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Review

Introducing Smart Marine Ecosystem-Based Planning (SMEP)—How SMEP Can Drive Marine Spatial Planning Strategy and Its Implementation in Greece

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Abstract: This paper introduces smart marine ecosystem-based planning (SMEP), a marine spatial planning (MSP) strategy for more participatory and responsive marine governance by leveraging "smart" digital services. SMEP denotes an iterative MSP process with planning cycles that incorporate continuous data gathering of spatial–temporal natural phenomena and human activities in coastal and marine areas, with ongoing data mining to locate key patterns and trends, to strive for periodic refinement of the MSP output. SMEP aims to adopt an ecosystem-based approach, taking into account both living and nonliving aspects of the marine environment, and making use of all available spatial data at various resolutions. In pursuit of SMEP implementation, the paper examines the current state of the MSP process in Greece and relates its long-term success with the establishment of a marine spatial data infrastructure (MSDI), employing contemporary nautical cartography standards along with hydrospatial data services.

Keywords: smart marine ecosystem-based planning (SMEP); marine spatial planning (MSP); marine spatial data infrastructure (MSDI); marine cadastre; Maritime Limits and Boundaries (IHO S-121); Marine Protected Areas (IHO S-122); maritime service portfolios; hydrospatial data services

Citation: Contarinis, S.; Nakos, B.; Pallikaris, A. Introducing Smart Marine Ecosystem-Based Planning (SMEP)—How SMEP Can Drive Marine Spatial Planning Strategy and Its Implementation in Greece. *Geomatics* **2022**, *2*, 197–220. https://doi.org/10.3390/geomatics2020012

Academic Editors: Giuseppe Masetti, Ian Church, Anand Hiroji and Ove Andersen

Received: 26 April 2022
Accepted: 12 May 2022
Published: 13 May 2022

1. Introduction

Greece is the country with the ninth longest coastline in the world and the third in Europe (https://www.worldatlas.com/articles/countries-in-europe-with-the-longest-coastline.html (accessed on 8 May 2022)) (being approximately 15,000 km at the scale of 1:250,000) [1,2], with approximately 6000 islands and islets (https://www.visitgreece.gr/islands/ (accessed on 8 May 2022)), offering a highly diversified landscape. Based on OECD data [3], in the coastal zone of the country are concentrated almost 80% of industrial activity, 90% of tourism and leisure, 35% of rural land, and a significant portion of basic infrastructure (ports, airports, roads, electricity, telecommunications). However, despite its significant maritime wealth, Greece still lacks national spatial planning for the development of maritime activities.

The objectives of this paper are initially to have a short background on MSP in Section 2, highlighting ecological concerns and to describe the international and regional marine governance frameworks in Sections 3 and 4. In Section 5, the current situation in the MSP process in Greece is presented based on the recent legislation. In Section 6, the concept for smart marine ecosystem-based planning is introduced to accommodate a holistic view the constantly evolving "smart" needs of the marine areas. In Section 7, the possible next steps in the marine cadastre implementation in Greece is discussed facilitated by a marine spatial data infrastructure (MSDI), highlighting the use of relevant data model specifications of the International Hydrographic Organisation (IHO) for Maritime Limits and Boundaries and Marine Protected Areas. In addition, public cloud services (G-Cloud) are used as platforms to host the MSDI and serve the various stakeholders. Finally, in Section 8, the developments for the marine spatial planning (MSP) in Greece is discussed in the context of the post COVID-19 state's plan for reforms.

2. MSP Background

2.1. Ecological Concerns

Human activities have frequently resulted in measures to protect marine areas. For example, the Great Barrier Reef in Australia was conserved in the 1970s from the threat of offshore oil and gas extraction [4]. Likewise, in the Mediterranean Sea, the marine regions in the Ionian and Cretan seas (about 56,000 km^2), which have been granted as concessions to the oil and gas industry for hydrocarbon exploration, require protection [5]. From north of Corfu to southern Crete, the area coincides with the southwest Hellenic Trench, an important habitat and marine biodiversity hotspot of global ecological significance.

2.1.1. The Hellenic Trench

The deepest point in the Mediterranean Sea is located in the southwest of Greece, 62 miles off the coast of Cape Tainaros, and has a depth of 5120 m (https://iskra.gr/%CF%84%CE%B1-%CE%BC%CE%B5%CE%B3%CE%B1%CE%BB%CF%8D%CF%84%CE%B5%CF%81%CE%B1-%CE%B2%CE%AC%CE%B8%CE%B7-%CE%B8%CE%B1%CE%BB%CE%B1%CF%83%CF%83%CF%8E%CE%BD-%CF%83%CF%84%CE%B7%CE%BD-%CE%B5%CE%BB%CE%BB0%CE%AC/ (accessed on 8 May 2022)). It is about half the depth of the Mariana Trench, the deepest point on Earth, with a depth of 11,035 m, located between Indonesia and Japan. The second deepest point in the Mediterranean Sea is the deep of Rhodes, 14 miles east of the rock Paximada, with a maximum depth of 4710 m, and the third one is the deep southwest of Karpathos Island, with a maximum depth of 3294 m.

All three are part of the Hellenic Trench (Figure 1), a lengthy bathymetric feature consisting of a continuous steep continental seaward slope, bounded by offshore linear trenches, troughs, and basins. The area is a habitat for the endangered sperm whale (https://www.arion.org.gr/mammal/sperm-whale/ (accessed on 8 May 2022)) that includes some 200–250 animals threatened by potential ship-strikes and seismic blasts [6]. Because of the deep water and the seabed features, the Hellenic Trench is a shelter for deep-diving marine animals such as beaked whales, fin whales, several types of dolphins, Mediterranean monk seals, and sea turtles.

2.1.2. The Ionian Archipelago

In the adjacent Northern Ionian Archipelago, the population of common dolphins was substantially decreased a few decades ago, but the latest research has indicated that they are likely to be spread across the whole archipelago. The region also has one of the most important populations of Mediterranean monk seals (Monachus monachus), accounting for around 7% of the global population, and the breeding sites for pupping in the region have been systematically researched [7].

2.2. Important Marine Mammal Areas

Marine mammal specialists from across the globe have recognized the Hellenic Trench and the Ionian Sea Archipelago as "important marine mammal areas", while the Hellenic Trench has been also proposed as a marine protected area [5]. Moreover, the agreement for the Conservation of Cetaceans in the Black Sea and the Mediterranean Sea, known as ACCOBAMS (https://accobams.org/conservations-action/protected-areas/ (accessed on 8 May 2022)), has also acknowledged the ecological importance of the Hellenic Trench. However, just a small portion of Greece's southwest coast has been designated for protection thus far.

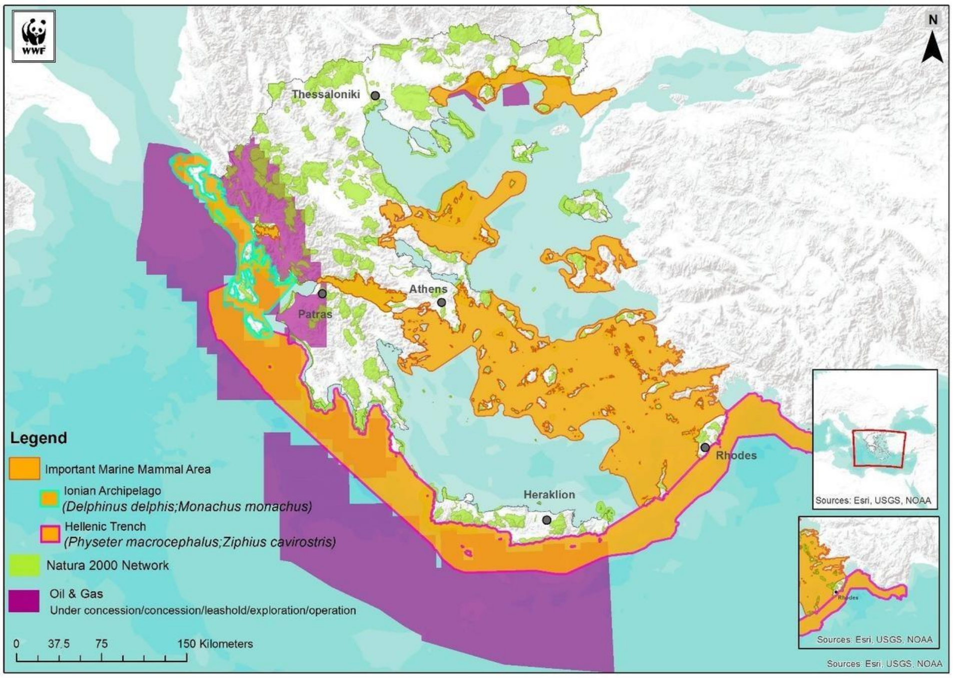

Figure 1. The Hellenic Trench (min. lat. 34°8′ N, min. long. 20°15′ E, max. lat. 37°15′ N, max. long. 28°0′ E) (https://www.marineregions.org/gazetteer.php?p=details&id=3347 (accessed on 8 May 2022)). Important marine mammal area. Reprinted with permission from Ref. [5]; Copyright 2019 WWF Greece.

