MPA, 6 stakeholders (3 energy, 1 fisheries, 1 maritime transport, 1 NGO)
Germany	3	1 MSP planner, 2 sector stakeholders (energy, NGO)
Italy	3	2 regional authorities involved in MSP preparation, 1 sector stakeholder (NGO)
Latvia	3* **all represented direct involvement in the process of developing, evaluating and elaborating the Plan*	1 dual-role representative of competent MSP Authority and as a national authority from the Ministry of Smart Administration and Regional Development, 1 representative of a research organisation, 1 representative of an environmental NGO
Spain	3	2 representatives of MSP Competent Authority 1 representative of a research organization 1 representative of an environmental NGO

TABLE 5 Example of assignment of the attribute of occurrence to a topic, based on the occurrence of its sub-topics.

Topic	Occurrence
Climate change mitigation	**Y**
Sub-topics	
Renewable energy production, storage and transportation	Y
Clean energy transition in maritime sectors	Partially
Transformations in ports	Partially
Blue carbon sinks	N

The example considers one hypothetical country. The attribute of occurrence for the Topic Climate change mitigation indicated in bold is "derived" by the results of occurrence of the Sub-topics, according to the approach described in the text.

3.1 Climate change mitigation

All assessed MSP plans address climate change mitigation, primarily through the energy transition at sea. Offshore Renewable Energy (ORE) —almost exclusively offshore wind—is identified as the main lever to reduce emissions and enhances energy security. In Germany, the MSP plan combines zoning and quantitative targets, designating priority and reservation areas aligned with national offshore wind goals of 20 GW by 2030 and 40 GW by 2040. France and Italy link their plans to national energy strategies but without explicit spatial allocations: France follows the 2019–2028 Multiannual Energy Plan (2.4 GW by 2023; 5.2–6.2 GW by 2028), while Italy targets 30% of total energy consumption from renewables (both onshore and offshore) by 2030 (≈ 33 Mtoe) and foresees guidelines and to identify suitable offshore areas for energy production and manage potential conflicts. By contrast, Finland and Latvia include spatial provisions in their MSP plans but do not define production targets. According to the Integrated National Energy and Climate Plan (PNIEC 2023–2030), Spain is considering the development of up to 3 GW of floating offshore wind power by 2030; the PNIEC was approved several months after the MSP plan, which refers to its earlier version. Finland identifies potential offshore wind areas covering 4.4% of its planning area; Latvia designates five energy zones totalling 1,649 km² (6% of the MSP area); and Spain defines "High Potential Areas" for offshore wind covering 0.46% of national waters, in line with its National Roadmap for Offshore Wind and Marine Energy. Bulgaria's plan acknowledges the potential for offshore renewables but does not specify targets or designed areas. Integration between MSP and energy planning varies across countries and, in some cases, extends beyond offshore renewables. France has recently amended its legal framework to include offshore wind zones directly within MSP and conducts joint public consultations, while Spain aligned its MSP with national offshore energy planning. Attention to multi-use—such as coexistence with fisheries or shipping—is emerging in Latvia and Spain, while Italy and Spain also promote port electrification and alternative fuels. Consideration of blue carbon ecosystems remains limited and largely confined to vague references in the Bulgarian and Italian MSP plans.

3.2 Climate change adaptation

All analysed MSP plans reference climate change adaptation, but mostly indirectly, often embedded in environmental protection or MPA-related measures, rather than framed as explicit adaptation objectives. France focuses on adaptation to coastal erosion and flood risk management, while postponing more comprehensive integration to future planning cycles. Nevertheless, the French plans mention the use of Marine Green Infrastructures (MGI) and nature-based solutions (NBS) as tools for coastal resilience. They also highlight sector-specific challenges, such as the need to improve the fisheries sector's adaptability to changing ocean conditions, including risks linked to toxic micro-algae and pathogens. Finland links adaptation to the identification of underwater natural values that support functional ecosystems and thereby contribute to flood protection, erosion control, and nutrient binding. The Finnish plan also introduces a flexibility mechanism, leaving certain maritime areas unassigned to allow future adaptation to evolving conditions. Italy adopts a structured

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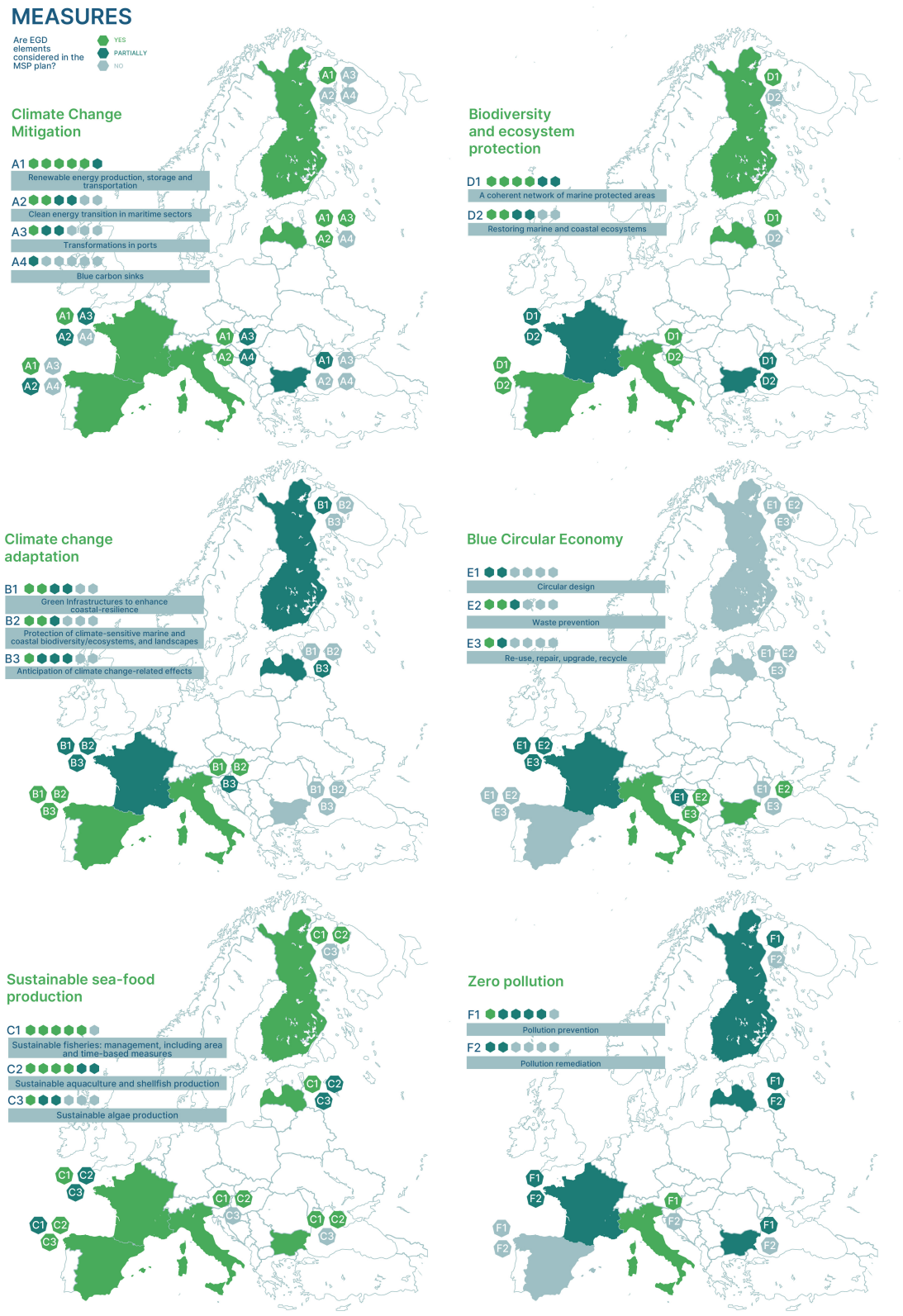

FIGURE 1
Occurrence of EGD elements (topics and sub-topics) in the objectives of the assessed MSP plans. The figure includes six panels, one for each topic (Climate change mitigation; Climate change adaptation; etc). Occurrence of topics in the MSP plan of each country is represented by the colour of the country (Light green = YES, Dark green = partially; Grey = NO). Occurrence of each sub-topic is also provided by the colour of the circles (same color palette as before).

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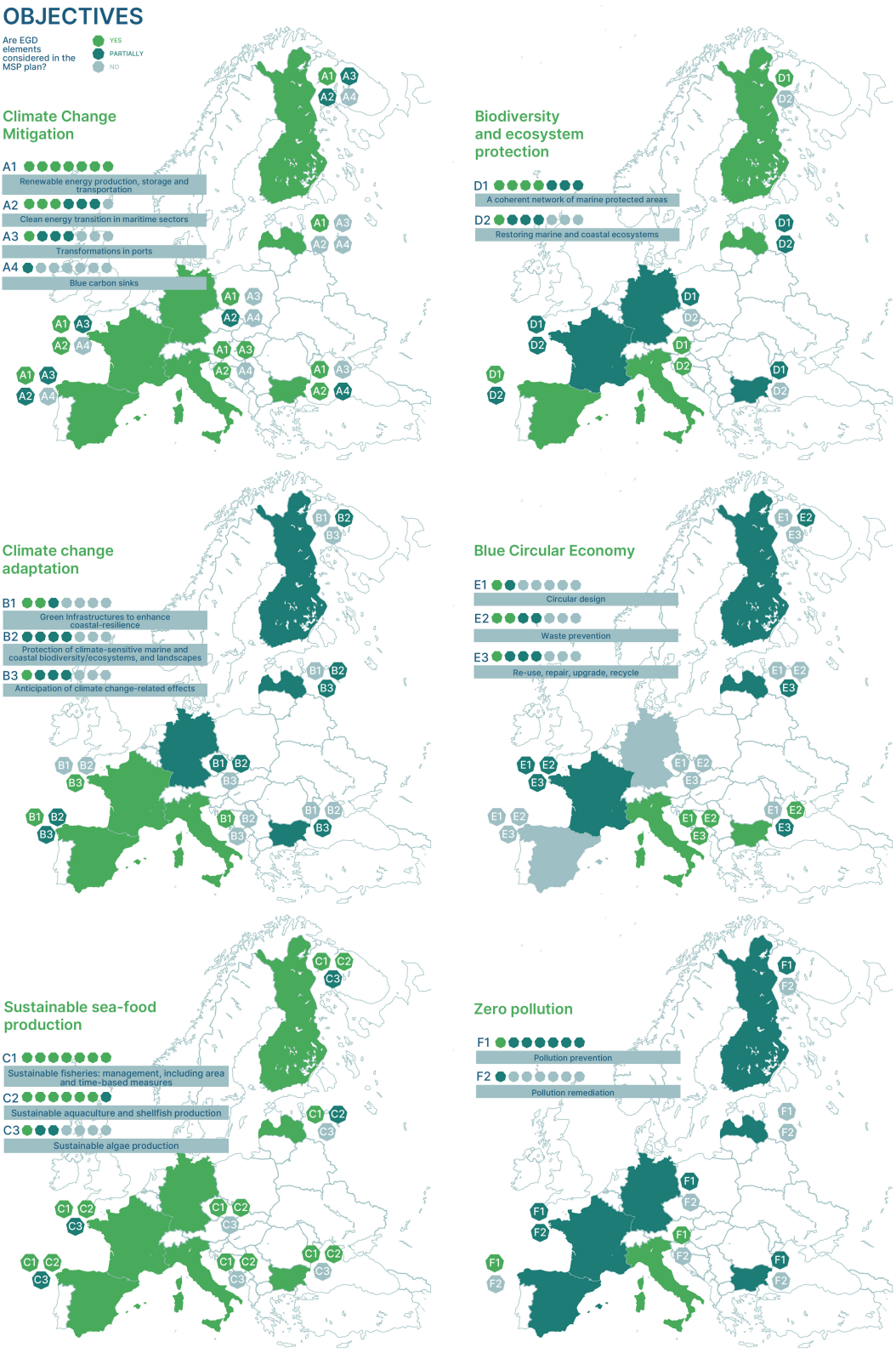

FIGURE 2
Occurrence of EGD elements (topics and sub-topics) in the measures of the assessed MSP plans (Germany is not considered because the plan does not include measures). The figure includes six panels, one for each topic (Climate change mitigation; Climate change adaptation; etc). Occurrence of topics in the MSP plan of each country is represented by the colour of the country (Light green = YES, Dark green = partially; Grey = NO). Occurrence of each sub-topic is also provided by the colour of the circles (same color palette as before).

approach, including a cross-cutting measure to assess climate change impacts on maritime sectors, coastal protection, and biodiversity, and promotes NBS such as dune systems and coastal wetlands. Spain similarly acknowledges the use of NBS and MGI, linking them to integrated coastal zone management and ecosystem restoration. Workshop discussions confirmed that adaptation remains underdeveloped in MSP plans due to the mid-term planning horizon, which complicates the anticipation of long-term impacts. Participants stressed the need to frame adaptation as part of a fair and just transition, involving vulnerable coastal communities, improved data availability, and capacity building.