2.3. Marine Spatial Planning

Marine spatial planning (MSP) is already used in over 60 countries worldwide to identify and resolve conflicts between competing uses of marine space in conjunction with ocean environment conservation programs. MSP is typically driven by the need to identify possible places for new uses in crowded waterways, such as energy extraction and production, and to reduce spatial and temporal conflicts between uses, as well as between demand and environmental protection [8].

MSP and Integrated Coastal Zone Management

The MSP process is related to the objectives of Integrated Coastal Zone Management (ICZM (http://www.coastalwiki.org/wiki/Integrated_Coastal_Zone_Management_(ICZM) (accessed on 8 May 2022))), which is defined by the European Union [9] as "a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning, decision making, management and monitoring of implementation". Moreover, according to the Baltic Marine Environment Protection Commission, also known as Helsinki Commission (HELCOM), there is a need to clarify the role of ICZM, as due to adoption of the MSP, many countries do not implement ICZM as a separate activity [10]. HELCOM is an international body that oversees the Baltic Sea Area Convention for the Protection of the Marine Environment, which suggests ten principles [11] that provide helpful direction for establishing greater cohesion for the region's growth, where the sixth principle is related to the quality of data available.

3. International Governance Framework for the Sea

3.1. United Nations Convention for the Law of the Sea (UNCLOS)

The United Nations, in the context of its founding principles and in order to contribute to the preservation of peace and justice in all the countries, confirmed at the Geneva Conferences in 1958 and 1960 that there should be an acceptable convention for the law of the sea. The complete version of the United Nations Convention on the Law of the Sea (UNCLOS) was presented in 1982 in Montego Bay, Jamaica (https://treaties.un.or g/Pages/Treaties.aspx?id=21&subid=0&lang=en&clang=_en (accessed on 8 May 2022)), entered into force in 1994, and is today the world's most recognized maritime law regime. The central idea of the UNCLOS convention is that maritime problems are interconnected and should be tackled as a whole. Greece ratified the Convention on the Law of the Sea (https://www.un.org/depts/los/convention_agreements/convention_declarations.htm (accessed on 8 May 2022)) in June 1995 (Law 2332/1995, Government Gazette 136/A/23-06-1995) [3]. The provisions of the UN convention apply to all areas of marine affairs, including the organization and development of productive activities and the emergence of marine entrepreneurship.

3.2. Sea Zones in Accordance with UNCLOS Provisions

According to UNCLOS [12] the following maritime zones can be distinguished (Figure 2) in marine areas:

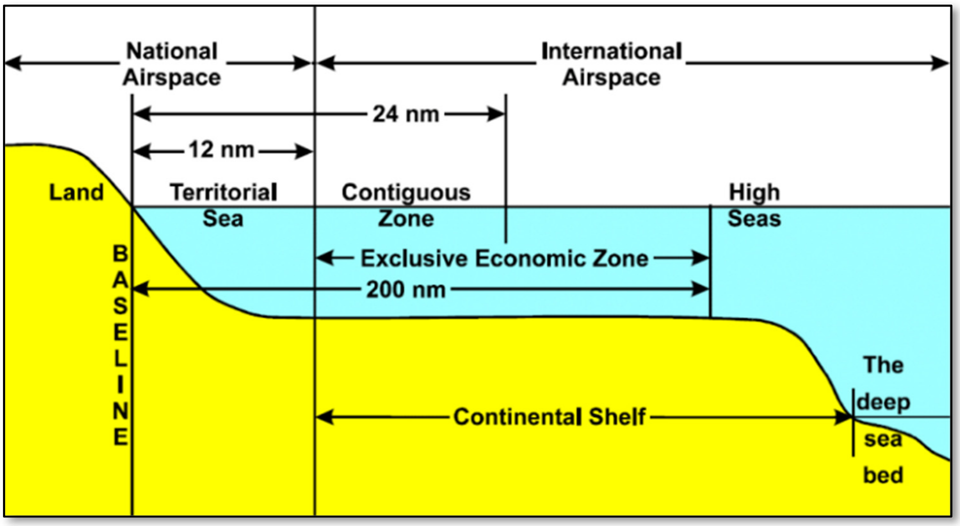

Figure 2. Maritime zones. Reproduced from footnote link (https://sites.tufts.edu/lawofthesea/chapter-two/ (accessed on 8 May 2022)), with permission of Tufts University.

- **Internal Waters** include the sum of the stagnant or flowing surface water and groundwater located on the landward side relative to the territorial sea baseline. Inland waters are dominated by the coastal state and ships from other countries are not allowed to freely pass.

- **Territorial Sea** (or coastal zone) is the zone extending over a range of up to 12 nautical miles from the shoreline (baseline), involving the water column, bottom, subsoil, and airspace, within which states are free to impose any rule of law, regulate any use, and exploit any resource. In the territorial waters, the right of "innocent passage" of ships and aircraft is permitted (continuous, fast transit that does not disturb the peace and security of the coastal state).

- **Contiguous Zone** is the zone having an internal boundary outside the territorial waters and an external boundary of up to 24 nm from the baseline of territorial waters. In this border zone, the coastal state does not have complete authority, but has the necessary control to prevent specific infringements concerning its national legislation in the field of health, customs, migration, and economic matters.

- **Exclusive Economic Zone** (EEZ) is the seabed and its subsoil extending beyond territorial waters to (potentially) a distance of 200 nm from the baseline (Figure 3). In the EEZ, the state does not exercise full sovereignty but sovereign rights. The EEZ regime covers all natural resources, whether living or not, as well as their economic exploitation, research, and environmental protection activities. In the case that the EEZs touch each other, it is up to the countries that are demanding them to jointly define maritime borders.

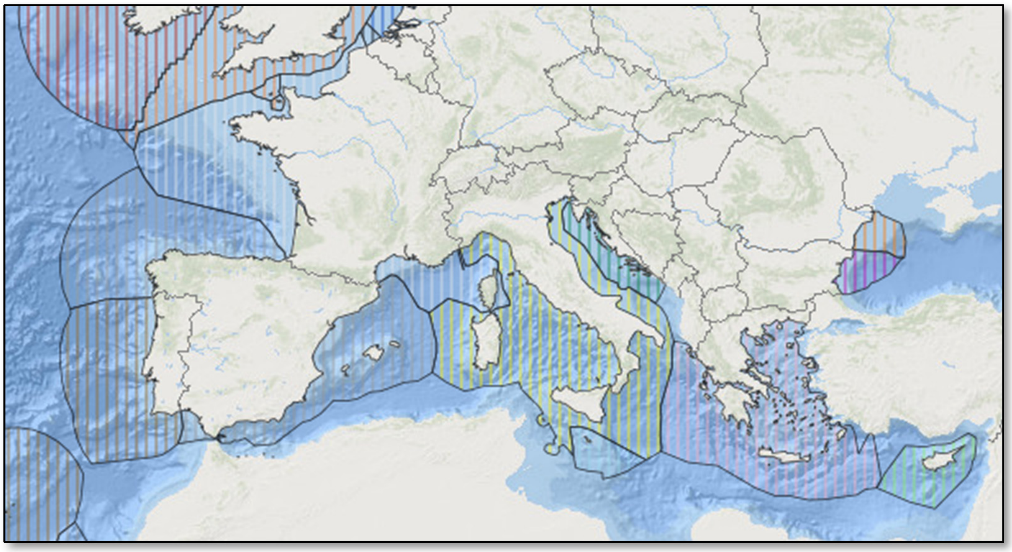

Figure 3. Borders of EU countries of the Mediterranean Sea from the view of the exclusive economic zones. Reproduced from https://emodnet.ec.europa.eu/en/map-week-%E2%80%93-exclusive-economic-zones (accessed on 8 May 2022)), with permission of EMODNET.

According to UNCLOS, an EEZ has only the inhabited islands, resulting from the presence of inhabitants, a lighthouse guardian, farm animals, cultivated land, and anything else that proves economic activity. However, for all other islands and rocks, the article of 12 nautical miles of the coastal zone is normally applied. A state's rights in the EEZ are only created after a declaration of its sovereign rights to the UN. The EEZ regime explicitly permits the construction and use of artificial islands, installations and other structures, scientific research, and the protection and preservation of the marine environment. Within the EEZ of one state, all states have the right to navigate, flight, cable and pipe laying, and other uses in accordance with the international law of the sea.

- **Continental Shelf** is the seafloor and the subsurface extending beyond territorial waters up to (potentially) 200 nautical miles (and up to the outer boundary of the continental shelf if it extends over the 200 nm). In the continental shelf, the state does not exercise full authority but has the rights to extract and make use of the natural resources. Its meaning is weakened because it overlaps with that of the exclusive economic zone (EEZ).

- **High Seas** are located beyond the boundary of the continental shelf and where the premise of innocent passage, fishing, cable laying, and scientific research pipelines applies.