3.3 Sustainable sea food production

All assessed MSP support sustainable seafood production, in line with the objectives of the EU Farm to Fork Strategy. Achieving sustainable fisheries is a shared goal, though national approaches differ depending on how MSP interacts with fisheries policies and governance. In Germany, fisheries are not regulated directly through MSP, but the plan safeguards areas important for fishing, such as zones for Norway lobster, by excluding incompatible uses like offshore wind. Similarly, Latvia identifies sustainable fisheries as one of its six MSP priorities and maps fish nursery areas, spawning grounds, and catch distributions by species to inform spatial decisions. Spain's MSP plan targets Maximum Sustainable Yield (MSY) for commercial species and reduces fishing impacts on biodiversity; it also integrates Marine Reserves of Fishing Interest within the national network of marine protected areas and as priority use areas for biodiversity protection in the Spanish MSP plans. Finland promotes fishing that enhances marine environmental status and delineates potential areas for coastal net and trawl fishing, ensuring continued access for professional fleets. Other plans regulate fisheries more directly. Bulgaria introduces quotas and controls on unregulated fishing. France introduces measures to reduce bycatch and the impact of fishing gears, as well as to improve licensing procedures. Italy adopts a comprehensive package of measures addressing overfishing, Essential Fish Habitats (EFH), small-scale fisheries, Illegal, unreported and unregulated fishing (IUU) control, and multi-level governance aligned with EU and international levels (FAO-GFCM, CBD) policies. Fisheries' diversity—ranging from small-scale coastal fleets to large offshore operators—creates different spatial needs and conflicts with new maritime sectors such as offshore wind. The common lack of location data for Small-Scale Fisheries (SSF), often exempt from tracking systems, limits their inclusion in spatial planning. Aquaculture is widely addressed. Italy integrates aquaculture into zoning and supports Allocated Zones for Aquaculture (AZA), while Spain identifies Areas of Interest for Aquaculture (ZIA/ZICM) as part of the High Potential Areas for the development of the sector in the MSP plans. Germany promotes co-use between aquaculture and offshore wind, and Finland encourages integration of algaculture with fish farming to reduce nutrient output. Seaweed cultivation remains marginal, though it is emerging in France, Spain, and Finland.

3.4 Biodiversity and ecosystem protection and restoration

All assessed MSP plans recognise the protection of the marine environment as an overarching objective. However, the designation or extension of MPAs generally lies outside the formal scope of MSP. Instead, most plans act as facilitating or supporting frameworks for the implementation of biodiversity policies, contributing to the EU Biodiversity Strategy 2030 target of protecting 30 % of EU seas, of which 10 % should be strictly protected. In Bulgaria, although MPA designation is excluded from MSP, the plan expresses a political commitment to achieving the 2030 targets. Italy goes further by identifying priority planning units for nature protection and establishing a joint MSFD–MSP-fisheries policy working group to locate valuable areas for extending the Natura 2000 network and defining Other Effective Area-Based Conservation Measures (OECMs). France calls for the establishment of highly protected areas, but does not include operative measures. Latvia supports conservation indirectly, by requiring updated qualitative assessments of ecologically significant areas and biotopes. Some countries integrate biodiversity-oriented zoning within MSP. The German EEZ plan designates priority and reservation areas for nature conservation and excludes incompatible uses. The Finnish plan maps areas of significant underwater natural values to visualise ecological networks. Spain designates Priority Use Areas (existing MPAs and Natura 2000 sites) and High Potential Areas for Biodiversity Conservation to identify candidate zones for future protection. Ecological connectivity is receiving increasing attention. Spain promotes MGI to strengthen ecological functionality, connectivity and resilience, providing annexes for each marine demarcation that include factsheets, descriptions and maps. The Italian MSFD–MSP-fisheries policy working group will assess marine connectivity, while Germany addresses it through measures safeguarding bird migration corridors and ensuring permeability of marine space for migratory species. Ecosystem restoration remains limited in MSP practices. Italy explicitly aligns MSP with the European Restoration Law (European Union, 2024), introducing a strategic objective to prepare a National Plan for Environmental Restoration and identify priority habitats for restoration. Spain indirectly supports restoration through the reference to its National Strategy for Green Infrastructure and Ecological Connectivity and Restoration. Overall, MSP plans increasingly complement conservation frameworks by integrating ecological considerations, strengthening connectivity, and aligning marine planning with EU biodiversity and restoration objectives.

3.5 Blue circular economy

The integration of the blue circular economy into MSP plans varies widely across countries, reflecting differences in planning scope, institutional mandates, and links with national circular economy policies. France and Italy show the most comprehensive approaches, addressing circularity both strategically and operationally. In France, all MSP plans incorporate blue

circular economy principles within their vision statements and measures, including eco-design of vessels and infrastructures, recovery of waste from decommissioned boats and fishing gear, and sediment reuse from dredging. The plans also promote citizen engagement through waste-oriented ocean literacy initiatives and support for voluntary shoreline clean-ups. A sea-basin perspective is encouraged, calling for cross-country information exchange and coordination of European circular economy initiatives. Italy's MSP plans similarly embed circularity through a cross-cutting objective promoting sustainable opportunities across marine and maritime sectors. Specific measures target ship and boat supply chains, aquaculture and fisheries by-products, and the recycling of port and coastal waste. The plans also propose synergies between these measures and the requalification of decommissioned coastal industrial areas, explicitly linking MSP to the National Strategy for the Circular Economy and the National Bioeconomy Strategy. In Finland, the blue circular economy is treated as a cross-sectoral theme, with emphasis on resource efficiency, material reuse in offshore wind and dredging activities, valorisation of fish side streams for biotechnology, and improved recycling infrastructure in ports and marinas. Although Bulgaria and Latvia do not include explicit objectives on the blue circular economy, both contain sector-specific references: Bulgaria promotes waste prevention and pollutant reduction based on circular principles, while Latvia addresses sediment reuse from dredging. Overall, a limited number of MSP plans translate circular economy principles into concrete operational measures. Nevertheless, the increasing attention to circularity suggests a gradual shift toward integrating resource efficiency, waste valorisation, and cross-sectoral synergies within MSP.