3.3. Delimitation of Maritime Zones

According to this article [13], the UNCLOS mandated delimitation of marine zones is a driver of economic development, a management tool for the marine environment, and the foundation for spatial planning. Maritime regions and limits determine the borders of coastal nations, and their precise demarcation and cartographic portrayal is obligatory for every state. Even though the UN convention is a legislative document, its execution is purely technical, requiring scientific and practical knowledge of geoinformatics for those engaged.

Maritime Zones in Eastern Mediterranean

The delimitation of maritime zones in the Mediterranean Sea, and in particular in the Eastern Mediterranean, is well known and ambiguous, because as well as geographical, it is also political. In Greece today, there are declared territorial waters for the marine area at 6 nm from the baseline in accordance with Law No. 230/1936 (Government Gazette A-450/13-10-1936) (and 10 nm for airspace). Greece has not yet designated an EEZ with any neighboring country, although it has the right to do so in accordance with international maritime law and international law.

Disputes between Greece and Turkey over the Aegean continental shelf stretch back to 1973 (https://www.mfa.gr/en/issues-of-greek-turkish-relations/ (accessed on 8 May 2022)), when the Turkish Government released a permit to the national petroleum corporation to conduct research on the Greek continental shelf in the Eastern Aegean. Since then, Turkey's persistent attempts to infringe on Greece's sovereign rights to the continental shelf have become a major cause of conflict in the bilateral relations between the two nations. This article [14] takes into account the positions of the two countries as they have been formally articulated. The Greek perspective is that territorial waters demarcation should be ruled by the average line principle, while the Turkish perspective is that demarcation should be conducted in such a manner that it creates an equitable result, that does not essentially authorize islands to entire maritime zones.

3.4. The UNEP Regional Seas Programme

The concept of regional seas is used to identify and describe policies aimed at establishing and supporting multilateral, transnational cooperation networks in maritime clusters addressing common environmental issues. The ultimate goal is to create networks and partnerships between states to promote sustainability and identify the benefits of cooperative management of marine areas. The United Nations plays a central role in supporting such cooperation networks, and from the early 1970s has been trying to tackle integrated marine environmental problems through the Regional Seas Programme (RSP) (https://www.unep.org/explore-topics/oceans-seas/what-we-do/regional-seas-programme (accessed on 8 May 2022)), currently developed for 13 marine areas. This program is being implemented in the context of the United Nations Environment Programme (UNEP) (https://www.unep.org/ (accessed on 8 May 2022)), a central body for establishing the global agenda for the environment.

The Mediterranean Action Plan

Greece and the Mediterranean coastal countries are included in the Mediterranean Action Plan (MAP), which is the first project implemented under the UN Regional Seas Program. In 1976, the Mediterranean Action Plan was ratified by fourteen Mediterranean countries and has since become institutionalized through the Barcelona Convention (https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/barcelona-convention/index_en.htm (accessed on 8 May 2022)). The Mediterranean Action Plan was amended in 1995 (MAPII) and the revised Barcelona Convention has been in force ever since. The headquarters of the Mediterranean Action Plan—Coordination Unit is in Athens, is responsible for the Barcelona Convention Secretariat, and develops general strategies, the latest being the Mid-Term Strategy (MTS) (https://wedocs.unep.org/bitstream/handle/20.500.11822/6071/16ig22_28_22_01_eng.pdf (accessed on 8 May 2022)) 2016–2021. The goal of this strategy is "a healthy Mediterranean with marine and coastal ecosystems that are productive and biologically diverse contributing to sustainable development for the benefit of present and future generations".

4. European Governance Framework for the Sea

4.1. Directive on the Conservation of Natural Habitats

The EU Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) sets out the various procedures and commitments regarding the management of nature conservation in Natura 2000 sites (Figure 4), habitats, and species therein, including marine areas. These provisions have been transposed into the Greek Law 4014/2011. In fact, in the recent joint ministerial decision where the list of Natura sites in Greece were revised, the new areas that are part of the network mainly concern the marine area. The total marine area covers about 22% of national territorial waters, well above the 6.12% of territorial waters previously integrated.

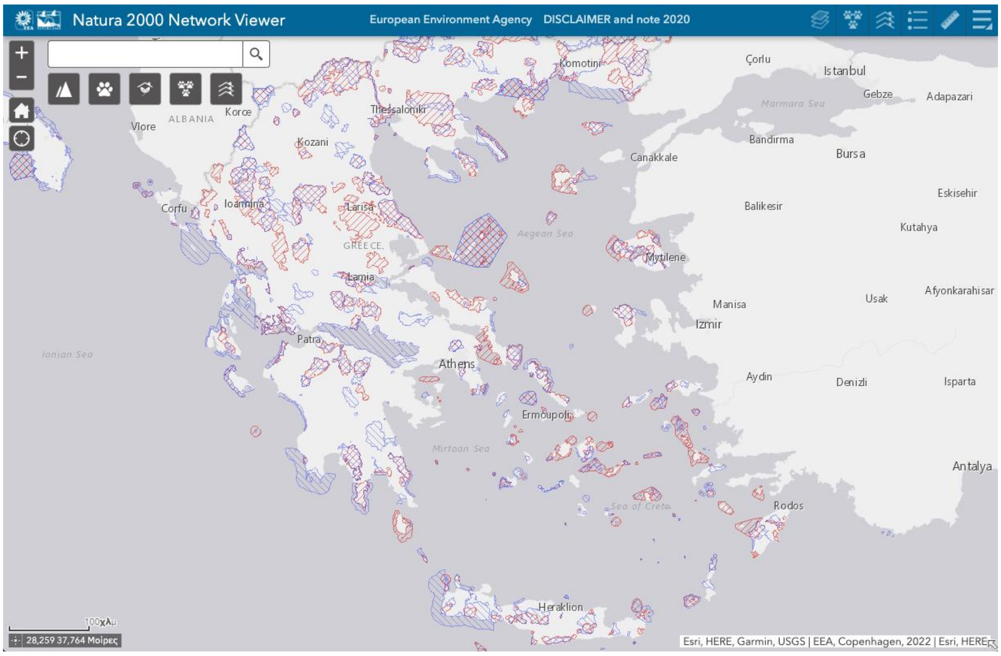

Figure 4. Natura 2000 Network Viewer. Reproduced from https://natura2000.eea.europa.eu/ (accessed on 8 May 2021).

4.2. Integrated Maritime Policy

The European Union (EU), recognizing the significant growth opportunity and dynamics of the seas, introduced the Integrated Maritime Policy (IMP), in order to organize and develop maritime cross-sections [15]. Due to the maritime space having many peculiarities, including demarcation of knowledge and available data for geomorphology and environmental status, the pursuit of a new policy was a complex endeavor. The IMP was formally introduced in 2007, laying the foundations for a new European space development strategy, and to date, significant developments have been recorded. IMP defines MSP as a cross-sector policy instrument enabling public authorities and stakeholders to adopt a coordinated, integrated, and cross-border approach. The Marine Strategy Framework Directive (2008/56/EU) is the environmental pylon of the integrated policy that immediately followed and was incorporated in Greek law 3893/2011 (Government Gazette 144/A/17-6-2011).

4.2.1. Blue Growth Strategy

In 2012, EU introduced a long-term strategic planning focused towards long-term sustainability of the marine economic sectors. The strategy was introduced with the communication "Blue Growth: opportunities for marine and maritime sustainable growth" [16], having as the main idea that the oceans are vital parameters for the development of the European economy, with comparative advantages in the fields of innovation and employment. Through the Blue Growth initiative, IMP could achieve the objectives set under the Europe 2020 strategy [17] for smart, sustainable, and inclusive growth. The strategy consists of three components:

(a) Developing the marine sectors with the promise for long-term jobs creation and expansion.
(b) Providing knowledge, regulatory stability, and confidence in the ocean economy.
(c) Implementing sea basin policies to ensure states' collaboration.

4.2.2. Data and Knowledge about the Sea

In August 2012, the green paper "Marine Knowledge 2020: from seabed mapping to ocean forecasting" was published [18]. The Knowledge of the Sea 2020 Strategy, in addition to providing a comprehensive methodological framework and guidelines for marine data, aimed to make a real contribution to knowledge through the gathering of data from various sources. The ultimate goal was to facilitate the access of all interested public authorities and research organizations to marine data and to exploit the development of the Union's maritime policy priorities for exploring new areas of activity.

On this direction, the EU has undertaken the recording of marine data, at Union level, through the European Maritime Observation Network (EMODnet). This network is in its third phase of implementation by recording data across the marine area (surface, water column, bottom, and subsurface) with the participation of 150 research organizations (see Figure 5). Through seven thematic websites (Figure 6), EMODnet facilitates access to maritime data. As outlined in [19], EMODnet's goals are to:

- Enhance efficiency in all operations that use marine data by minimizing data recollection and the expenses for gathering.
- Boost competitiveness and creativity in existing and emerging maritime industries.
- Decrease ambiguity in our understanding of the oceans and increase our ability to forecast.

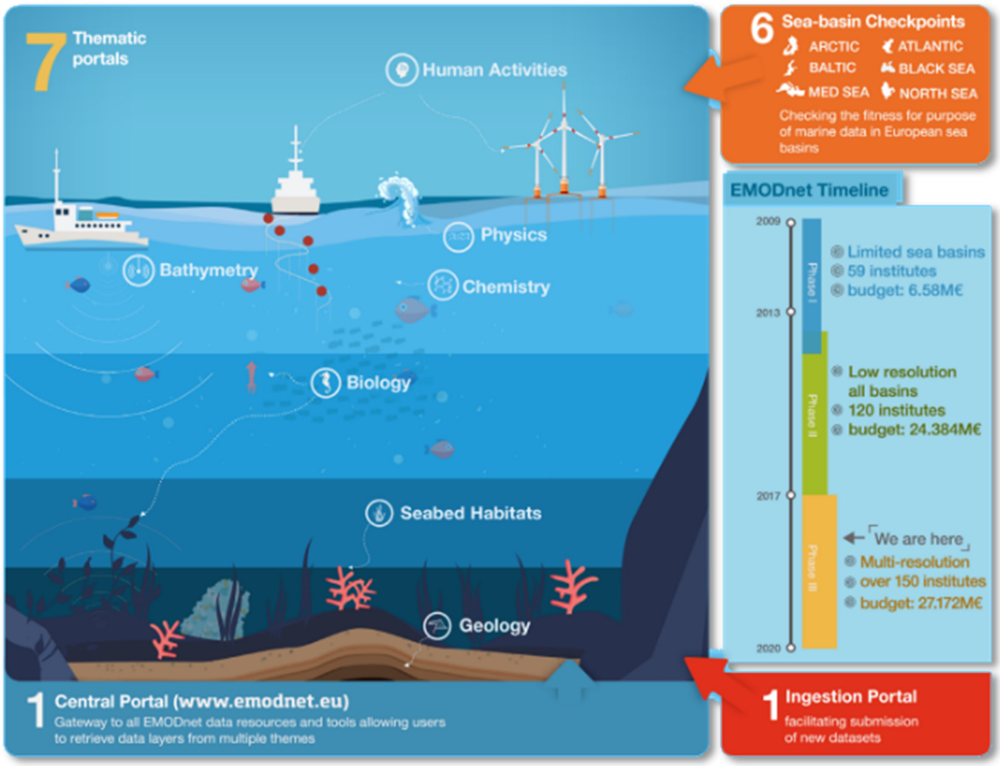

Figure 5. EMODnet infographic. Reproduced from https://emodnet.eu/sites/emodnet.eu/files/public/image_news/EMODnet_in_a_Nutshell.JPG (accessed on 8 May 2022).

4.3. Marine Spatial Planning Directive

In 2014, the EU adopted the Directive 2014/89/EU [20] on the creation of a common framework for maritime planning in Europe. The Directive was incorporated as national law by the end of 2016, and all Member States should have maritime spatial planning studies in place by March 2021.

According to the preamble to Directive 2014/89/EU:

a. The rising interest for marine space for various marine activities, such as energy plants, oil and gas extraction, shipping, fishing, biodiversity conservation, tourism, and underwater cultural heritage, in conjunction with the numerous demands on coastal resources necessitate a holistic approach to planning and management of marine domain.

b. Adopting an ecosystem-based approach will aid in the long-term development and expansion of marine and coastal economies and the responsible use of coastal and marine resources.
c. To encourage the sustained coexisting of activities and, when applicable, the proper placement of complementary uses in the marine region, a framework is needed that typically includes the acceptance and execution by Member States of marine spatial planning outcomes in appropriate charts.

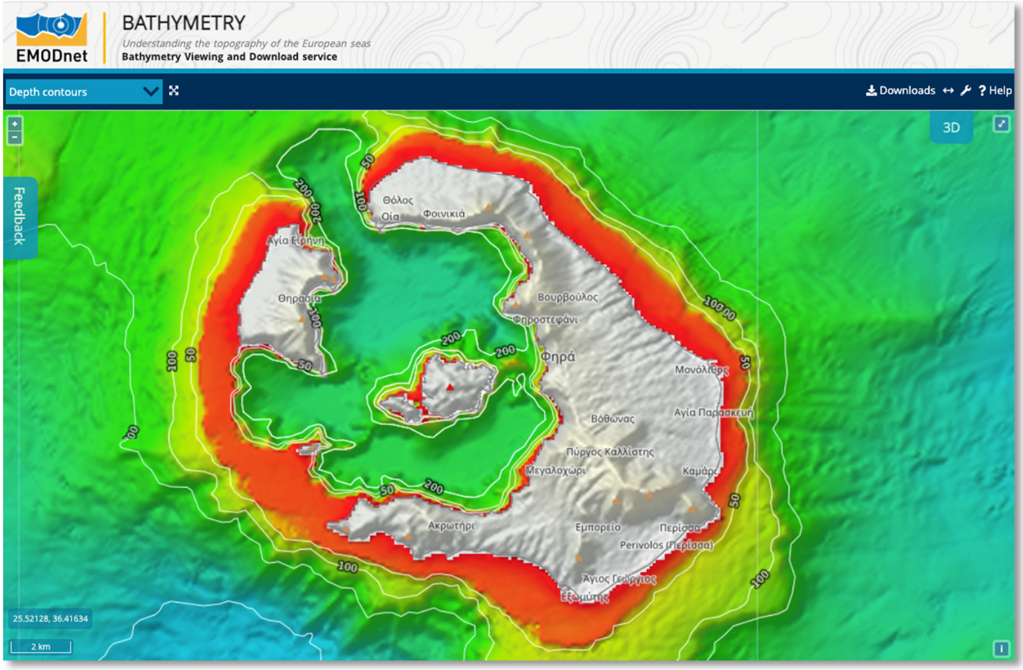

Figure 6. EMODnet Bathymetry portal. Reproduced from https://portal.emodnet-bathymetry.eu (accessed on 8 May 2022).

Environmental Impact Assessments

Special reference is made in the preamble of EU Directive 2014/89 to Directive 2001/42/EU, establishing the environmental impact assessment as a significant instrument for incorporating environmental concerns into project planning and programs approval, and it is noted that where maritime spatial plans:

a. Have a serious environmental impact, they are subject to Directive 2001/42/EU.
b. Incorporate Natura 2000 sites and to prevent overlap, the environmental impact assessment shall be supplemented with the criteria of Article 6 of Directive 1992/43/ EU.

4.4. MSP Plans in Europe

In order to ensure that maritime spatial planning is based on reliable data, Member States must utilize the best possible information and data, enabling parties to share data and information, as well as using existing data and data collecting mechanisms, such as those established under the “Knowledge for the Sea 2020” initiative and Directive 2007/2/EC. MSP plans progress in Europe is monitored closely at msp-platform.eu, and below, the main ones are reviewed.

4.4.1. Germany

In Germany (https://maritime-spatial-planning.ec.europa.eu/countries/germany/ (accessed on 8 May 2022)), MSP is based on the Federal Land Use Planning Act, which has been extended to the exclusive economic zone. The German Länder prepare spatial plans for the territorial sea (out to 12 nautical miles). The plans in Germany are both legislative and effective. The North Sea federal plan entered into force in September 2009, while the Baltic Sea federal plan went into effect in December 2009.

Maritime planning in Germany is based on strategic guidelines, such as:

- Securing and enhancing maritime traffic.
- Enhancing maritime business activities with integrated spatial organization and efficient use of space.
- Encouraging the use of offshore wind energy in accordance with the federal government's sustainability plan.
- Long-term safeguarding and use of rotation mechanisms in case of problems and giving priority to specific uses.
- Ensuring natural resources for tackling ecosystem disturbances and marine pollution.

Germany uses three types of zones to implement its spatial plans, that include:

- Priority areas where one use (for instance, shipping, energy, etc.) takes precedence over all the other uses in the region.
- Reserve areas in which one use is given particular attention to benchmarking with other spatial planning activities.
- Marine protected areas where sustainable measures are applied to the marine environment.

4.4.2. United Kingdom

In England, the UK Government has delegated the responsibilities of marine planning to the Maritime Management Organization (MMO) (https://www.gov.uk/government/collections/marine-planning-in-england (accessed 8 May 2022)), for developing marine projects in coastal and offshore areas. Eleven maritime areas have been established around the coast of England and each area will be covered by a maritime plan with a long-term (20 year) distribution of activities. The plans are being developed on an ongoing basis for the various regions, with the aim of fully covering the English coastal and offshore areas by 2021.