3.6 Zero pollution

The Zero pollution objective receives limited but consistent attention mainly through preventive, sector-specific measures. Plans typically address key pollution drivers associated with shipping, ports, fisheries, aquaculture, offshore energy, tourism, and security activities, while some also acknowledge land-based sources and land–sea interactions. France, Latvia, and Spain explicitly include objectives to reduce nutrient and pollutant discharges from agriculture, landfills, and wastewater systems into the marine environment. All plans refer to achieving or maintaining Good Environmental Status (GES) and to implementing the Marine Strategy Framework Directive (MSFD), and several also align with regional and international frameworks such as OSPAR, HELCOM, and MARPOL. For example, the German EEZ plan explicitly references these conventions in relation to controlling emissions from shipping. Specific pollution pressures addressed in the MSP plans include water and air emissions, underwater noise, solid waste, and invasive species. However, remediation measures remain rare. France includes actions to identify and address marine waste accumulation areas, and Latvia promotes algae and mussel aquaculture as potential nature-based solutions for nutrient removal and eutrophication control. Overall, MSP contributes to the zero-pollution ambition primarily through alignment with existing environmental frameworks and sectoral regulation, while active remediation and integrated management measures remain limited.

3.7 Fair and just transition in MSP

Although no common definition of a fair and just transition in MSP exists, it is generally interpreted through inclusiveness, transparency, access to data and participation in decision-making. Fairness is mainly associated with the balanced representation of stakeholders and sea uses, as well as with the capacity of public authorities, private actors, and civil society to influence planning outcomes. All assessed countries organised participatory processes to coordinate sea uses and align policy objectives, although approaches vary according to governance structures. Bulgaria's MSP plan promotes multifunctional zones to foster sectoral synergies. Italy's plans show strong regional involvement, ensuring that local expertise informs national decisions and embedding a long-term participation strategy for implementation and monitoring. Germany applied separate participation processes for MSP in the EEZ and the territorial waters, while France organised participation at the level of each sea façade, including the general public. Finland integrated MSP coordination with coastal strategy development, and Latvia merged its MSP Group with coastal coordination networks to strengthen intersectoral dialogue. In Spain, stakeholder engagement was central to defining offshore wind development zones in cooperation with biodiversity and fisheries authorities, although some sector representatives considered this insufficient. Overall, differences in capacity and influence among sectors persist, particularly between large industrial actors and small-scale or local stakeholders. Public communication and data accessibility are widely promoted through online portals, newsletters, and social media. All MSP plans and datasets are publicly available at the national level or via EMODnet, contributing to improved awareness and trust. However, socio-economic implications are rarely addressed, and the fairness of the distribution of costs and benefits is largely absent. Overall, MSP plans in Europe are evolving from consultation toward co-creation, positioning participation as a key governance tool for a fairer, more inclusive, and socially sustainable blue transition.

4 Discussion

This section uses the study results to address the research questions. Section 4.1 responds to the first two questions: (1) how can the EGD's complexity be translated into a practical and operational framework for MSP; (2) to what extent does such a framework allow consistent evaluation across national contexts. This section also discusses the novelty of the approach and key methodological challenges. Section 4.2 addresses the third research question (3) what commonalities and differences in terms of EGD incorporation in MSP can be highlighted among the countries: in this section, the results of the analysis are discussed by looking at the EGD topics and how they are considered in the different MSP plans, and by comparing the findings with knowledge from the literature. Finally, Section 4.3 responds to the fourth

research question exploring (4) how can such a framework support monitoring, revision, and the development of indicators to track MSP contributions to the EGD.

4.1 Translating the EGD into a practical MSP framework

The EGD is one of the most comprehensive policy frameworks ever developed by the European Union, integrating climate neutrality, biodiversity protection and restoration, circular economy, sustainable food systems, and social justice under a single transformative agenda. However, the EGD's cross-sectoral and multi-level nature poses challenges when translating its objectives into specific policy instruments such as MSP. This study addresses this challenge through the development of the EGD–MSP nomenclature, conceived as a practical framework to organise the EGD's complexity and render it operational for MSP analysis and implementation.

By identifying seven thematic topics—ranging from climate mitigation and adaptation to biodiversity protection and the blue circular economy—the nomenclature condenses a broad and heterogeneous set of EGD objectives into a manageable structure aligned with MSP's marine and maritime focuses. The hierarchical articulation of topics, sub-topics, and operational elements offers a progressive level of granularity, allowing planners and analysts to move from high-level policy priorities to concrete planning measures and spatial objectives.

The EGD–MSP nomenclature thus functions as an interface between high-level EU policy and operational MSP practice. It translates strategic sustainability ambitions into terminology and categories compatible with planning instruments, thus bridging the policy–implementation gap. The framework also supports policy coherence by linking MSP provisions with the evolving corpus of EGD-related legislation, such as the Biodiversity Strategy, the Climate Law, and the Zero Pollution Action Plan, while remaining adaptable to future policy developments.

4.1.1 Consistency and flexibility in cross-national evaluation

The comparative analysis of MSP plans of seven EU Member States shows that the EGD–MSP nomenclature provides a robust structure for cross-country assessment. Its standardised coding system facilitated the identification and comparison of EGD-related elements across diverse planning traditions, governance systems, and sea-basin contexts.

At the same time, the exercise also revealed the need for a degree of interpretative flexibility when applying the framework. National MSP plans vary widely in format, level of detail, and institutional logic. While some plans articulate explicit sustainability objectives aligned with EGD principles, others embed them implicitly within sectoral measures or spatial designations. Accordingly, the correspondence between nomenclature elements and plan contents often required expert judgment and contextual interpretation. This flexibility is not a weakness but an inherent feature of comparative policy research (Pasetti et al., 2024; Minkman et al., 2018), particularly when dealing with complex and evolving policy systems such as the EGD.

Overall, the framework balances standardisation and adaptability. On one hand, it ensures a coherent analytical baseline for comparing how national MSP plans address EGD-related priorities. On the other hand, it accommodates the heterogeneity of planning documents and national contexts by allowing analysts to interpret the presence or absence of EGD elements "to a certain extent." Such a balanced approach proved instrumental in maintaining analytical consistency without imposing artificial uniformity on countries' diverse MSP systems.