4.4.3. France

In France (https://maritime-spatial-planning.ec.europa.eu/countries/france (accessed 11 July 2021)), there are currently no official maritime spatial plans in existence. The coasts of France are governed by four Interregional Directorates (Direction InterRégionale de la Mer—DIRM) including East Channel–North Sea, North Atlantic–West Channel, South Atlantic, and Mediterranean Sea. Plans are developed for each of the four coasts under the jurisdiction of the préfets coordonnateurs, the préfet de region appointed for that purpose, and the préfet marine. In 2016, the MSP Directive was transposed into French legislation through the entry into force of article123 of law n° 2016-1087 for the second "*reconquest of biodiversity, nature and landscapes*". Legislation amends the French Environmental Code by introducing the concept of marine spatial planning, which is described as "*the process by which the State defines and organises human activities at sea in an ecological, economic and social perspective. It does not apply to activities related to defense or national security*".

5. Marine Spatial Planning in Greece

5.1. MSP Law (4546/2018)—Marine Spatial Strategy

Greece incorporated the EU Directive with Law 4546/2018 (Government Gazette 101 A'12.6.2018) (https://www.e-nomothesia.gr/kat-periballon/prostasia-thalassiou-periballontos/nomos-4546-2018-phek-101a-12-6-2018.html (accessed on 8 May 2022)). The first chapter, which includes Articles 1–4, defines the purpose of its provisions, their scope, the definitions, and the objectives of maritime spatial planning. The second chapter of the law includes Articles 5–12, where:

- Article 5 provides for the procedure for the establishment and implementation of maritime spatial planning, which specifies that maritime spatial planning shall be completed as soon as possible and by 31 March 2021 at the latest and stipulates that the maritime spatial planning includes the national spatial planning strategy for sea space and the marine spatial plans.

- Article 6 defines the structure of the marine spatial planning and specifies that the national spatial strategy for the marine area is part of the national spatial strategy of article 3 of Law 4447/2016.
- Article 7 sets out the minimum requirements for maritime spatial planning, while Article 8 defines its content. Article 9 contains provisions for public consultation and public participation, and then Article 10 provides for issues related to the use and exchange of data.
- Articles 11 and 12 then provide for co-operation with Member States and third countries, respectively, while Article 13 sets out the obligation to monitor marine spatial planning.

5.1.1. MSP Authority

In the third chapter of the law, article 13, the Minister of Environment and Energy is defined as authority for maritime spatial planning and the responsibilities are specified. Finally, the fourth chapter of the law provides for transitional provisions for the approval of maritime spatial planning.

Other key points set out in the preamble of Law 4546/2018 are as follows [21]:

- In the Greek maritime and coastal areas, as well as in Europe, human activities, the effects of climate change, and natural disasters, as well as natural coastal transformations, can have serious economic, social, and environmental impacts.
- Marine spatial planning (MSP) is the public process of analyzing and planning the distribution of human activities in marine areas to achieve economic, environmental, and social objectives.
- Through the preparation of plans, the main purpose of maritime spatial planning is to promote sustainable development and determine the utilization of marine space for different uses, as well as the management of their uses and conflicts.
- It is particularly emphasized that another approach that forms part of the Integrated Maritime Policy of the European Union and is directly linked to MSP is the Integrated Coastal Zone Management (ICZM).
- The seamless link between marine and coastal areas requires the coordination and integration of maritime spatial plans and integrated coastal zone management strategies, in order to ensure the sustainable use of maritime space and the management of coastal zones, taking into consideration social, economic, and environmental factors.
- Cooperation between Member States, as well as with third countries, in the maritime areas concerned, in accordance with international law and conventions, in particular the provisions of the UNCLOS Convention, is essential when designing and implementing maritime spatial planning.

5.1.2. Planning for Coastal Land and for the Sea

According to the Regulatory Impact Assessment Report of Law 4546/2018, the law incorporates maritime spatial planning into the existing spatial planning system and seeks coordination and coherence between its spatial planning and marine spatial planning, noting for sectoral policies that:

Economy: ensures the sustainable development of all maritime economic sectors, as it is the process of organizing human activities in maritime and coastal areas in order to achieve the synthesis of ecological, environmental, economic, social, and cultural parameters.

Society: will contribute to improving the services provided and legal certainty for those active in the maritime economy as well as enhancing and securing jobs by organizing maritime activities and uses.

Environment: on the one hand, its ecosystem approach, and on the other hand, ensuring that the coexistence of uses and activities will minimize the impact on the natural and cultural environment.

Public Administration and Justice: the coordination of sectoral policies and the response caused by the lack of integrated spatial planning will facilitate the role of public administration and justice in addressing the spatial effects of the conflicting sectoral provisions.

According to HELCOM [11], land and sea spatial planning should be inextricably linked, consistent, and supportive of one another. To the greatest extent possible, legal systems governing land and sea spatial planning should be harmonized in order to achieve governance systems that are equally open to dealing with land and sea spatial challenges, problems, and opportunities, as well as to create synergies. Moreover, synergies with ICZM should be strengthened in a cross-border setting.

A key added value resulting from the integration of maritime spatial plans and integrated coastal zone management strategies is the strengthening of land–sea connectivity by requiring coherence between maritime spatial planning and integrated coastal planning. Both MSP and ICZM are complementary management tools under IMP [22]. Together, they support a more integrated decision-making process that coordinates, potentially, competing sectoral policies, thereby contributing to the achievement and coherence of objectives and measures in the context of other relevant policies, including energy, the environment, maritime transport, tourism, and fishing. Taken together, they will improve the spatial planning and management of the intermediate zone between land and sea and allow for better coordination of maritime and coastal activities, which may subsequently lead to significant financial and economic benefits for investors as well as reduction in coordination costs.

5.1.3. Planning on Multiple Scales

According to [23], MSP and the regulation of marine uses should be implemented on multiple scales (local, regional, and national), and, especially at the local scale, should not be confined to the marine space, but should include land space, as in the ICZM. For the better implementation of the ecosystem approach, MSP should not be confined to the territorial waters of a coastal state but should as far as possible exhaust EEZ boundaries to include sets of ecosystems (and not just subdivisions thereof).

6. Smart Marine Ecosystem-Based Planning (SMEP)

6.1. Smart Marine Ecosystem

Smart technologies can provide numerous opportunities, when implemented in a holistic, methodical manner that is based not just on technology, but also on successful cooperation, partnerships, and a coherent regulatory environment. At the 2019 Smart4Sea conference, it was highlighted that [24] as the world becomes more connected, the opportunities offered by smart technologies will reach new levels of collaboration and knowledge sharing across all maritime stakeholders. Marine operators can gain greater efficiency by employing smart technology, leading in higher revenues, as well as allowing sustainable communities. Every year, billions are lost due to inefficiencies in the maritime sector, including vessel and port operational accidents. The shipping industry also contributes to climate change [25], which affects everyone. The goal of marine administration should be to pave the way for the transition to a smart marine ecosystem. Smart marine ecosystems, similar to smart cities, are areas where conventional services are made more effective via the use of digital and communication technology for the benefit of both people and the marine population.

Smart Marine Ecosystem-Based Planning Strategy

In this regard, smart marine ecosystem-based planning (SMEP) is proposed as an MSP strategy for going beyond the conventional use of information and communication technologies (ICT) for marine sustainable development, across the three marine information domains [26] (Figure 7), being the marine environment protection, the maritime safety, and the marine spatial planning. SMEP's holistic approach across the domains entails a more participatory and responsive maritime administration for safer marine environments and for better addressing the requirements of the marine population and stakeholders.

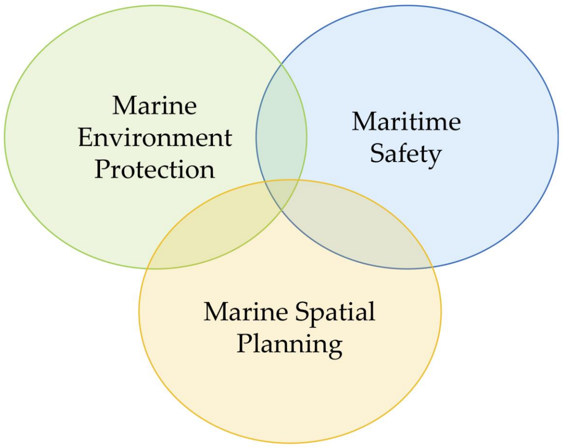

Figure 7. Marine information domains. Reproduced with permission from reference [24]. Copyright 2020, NTUA Cartography Laboratory.

SMEP strategy aims to achieve:

- Improved aquaculture and coastal waste recycling infrastructure.
- More efficient methods of protecting and utilizing maritime space.
- Increased marine life by using more sustainable integrated solutions.
- Smarter maritime transportation networks.
- Solving policy issues in sectors such as fisheries, marine, energy, and information and communication technology.

SMEP is about making the best use of resources while having the least amount of influence on the environment and the highest level of safety. It aids in averting conflicts and optimizing operations by using data from different sensors and data analytics of accessible information, such as shipping routes and weather. SMEP may also be viewed as a transactional platform for driving value and process improvement for both the ecosystem and marine populations. It is focused on the collaboration of the community, industry, and other relevant parties in developing new solutions and participating in maritime space administration. Its objectives are to create and deploy integrated smart marine solutions to enable networking, collaborations, and information sharing, with an emphasis on the confluence of environment, information technology, and maritime.

6.2. Smart Hydrospatial Data Services

In the following paragraphs, "smart" hydrospatial data services related to SMEP are briefly discussed, highlighting the diversity and the potential this planning strategy can achieve (Figure 8).

6.2.1. Smart Ports

With shifting global trade needs, ships that are becoming bigger, products that need to be moved quicker, and geopolitical tensions that are generating new issues for ports all over the globe, the need to adapt and become "smart" is a requirement today. Three main sources of waste have been identified in the maritime sector [24]: excess supply, fuel economy, and wait period at ports and other high-traffic locations. On the other hand, there are four primary forces that can overcome them:

- Pooled ability for increasing capacity utilization and lowering costs.
- Data science, which is connected to digitization, for operational optimization.
- Intelligent vessels for automated and improved processes, as well as performance management.

- Automation to improve port operational effectiveness.

A smart port is one that improves its performance using automation and innovative technologies such as big data, smart sensors, blockchain and artificial intelligence. Although maritime industry is often regarded as conservative, there are solutions based on emerging technologies that alter this perception, steering the whole industry toward a more interconnected era. Vessel traffic control systems have been implemented in the maritime sector to improve port operations and effectively control vessel traffic in ports, harbors, and coastal regions. In this context also, this paper [27] tries to create a smart port paradigm and a quantifiable indicator, the smart port index (SPI), that ports may utilize to enhance their reliability and sustainable development.

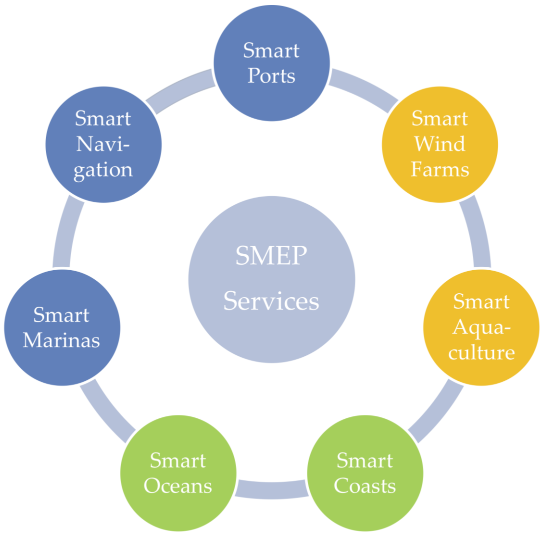

Figure 8. Smart hydrospatial data (SMEP) services across the marine information domains.

6.2.2. Smart Offshore Wind Farms

Related to offshore wind farms (OWFs), research [28] demonstrates the establishment of a spatial decision support system (SDSS) for designating areas for farm siting in accordance with MSP requirements, exclusion criteria, and assessment of environmental and socioeconomic criteria. As proposed by the author, it is critical to have the capability to provide a comprehensive management toolkit for renewable energy policymakers and stakeholders, incorporating a set of quantitative research and spatial–economic models. Moreover, based on characteristics of offshore wind farms and meteorology, as well as the plan construct a run lifecycle process, this paper studied [29] the placement of a smart offshore windfarm that reduces installation and operational costs, increases production capacity, increases equipment life, and ensures personnel safety.

6.2.3. Smart Aquaculture

Aquaculture, especially in developing countries, is one of the most important components in fulfilling the human community's food demand [30]. Year after year, many fish farmers suffer unfathomable losses as a result of unforeseeable circumstances, managerial and operational mistakes, or technical breakdowns. The water quality inside the tanks or around the cages is crucial for optimizing feeding strategy, ensuring growth, reducing mortality, and stimulating reproduction. Smart aquaculture management requires technological investment and reliable control of several environment uncertainties. In that spectrum, water quality management systems are integrated solutions for water quality monitoring, decision support, and process automation based on real-time data.

6.2.4. Smart Coasts

Blue Flag accreditation is an international program that ensures that a beach satisfies stringent ecological, administrative, and safety criteria (https://blueflag.global/ (accessed on 8 May 2022)). An EU Smart Coasts program [31] seeks to maximize the potential of the shoreline on both shores of the Irish Sea in order to safeguard the coastal areas by creating a new real-time water quality prediction system. As part of the service, forecasting water quality based on sampling and analysis of field coastal data connected to an online system provides up-to-date information on water conditions. By complying with EU bathing water regulations that require water samples at certain sites, the technology raises awareness of pollution sources and assists in the upkeep of Blue Flag certified beaches. Another smart coast service may also consider the erosion/accretion of sandy coasts and research to develop a predictive model of submersion to support coastal management in sea-level rise conditions over the next decades [32].

6.2.5. Smart Oceans

Smart monitoring that uses current ocean activities to gather and analyze data is crucial to close the knowledge gap about the open sea and the opportunities it provides [33]. Previously, monitoring technology was restricted by the duration of research vessel expeditions (e.g., battery capacity) and weather conditions, resulting in observations of short-term events or snapshots of longer-term events. Now, smart ocean systems constitute a substantial shift in how scientific research and ocean monitoring are performed. They overcome the limitation of existing technologies by permitting continuous, sub-second observations with a variety of measurement techniques, which are accessible in near real time through the internet to any community. New data solutions are being developed, tested, and implemented, allowing scientists, industry, and users to monitor them from anywhere on the planet.

6.2.6. Smart Marinas

One of the most significant issues for boat captains, particularly during the summer, is the lack of marina reservation online procedures. Most of the time it is not possible to plan a trip by boat securing the position where it will be moored throughout the course of the voyage. A project in Greece [34], financed by the Fiware Accelerator European Commission FrontierCities, arose from this need detected in Greek ports. They created an application for yachters and marina managers to provide e-booking services, navigational, and mooring assistance features. The pilot project, which was carried out at the Patras port yachting area, sought to modernize marina operations by establishing a monitoring system to manage mooring berths, evaluate sea water level, and record meteorological conditions. The project intends to address a need in marina services while also opening a route for smarter communication with the maritime tourism industry, which is conquering new areas for smarter technologies. Smart Marina is the also the name of another EU project [35], whose main mission is to create little guest harbors in the Baltic Sea. The investments in the guest harbors will mostly help toward the rehabilitation of service buildings, new bridges, payment and booking systems, and other types of environmental management in the harbors, all with the goal of creating a favorable environmental profile and a better tourist experience.

6.2.7. Smart Navigation

The SMART-Navigation project is a global initiative that uses the International Maritime Organisation (IMO)'s e-Navigation concept [36], to provide electronic services to Non-SOLAS ships—the ones that are not ruled by the International Convention for the Safety of Life at Sea—such as fishing boats and coastal vessels. The pilot project is focused on Korean maritime traffic providing advanced services, such as:

- Sea traffic management, resulting optimization in vessels traffic flow.

- Knowledge of the maritime domain, which allows vessels to anticipate potentially hazardous circumstances.
- Proactive maritime safety management, with a focus on avoiding identified dangers.
- Remote monitoring, allowing ship systems to be evaluated.
- Telematics service, which provides navigational safety information in a streamlined manner.

Maritime services called Maritime Service Portfolios (MSPs) have been identified by IMO providing operational and technical services for e-Navigation, and in the following table (Table 1) they are mapped to the six (6) services implemented by the SMART-Navigation project.

Table 1. Maritime Service Portfolios (MSPs) linked to SMART-Navigation services.

Code	MSP Service	SMART-Navigation Services
MSP1 MSP2 MSP3 MSP4	VTS Information Service (IS) Navigational Assistance Service (NAS) Traffic Organization Service (TOS) Local Port Service	SV1 → Navigation Monitoring & Assistance Service (NAMAS) SV2 → Ship-borne System Monitoring Service (SBSMS) SV3 → Safe & Optimal Route Planning Service (SORPS)
MSP5	Maritime Safety Information Service (MSI)	SV6 → Maritime Environment and Safety Information Service (MESIS)
MSP6 MSP7	Pilotage service Tug Service	SV5 → Pilot & Tugs Assistance Service (PITAS)
MSP8	Vessel Shore Reporting	
MSP9	Telemedical Assistance Service (TMAS)	
MSP10	Maritime Assistance Service (MAS)	SV1 → Navigation Monitoring & Assistance Service (NAMAS) SV2 → Ship-borne System Monitoring Service (SBSMS)
MSP11	Nautical Chart Service	
MSP12	Nautical Publications Service	
MSP13	Ice Navigation Service	
MSP14 MSP15	Meteorological Information Service Real-time Hydrographic and Environmental Information Service	SV6 → Maritime Environment and Safety Information Service (MESIS)
MSP16	Search and Rescue Service	SV1 → Navigation Monitoring & Assistance Service (NAMAS) SV2 → Ship-borne System Monitoring Service (SBSMS)

7. Implementing the Marine Cadastre

7.1. MSP Implementation Guide

According to UNESCO's report [37], marine spatial planning is "*a process that enables integrated, forward looking, and consistent decision making on the human uses of the sea*". It is a method of providing an ecosystem-based approach for controlling human pressures to the marine environment, similar to land use planning in terrestrial ecosystems. UNESCO has proposed a 10-step guide to accomplish a marine spatial planning endeavor, as shown in Figure 9.