From a methodological perspective, cross-national comparability is challenged by differences in MSP plan typologies, legal mandates, and degrees of operationalisation, particularly with regard to the presence or absence of explicit measures. Some MSP plans function primarily as strategic or indicative frameworks and therefore limit the articulation of concrete measures, while others adopt prescriptive planning models with binding spatial allocations and regulatory provisions. In this context, the absence of measures cannot be interpreted straightforwardly as a lack of alignment with EGD objectives, but must be understood in relation to the institutional scope and legal function of each plan. The EGD–MSP nomenclature addresses this challenge by structuring the analysis across vision, objectives and measures while allowing for differentiated interpretation of their occurrence. This methodological approach supports comparability across heterogeneous planning systems without introducing bias linked to national differences in MSP mandates or regulatory depth.

4.1.2 Novelty and added value

The EGD–MSP nomenclature brings methodological innovation and a potential transformative role in linking MSP with the EGD. It supports the harmonisation of approaches to ecological transition across different countries. National MSP plans differ in mandate, level of detail, and governance tradition, and are deeply shaped by their geographic, cultural, and political contexts (Zaucha et al., 2025; Jones et al., 2016; Kidd and Shaw, 2014). Cross-country comparison of MSP plans is frequently hampered by divergent labels, sea-use categories and zoning terms, even when underlying concepts are similar. While existing initiatives have sought to standardise MSP terminology at regional and European levels (TEG-MSP, 2024; MSPglobal, 2021; HELCOM-VASAB, 2019), these frameworks primarily focus on ensuring semantic consistency and data interoperability. The EGD–MSP nomenclature complements these efforts by introducing a conceptual bridge between MSP outputs and the strategic objectives of the EGD. In doing so, it extends the scope of harmonisation beyond data alignment, providing a structured vocabulary that explicitly links planning actions, policy objectives, and sustainability outcomes. This integration enables comparative assessments not only across countries and sea basins, but also across Green Deal thematic areas.

The nomenclature also extends the role of MSP analysis beyond the identification of textual references to EGD-related policies. Earlier assessments of EGD used in MSP (Wageningen Research et al., 2022) largely stopped at the level of whether the Green Deal, or its associated strategies, were mentioned in plan documents. In contrast, the nomenclature provides a framework that captures multi-level granularity: it distinguishes between high-level commitments (topics), thematic categories (sub-topics), and detailed operational elements, enabling the assessment not only of the presence of EGD elements, but also of how they are embedded in objectives and measures (Zaucha and Gee, 2019; Kidd and Ellis, 2014). This allows, for example, differentiation between generic references to biodiversity protection and specific zoning measures for ecological corridors.

The nomenclature also has clear operational relevance. It supports three interconnected functions. First, it enables *analysis* by providing a structured checklist for identifying EGD elements at different levels and for different components of the MSP plans. Second, it guides *implementation*, offering authorities a practical tool to ensure that sectoral measures—such as emission reductions in ports or restoration of degraded ecosystems—are explicitly included. Third, it creates the conditions for systematic *monitoring and revision*, allowing authorities and researchers to track how MSP plans evolve over time, whether new EGD components are integrated, and how measures are translated into practice. By combining these functions, the nomenclature moves from being a static analytical tool to becoming a dynamic governance instrument (Ehler and Douvere, 2009; Pomeroy et al., 2014; Ehler, 2017; European Commission, 2022a).

The results of applying the nomenclature confirm its utility in this respect. It successfully highlighted both strengths and weaknesses across the analysed MSP plans. Importantly, the nomenclature made it possible to generate harmonised datasets and summaries across the seven countries, despite significant national differences. This demonstrates its capacity not only as an analytical tool but also as a communicative device to support the needed science-to-policy dialogue in MSP (Zürcher R. et al., 2022; Schumacher et al., 2020).

4.1.3 Methodological challenges

The application of the nomenclature also points to some methodological limitations. The semi-quantitative assessment (results reported in Figure 1) does not capture frequency differences in the occurrence of the EGD elements in the plans, appearing across sub-topics. In addition, some degrees of heterogeneity exist between topics, for instance, regarding the number of sub-topics they rely on. From that perspective, comparisons between topics' occurrence should be approached carefully, and reflect only generic tendencies. The assignment of occurrence assessment (NO, PARTIALLY, YES) was an expert-based judgement. Another challenge is maintaining relevance as the EGD continues to evolve, introducing new priorities and strategies. The nomenclature must remain flexible and open to updates, while preserving the stability needed for cross-country comparability. Balancing national specificities with harmonised analysis poses challenges too: some measures may appear differently across contexts, and interpretations of EGD concepts (for example, ecosystem "restoration") can vary. In addition, provisions that advance EGD objectives may not always be explicitly framed in Green Deal terms, such as ecosystem protection contributing to climate adaptation without being labelled as such.

Finally, it is important to underline that the proposed nomenclature is designed to assess the occurrence and framing of EGD elements within MSP plans, but this should not be conflated with MSP's actual contribution to achieving EGD objectives. The presence of EGD-related topics, sub-topics, and detailed elements in planning documents indicates a level of policy alignment and sonohow commitment, yet it does not provide evidence of their effectiveness in practice. Whether MSP contributes meaningfully to EGD outcomes depends on how measures are implemented, enforced, monitored, and adapted over time, as well as on their interaction with sectoral policies and governance instruments beyond MSP.

4.2 EGD topics in MSP: key patterns

Before discussing the key patterns emerging from the results, it is important to acknowledge that the analysis draws on MSP plans from seven EU Member States, spanning different sea basins, governance traditions, and planning approaches, rather than covering the full set of 22 EU countries with marine waters. While this necessarily limits the scope of the assessment, the heterogeneity of the cases considered supports the analytical value of the findings. Accordingly, the results should be interpreted as indicative rather than exhaustive, offering meaningful insights into prevailing patterns and tendencies in the incorporation of EGD elements in MSP plans, rather than a comprehensive assessment of EU-wide coverage.