Several of the MSP steps are related to analysis of marine data and their visualization in order to make the necessary decisions. Therefore, the need for establishing an MSDI as a parallel process is of vital importance for the MSP process. Using UNESCO's guide paradigm, the main relationships are highlighted below:

- In step 3, related to pre-planning and establishing planning limitations to organize the process.
- In step 5, for defining and analyzing existing conditions by mapping areas of human activities as well as important ecological areas and identifying spatial conflicts.
- In step 6, which is about defining and analyzing future conditions by mapping new demands for marine space and identifying alternative spatial scenarios.

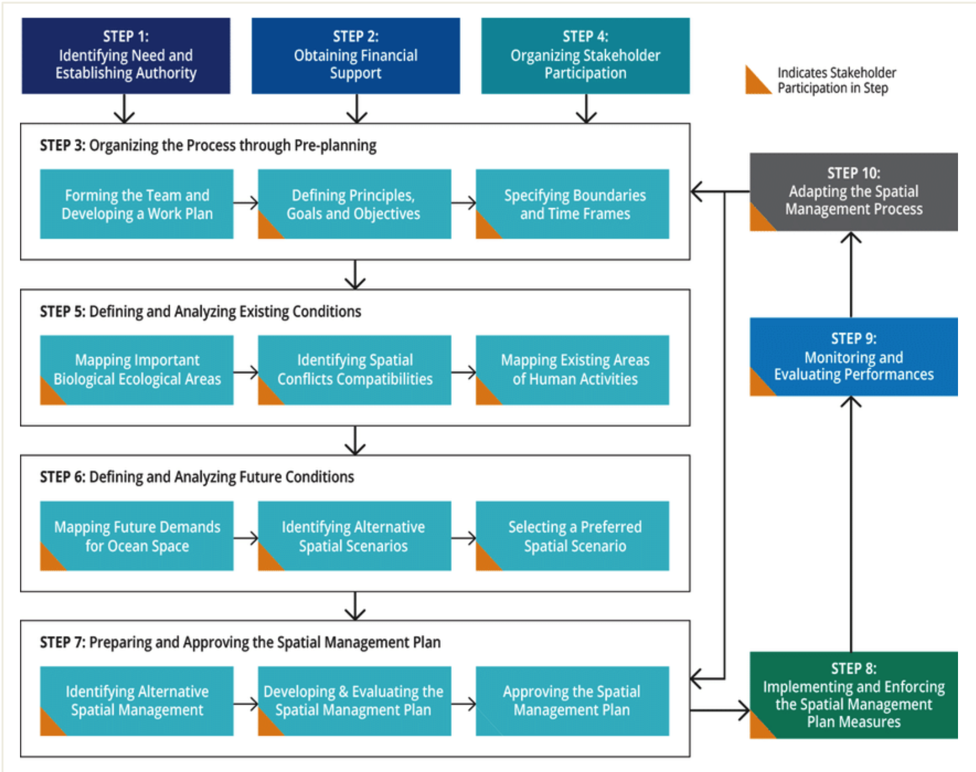

Figure 9. MSP step-by-step guide. Reprinted with permission from Ref. [37], Copyright 2006 UNESCO.

7.1.1. Multipurpose Marine Cadastre

MSP elevates the stakes and broadens the individual states' duties to provide resource capacity management across sea and land interaction. The features of the maritime environment must be recognized and combined into a management system to develop a marine administration system that meets the spatial marine criteria [11]. The marine cadastre is defined [38] as "*a system to enable the boundaries of maritime rights and interests to be recorded, spatially managed and physically defined in relationship to the boundaries of other neighboring or underlying rights and interests.*"

Marine cadastre (MC) research articles recognize the three-dimensional (3D) character of marine ecosystems and emphasize the cadastre's need to operate as a multifunctional instrument. The multipurpose maritime cadastre (MMC), an expanded term, has been deployed in the United States [39] as an integrated marine information system that offers jurisdictional, legal, physical, ecological, and human usage data in a shared geographic information system (GIS). It is essentially a data viewer that gives the baseline information required for coastal and marine spatial planning initiatives, notably those involving determining the optimal placement for renewable energy projects. The MMC can also be used during the permit review process. Users can readily view relevant jurisdictional boundaries, restricted areas, laws, sensitive habitat places, and other recorded features by selecting the marine region of interest.

7.1.2. MSDI Establishment

The foundation of a marine spatial data infrastructure (MSDI) in Greece [40] may be closely linked to the realization of the marine cadastre. According to the International Hydrographic Organization [41], "*MSDI is the component of an SDI that encompasses marine geographic and business information in its widest sense. This would typically include seabed topography, geology, marine infrastructure, resource utilisation, administrative and legal boundaries, areas of conservation, marine habitats and oceanography*". MSDI facilitates the discovery, access, management, distribution, reuse, and preservation of hydrospatial data [42]. In the same way, marine cadastre is recognized as the foundation layer of an MSDI, comprising important marine boundary data as well as associated rights and duties that are continually updated [43,44] (Figure 10). It is important to note that Geographic Information Systems (GIS) provide marine cadastre managers advanced tools for accessing and compiling charts, leveraging information stored in databases, and automating relevant processes [45].

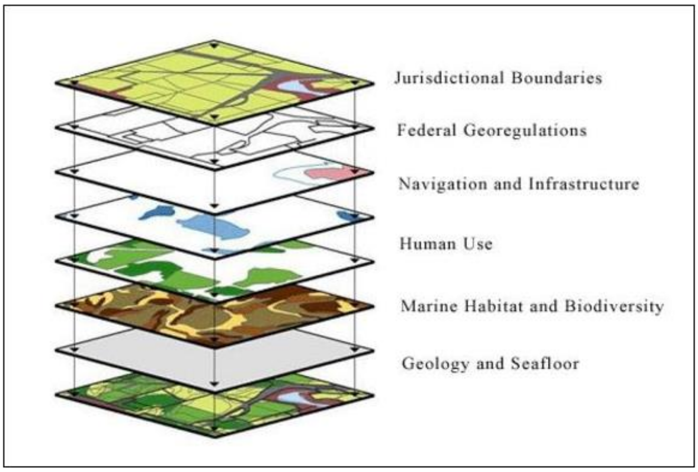

Figure 10. Data layers in an MSDI. Reprinted from Ref. [44]. Copyright 2010, Fowler et al.

The function of the marine cadastre as a data layer in a marine SDI has been discussed since the international workshop on regulating the marine environment held in Malaysia in 2004 [46]. The workshop proposed that, as an analogue to a "land administration system," the name "marine administration system (MAS)" to be used for the "*administration of rights, restrictions and responsibilities in the marine environment with the spatial dimension facilitated by the Marine SDI*".

7.1.3. MSDI Enablers

The availability of spatial information content to users is the most significant component of MSDI, as it is of little value without it. The data shall be presented within the context of a consistent coordinate reference system. At the heart of this content is reference information, which refers to the most commonly used datasets, themes, or spatial data layers, which together form a digital base chart that can be portrayed and searched. According to the International Hydrographic Organization (IHO) [41], the following MSDI capabilities listed below are regarded as important building elements that serve as the foundation for data collection, administration, modification, and dissemination:

- **Standards**: The ISO 19100 series of international geographic standards, as well as the Open Geospatial Consortium (OGC) standards, are critical to building a strong SDI architecture, particularly in the areas of data content modeling, data transfer, and web services.

- **Technology**: The availability of technological infrastructure supports the delivery of data and services that enable data reading, exchange, conversion, and dissemination to enhance informational goods. As the infrastructure improves, the SDI may be able to function not just in multiple geodetic schemes, but also to convert data to create informational content in various projections.

- **Metadata**: They are "data about data" that indicate the qualities of a dataset (for instance, content, value, and restrictions) and are generally kept in a metadata management system to enable information extraction capabilities. It is essential for locating data and information as well as knowing how the data may be utilized. A web site is the most common way for individuals to quickly and easily search for content using its metadata.

- **Universal Hydrographic Data Model**: IHO's S-100 series of standards provides the data framework for the production of relevant digital products and services needed by marine communities [47]. S-100-based product specifications are currently available for a variety of marine data services, such as S-121 for Maritime Limits and Boundaries (MLBs) and S-122 for Marine Protected Areas (MPAs).

7.1.4. S-121 Maritime Limits and Boundaries

The Maritime Limits and Boundaries standard (S-121) is designed for the encoding and sharing of digital maritime boundary information, such as maritime limits, zones, and boundaries as defined by the United Nations Convention on the Law of the Sea (UNCLOS) [13,48]. International boundaries, coastlines, internal waterways, territorial waters, contiguous and exclusive economic zones, and the continental shelf are all covered under S-121. Additional entities that nations should declare (for example, joint development regions) as a result of bilateral treaties should be defined for use in a marine cadastre system [49]. Each real-world feature is represented as an object in S-121, with properties represented as attributes (both geographic and thematic) and associations that give context for the feature.