4.2.1 Climate change mitigation

Climate change mitigation is the most explicitly addressed EGD dimension in MSP, primarily through offshore renewable energy. This reflects the emergence of the "climate-smart MSP" concept, where renewable energy zones and supporting infrastructures represent MSP's most direct spatial contribution to decarbonisation (Frazão Santos et al., 2020; Queirós et al., 2025). The prominence of offshore wind energy as a mitigation tool aligns with current guidance on embedding clean energy expansion in MSP processes (ICES, 2024) and with modelling research showing how zonation and cumulative-impact analysis can strengthen siting decisions (Depellegrin et al., 2024). Yet, the extent and form of this integration vary considerably among countries, reflecting differences in governance structures and institutional maturity. A second emerging dimension concerns the diversification of mitigation approaches beyond offshore renewables. Several MSP plans now mention port electrification, alternative fuels, or multi-use configurations that combine energy production with other maritime activities. Regarding multi-use platforms and coexistence at sea, several studies highlight both the technical potential and

the regulatory barriers of co-locating uses (van den Burg et al., 2020; Smith et al., 2025; Pardo et al., 2025). Nonetheless, the analysis confirms that most MSP plans treat mitigation in sectoral terms, with limited uptake of ecosystem-based or nature-inclusive strategies. References to blue carbon ecosystems and carbon capture and storage (CCS) appear only sporadically—mainly in Italy and Bulgaria—echoing the still-nascent consideration of carbon sequestration in MSP practice (Santos, 2023).

4.2.2 Climate change adaptation

Climate change adaptation is considered, implicitly in MSP plans, embedded within environmental protection or ecosystem management goals rather than as a standalone planning objective. Such indirect framing is consistent with the literature, which shows that adaptation remains underrepresented and largely descriptive in current MSP practice (Frazão Santos et al., 2020; Zürcher B. et al., 2022; Queirós et al., 2025). A notable development across several MSP plans is the growing attention to NBS and MGI as instruments for coastal resilience. National plans increasingly mention restoration of dunes, wetlands, and seagrass meadows as ways to buffer storm surges, stabilise coastlines, and maintain ecosystem services. These practices align with the EU's policy orientation promoting NBS for climate adaptation (European Commission, 2023) and with growing scientific recognition of their ecological and socio-economic co-benefits (Corgo et al., 2024; Marino et al., 2025). Finally, the study highlights the need for adaptive and long-term governance mechanisms to effectively address climate uncertainty. The mid-term horizon of most MSP plans constrains the capacity to anticipate long-term climate impacts or to design iterative responses. Literature on adaptive MSP governance stresses that flexibility, participatory processes, and continuous learning are essential for resilience in complex marine systems (Flannery et al., 2019; Pomeroy et al., 2023; IOC-UNESCO, 2021).

4.2.3 Sustainable seafood production

All analysed MSP plans incorporate sustainable seafood production, demonstrating convergence with the EU Farm to Fork Strategy (European Commission, 2020b) and the Common Fisheries Policy. However, the depth of integration varies considerably. This mirrors broader patterns identified in the literature, where fisheries integration in MSP ranges from minimal spatial consideration to comprehensive cross-sector coordination (Janssen et al., 2018; Pinarbaşi et al., 2019). While MSP provides a useful spatial interface for fisheries sustainability, full alignment with fisheries governance frameworks remains incomplete, often constrained by institutional boundaries and differing policy cycles. Several national plans explicitly identify AZAs or ZIA/ZICM, following FAO (2021) and EU guidance for sustainable aquaculture development (European Commission, 2021c). The inclusion of seaweed and algae cultivation in France, Spain, and Finland reflects the growing recognition of aquaculture's role in the circular and blue bio-economy, expanding the traditional seafood concept toward low-impact and climate-positive production. Despite these advances, significant knowledge and governance gaps remain, particularly for small-scale fisheries (SSF). The absence of spatial data—due to limited vessel tracking—and the diversity of fleets hinder their adequate representation in MSP (Demanèche et al., 2025; Symes et al., 2020). Addressing these knowledge gaps requires participatory mapping, local knowledge integration, and inclusive governance. Without these measures, the coexistence of artisanal and industrial fleets will continue to create spatial tensions, especially as offshore energy and aquaculture expand.

4.2.4 Biodiversity and ecosystem protection and restoration

Biodiversity and ecosystem protection and restoration is recognised as a central and cross-cutting goal in all MSP plans, yet the designation or extension of MPAs generally remains outside the formal remit of MSP. Instead, national plans operate as facilitating frameworks, supporting the implementation of the EU Biodiversity Strategy for 2030 and its target of protecting 30% of European seas, including 10% under strict protection (European Commission, 2020a). Bulgaria and France, for instance, express political or strategic commitments to the 2030 targets without operational mechanisms, while Italy advances further by delineating planning units prioritising nature protection and establishing a joint MSFD–MSP working group to identify areas for Natura 2000 expansion and OECMs. These examples demonstrate how MSP can complement conservation instruments even without formal authority over designation. A second trend concerns the integration of biodiversity-oriented zoning and ecological connectivity. Several MSP plans, including those of Germany, Finland, Spain, and Italy, incorporate ecological mapping and identify sensitive or valuable areas to reconcile marine uses with conservation needs. This focus on connectivity represents a step toward ecosystem-based MSP and aligns with current scientific understanding that maintaining connected seascapes enhances ecological resilience and the long-term effectiveness of MPAs (Virtanen et al., 2020; Jonsson et al., 2021; Podda et al., 2023). Finally, the incorporation of ecosystem restoration into MSP is still at an early stage. Italy's alignment with the EU Nature Restoration Law (European Union, 2024) marks a pioneering step toward integrating restoration objectives, supported by its proposal for a National Plan for Environmental Restoration. Spain follows a complementary approach through its National Strategy for Green Infrastructure and Ecological Connectivity and Restoration.

4.2.5 Blue circular economy

Blue circular economy is considered differently in MSP plans, reflecting differences in national mandates and their linkage with circular economy policies. Some plans explicitly connect spatial planning to national circular economy frameworks, translating policy ambitions into actionable planning tools, while others address issues such as sediment reuse or waste prevention within sectoral contexts. This pattern is consistent with recent EU analyses showing that the uptake of circular practices in blue sectors depends largely on institutional coordination and the

maturity of national policy frameworks (CINEA, 2021). Where circularity is more developed, MSP plans include operational measures that translate abstract principles into tangible outcomes, illustrating the growing role of MSP as a spatial enabler for circular economy transitions, fostering synergies between maritime industries, ports, and environmental goals. The concept of circular ports is emerging, where resource recovery, industrial symbiosis, and waste valorisation are coordinated through spatial planning (Faut et al., 2023; van den Berghe, 2024; OECD and International Transport Forum, 2023). At the same time, the most advanced MSP plans frame circularity as a systemic and governance-driven process, linking sectoral measures with multi-level cooperation and stakeholder participation. These directions align with broader guidance calling for integrated governance, financial mechanisms, and knowledge sharing to scale up marine circularity (UNEP FI, 2023; Ellen MacArthur Foundation, 2021; European Commission and Joint Research Centre, 2025).

4.2.6 Zero-pollution

MSP plans contribute to the EU's zero-pollution mainly by aligning spatial planning with existing environmental frameworks and prevention policies rather than by introducing new remediation measures. Practically, maritime uses and spatial rules are regulated within the MSFD objective of achieving Good Environmental Status (GES) (European Commission, 2008, 2017) and coordinating with sea-basin conventions. The alignment with the EU Zero Pollution Action Plan reinforces a prevention logic—reducing pollution inputs from sectors—over ex-post clean-up measures (European Commission, 2021c). At the level of specific pressures, MSP provisions typically reference or enable compliance with sectoral instruments: air emissions from shipping [(MARPOL Annex VI—IMO, 2020) sulphur cap]; solid wastes (European Directive 2019/883 on port reception facilities—European Union, 2019); underwater noise (MSFD Descriptor 11—European Commission and Joint Research Centre, 2023); and invasive species controls (IMO Ballast Water Management Convention—IMO, 2017). MSP functions as a coherence layer linking sectoral regulation by embedding these instruments into spatial provisions. By contrast, remediation and nature-based measures remain less developed. Only the French MSP plans mention the mapping and treatment of waste accumulation areas, and a pilot project exploring mussel or macroalgae aquaculture as nutrient-removal interventions is mentioned in the Latvian MSP plan.

4.2.7 Fair and just transition

Across the assessed countries, a fair and just transition is interpreted through ensured participation, including the effectiveness of the diverse actors to influence the process outcomes. In practice, fairness is operationalised by broad stakeholder participation, transparency of procedures, and balanced representation across scales. In the literature, social justice and inclusiveness are indicated as key dimensions of MSP, but participation is reported to remain uneven, and power asymmetries persist (Stalmokaite et al., 2025; Gilek et al., 2021; Flannery et al., 2018). A second dimension of fairness considered in this study was data access and transparency. The widespread publication of MSP documents and datasets via national portals and EMODnet has increased the visibility of planning evidence and improved stakeholder trust. According to international guidance, open data and communication tools are essential enablers of inclusive marine governance (IOC-UNESCO, 2021; EMODnet, 2024). Finally, the results show the value of cross-sectoral coordination platforms and participatory scenario exercises to mediate competing interests—such as offshore wind development and fisheries. These results are in line with the literature, indicating the need for continuous, bottom-up engagement to integrate social, ecological, and economic priorities within MSP (Zaucha et al., 2021; Bonnevie et al., 2023; Carpenter-Kling et al., 2025).

4.2.8 Commonalities and differences among countries

The cross-country analysis highlighted some aspects influencing the capacity of MSP to incorporate EGD-related elements and therefore contribute to its objectives. Firstly, national contexts play a decisive role in shaping how EGD objectives are reflected in national MSP plans. Several interlinked factors—policy timelines, the nature of references to the EGD, the implementation of pre-existing EU policies, the institutional mandate assigned to MSP, and the biophysical characteristics of marine areas—collectively determine the degree to which national plans contribute to the European Green Deal.

A major differentiating element lies in policy timing. Countries that had adopted or finalised their plans before the release of the EGD in December 2019, such as Finland, France, and Latvia, do not explicitly reference the European Green Deal. In contrast, those that developed or revised their plans afterwards, including Bulgaria, Germany, Italy, and Spain, more often integrate EGD language and components. The extent of such integration varies according to the moment of adoption and the national planning process (European Commission, 2022a; Wageningen Research et al., 2022). This demonstrates that temporal alignment with EU policy publication cycles largely influences the inclusion of EGD direct references.

However, explicit textual references alone provide limited insight into whether MSP plans actually operationalise European Green Deal objectives. In some plans, EGD and its strategies are mentioned bur there is a lack of operationalisation because specific measures are missing. Conversely, other countries may not explicitly cite certain EGD strategies but still embed their goals through planning objectives, zoning, or measures. This highlights that alignment cannot be assessed solely by textual reference but must consider how objectives are translated into implementation tools (Wageningen Research et al., 2022; Ehler and Douvere, 2009).

Differences also emerge from national approaches and mandates assigned to MSP. While the EGD encompasses a wide spectrum of spatial and non-spatial objectives across sectors, countries interpret the scope of MSP differently. Some adopt prescriptive, space-based systems (e.g., Spain); others rely on more strategic or indicative planning frameworks (e.g., Italy). These institutional and legal variations reflect political and cultural differences that shape how EGD principles are interpreted through MSP (Jones et al., 2016; Zaucha and Gee, 2019).

Finally, geographical and biophysical conditions further influence how EGD goals are considered. Marine planning must account for natural variability, dynamic sea uses, and physical constraints. In northern regions such as Finland, ice conditions affect maritime routes and offshore energy siting, while countries facing erosion and storm surges tend to prioritise climate adaptation. Spain's offshore planning, for example, designates floating wind energy areas farther offshore to avoid conflicts with coastal uses, whereas Baltic countries face chronic eutrophication that drives emphasis on pollution control and land–sea interactions (Gobierno de España, 2023; HELCOM, 2018). These environmental characteristics condition both the feasibility and cost of maritime activities and, consequently, the extent to which planners can enable EGD objectives.

Overall, the incorporation of EGD elements into MSP is not uniform across Europe. It depends on the intersection of institutional timing, legal mandates, policy continuity, and the physical realities of each marine environment. Understanding these contextual dimensions is essential to interpreting national variations and guiding future revisions of MSP plans toward stronger alignment with European Green Deal goals.

4.3 Conclusions and possible developments

Defining and applying an EGD-MSP nomenclature, this study describes how EGD elements are reflected in the MSP plans of seven European countries. The limited number of countries analysed represents a limitation for the observed patterns, far from being representative of trends across all the EU Member States. Nevertheless, they provide some interesting perspectives on the opportunities offered by MSP to contribute to the EGD objectives, also considering the variety of contexts they refer to. Future research could therefore expand the geographical scope of analysis and complement plan-based assessments with implementation- and impact-oriented evaluations,

This study highlights that not all elements of the EGD are equally aligned with European MSP plans. EGD components with a clear spatial dimension show the strongest and most direct alignment with MSP. These include nature protection, fisheries, aquaculture, and the offshore renewable energy (ORE) component of climate change mitigation. In these areas, MSP can play a central role by coordinating competing uses, reducing spatial conflicts, and supporting ecosystem-based management through spatial allocation and zoning.

At the same time, several EGD sub-topics associated with these policy domains are not inherently spatial. Technological innovation, behavioural change, governance mechanisms, and financial instruments often operate beyond the scope of spatial planning alone. This confirms that MSP should not be expected to function as a comprehensive solution for all marine governance or EGD-related challenges. Rather, MSP should be understood as a cross-cutting framework that enables coherence and coordination across sectoral policies, while relying on complementary instruments—such as fisheries management measures, MPA designation, environmental regulation, and climate or industrial policy—to address non-spatial dimensions. Strengthening the integrative role of MSP would enhance the strategic value of MSP without overextending its mandate.

Conversely, policy areas such as the blue circular economy and zero pollution, while highly relevant to sustainability goals, do not necessarily require systematic integration into MSP. These themes are often better addressed through sector-specific strategies, regulatory instruments, and innovation policies. MSP may still offer an enabling or complementary role, particularly where spatial synergies exist, but their integration should remain flexible and context-dependent, allowing Member States to decide whether and how MSP can add value.

The analysis clearly indicates that the fair and just transition dimension of the EGD requires substantially stronger consideration within MSP processes. Moving beyond formal or procedural stakeholder engagement, MSP should incorporate robust socio-economic impact assessments, evaluate the distributional effects of planning decisions, and ensure that benefits and burdens are equitably shared. The development of clearer standards or guidance for social impact assessment within MSP could significantly strengthen its contribution to social equity and legitimacy.

Overall, MSP should not aim to address all EGD elements uniformly, but rather prioritise those with strong spatial relevance, while actively aligning with sectoral policies and governance instruments where appropriate. Such an approach would enhance both the effectiveness of MSP and its contribution to the broader objectives of the European Green Deal.

From a methodological point of view, the results show that the nomenclature enables a consistent, detailed, and forward-looking evaluation of maritime spatial plans. More than a methodological device, it represents a tool for both scientific inquiry and policy practice. In doing so, it reframes MSP not merely as a mechanism for coordinating maritime uses, but as a strategic instrument for advancing Europe's ecological transition in the marine domain.

Looking forward, the most promising development is the transformation of the nomenclature into an indicator-based monitoring framework. By linking detailed sub-elements to quantitative targets, the nomenclature can serve as a bridge between planning practice and measurable policy progress. For instance, renewable energy sub-elements could be tied to EU capacity benchmarks such as 300 GW of offshore wind by 2050; biodiversity elements could be mapped against the EU target of 30% of marine areas under protection, with 10% strictly protected; and pollution-related measures could be associated with descriptors, criteria, indicators and thresholds under the Marine Strategy Framework Directive. Such alignment would enable systematic assessment of how MSP contributes to Green Deal goals, providing evidence for both accountability and adaptive management.

The nomenclature is therefore best conceived as a living framework. Its value does not lie in offering a definitive classification, but in providing a structured, adaptable system that can evolve with policy, science, and practice. This balance between adaptability and consistency represents a significant innovation in policy analysis tools. It ensures that MSP can be continually assessed and improved as both a planning instrument and a vehicle for Europe's ecological transition.

However, the nomenclature alone cannot fully assess the actual contribution of MSP to achieving EGD objectives. Assessing the efficacy of MSP measures requires moving beyond plan content

analysis to consider implementation pathways, institutional capacity, compliance mechanisms, and measurable environmental and socio-economic impacts. In this respect, the nomenclature should be seen as a useful but not sufficient tool: it helps identify where and how EGD priorities are embedded in MSP; additional evaluation frameworks and indicators are needed to determine whether these planning provisions translate into tangible progress toward EGD objectives.

Beyond the use of the nomenclature, to contribute to the objectives of the EGD, MSP should be able to translate EGD priorities into planning choices, A key area where MSP practitioners can add tangible value is the explicit operationalisation of the nature–food–energy nexus. MSP is particularly well-suited to address this nexus because it provides a spatial framework where biodiversity protection, marine food production (fisheries and aquaculture), and offshore renewable energy development interact and potentially compete. Future generations of MSP should therefore move from treating these sectors in parallel to jointly assessing their cumulative spatial demands, environmental impacts, trade-offs, and synergies. MSP practitioners could contribute to EGD objectives using the strategic and integrative function of MSP, and specifically by embedding nexus-based objectives into plan visions, objectives, and evaluation criteria. This includes explicitly linking spatial decisions to ecosystem condition, food system sustainability, and energy transition pathways, and ensuring consistency with relevant sectoral strategies and regulatory frameworks.

Data availability statement

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

Ethics statement

Ethical approval was not required for the studies involving humans because each contributor applied her/his own institutional ethical procedures. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MB: Methodology, Conceptualization, Investigation, Writing – review & editing, Writing – original draft. AC: Investigation, Writing – review & editing, Formal analysis, Data curation. VA: Investigation, Data curation, Writing – review & editing, Formal analysis. FS: Writing – review & editing, Investigation, Visualization. AB: Investigation, Writing – review & editing. DB: Writing – review & editing, Investigation. MC-L: Investigation, Writing – review & editing. PC: Funding acquisition, Writing – review & editing. FC: Writing – review & editing, Investigation. CC-N: Writing – review & editing, Investigation. AD: Writing – review & editing, Investigation. KF: Investigation, Writing – review & editing. KG: Investigation, Writing – review & editing. MG-B: Funding acquisition, Writing – review & editing. EG: Writing – review & editing, Investigation. BK: Investigation, Writing – review & editing. OL: Writing – review & editing, Funding acquisition. LP: Investigation, Writing – review & editing. MP-M: Writing – review & editing, Funding acquisition, Investigation. HSa: Writing – review & editing, Investigation. HSt: Writing – review & editing, Investigation. MSta: Writing – review & editing, Investigation. MStu: Writing – review & editing, Investigation. ER: Conceptualization, Funding acquisition, Writing – review & editing, Investigation, Writing – original draft.

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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

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