The four major components of each MLB object are:

1. The party component which defines the different actors and their role associated with an object.
2. The geospatial component that specifies the object's location and type.
3. The legal component, which supports the definition of the related jurisdictions and rights in relation to the object.
4. Administrative or geographical sources such as treaties, legal papers, and maps.

The MLB model is sufficiently extensive whether implemented in a geospatial system or as part of an MSDI to facilitate the production of different products and services (http://www.s-121.com/ (accessed on 8 May 2022)). These could include the deposit of national maritime boundary claims or the compilation of maritime boundary objects for inclusion in S-57 and S-101 Electronic Navigational Charts. As stated in this article [11], S-121 focuses on the legal description of marine entities. Various definitions of legal rights, as well as associated constraints and obligations, can be created for different parties, even if these parties have potentially competing claims.

7.1.5. Land Administration Alignment

S-121 makes use of ISO-19152, which establishes a reference land administration domain model (LADM). ISO-19152 allows for the legal definition of associated rights, restrictions, and duties, as well as proper reference via sourcing and versioning, and this feature connects the standard with legal traceability procedures. The adoption of the ISO-19152 standard leverages the large community involvement in land administration, which has many similarities with the management of maritime boundaries and limits. The application of an LADM lays the groundwork for extending S-121 into the management of all other regulated boundaries, such as marine reserves and fisheries. The compatibility with the land domain model promotes uniform administration of the littoral zone for states that use S-121 for maritime areas and ISO-19152 for land jurisdiction.

A marine rights data model is described in [49,50] and provides a common means of capturing the rules that assist the assignment, demarcation, documentation, evaluation, and selection of marine property rights, awarded interests, resources available, and their 3D spatial extent (Figure 11). The section aims to represent regulatory, organizational, and environmental elements that are commonly associated with marine parcels, and the relevant design is based on the rationale that rights, obligations, and constraints in marine spaces relate to explicitly 3D/4D space, i.e., the sea surface, water column, seabed, and seafloor subsurface.

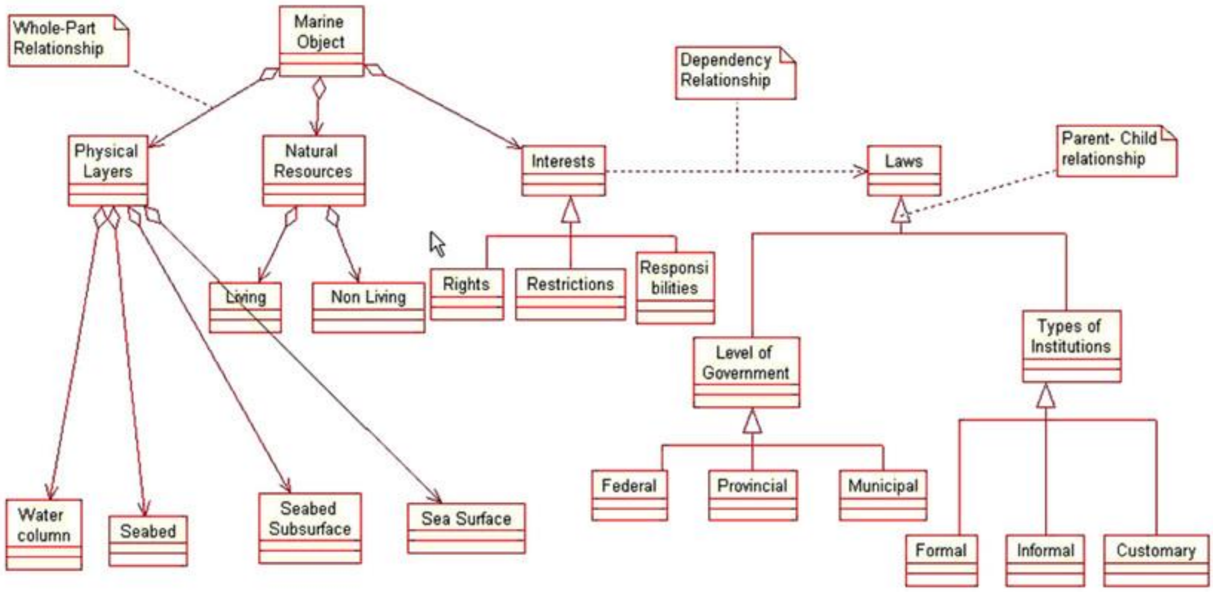

Figure 11. A marine parcel data model. Reprinted from Ref. [49]. Copyright 2014, Ng'ang'a et al.

7.1.6. S-122 Marine Protected Areas (MPAs)

The Marine Protected Areas product specification (S-122) is designed to encapsulate MPA information for use in MSDIs [50]. MPAs are seas, oceans, rivers, or lakes that have been designated as protected areas. They may include regions of intertidal or subtidal topography, as well as their underlying water and related flora, animal, historical, and cultural aspects, that have been reserved by law or other effective ways to safeguard a portion or the entirety of the enclosed ecosystem. MPAs could be designed to protect unique fish species, scarce habitat areas, or entire ecosystems. MPAs can range from basic declarations to protect a single resource to highly regulated areas.

The extent to which environmental standards affect maritime operations varies depending on whether MPAs are located in territorial waters, exclusive economic zones, or the high seas. The majority of MPAs are in the territorial waters of coastal nations, where enforcement is possible. MPAs can also be established in a state's exclusive economic zone and even within international waters. Italy, France, and Monaco, for example, have collaborated to build the Pelagos Sanctuary for Mediterranean Marine Mammals in the Ligurian Sea. This refuge encompasses both international and domestic seas.

7.2. MSDI Cloud Infrastructure

The public-based company Information Society S.A., in the context of the modernization of the public sector ICT infrastructure in Greece, designed and implemented the project for government cloud computing named Government Cloud, or in short, G-Cloud. It offers digital services based on state-of-the-art cloud computing and virtualization infrastructures. G-Cloud intends to share computing resources among government agencies, lowering purchase, operation, and service costs while enhancing flexibility and security, with the purpose of improving services to citizens and organizations. Figure 12 illustrates the three G-Cloud types of services and the stack of the components they include. MSDI could be offered either as platform as a service (PaaS) or software as a service (SaaS) type of G-Cloud, if specific "smart" services are offered to the various stakeholders.

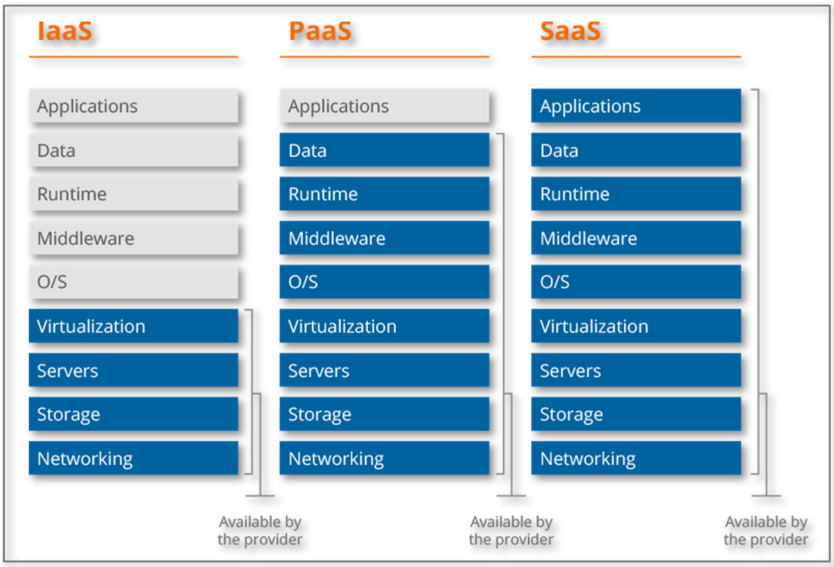

Figure 12. G-Cloud type of services in Greece. Reproduction from https://www.ktpae.gr/erga/government-cloud-g-cloud/ (accessed on 08 May 2022).

8. Discussion

In June 2018, Law 4546/2018 (Government Gazette 101/A/12-06-2018) was incorporated into the Greek legal order the Directive 2014/89/EU, setting out the general framework for the application of MSP for the sustainable development of the maritime economy, development of maritime areas, and sustainable use of resources. A defined framework for the spatial organization of maritime activities can be expected as a result of the MSP and the institutionalization of maritime spatial planning. However, maritime activity is heavily reliant on land, with the anticipation of further activities, which complicates the matter of both obligations and planning in general, as is the case of Greece.

The European Union's deadline on April 2021 for Member States to develop maritime spatial plans passed without the needed steps being completed for Greece [51]. The country demonstrated a lack of readiness on this critical issue in order to meet not only its European obligations, but also the responsibility to protect the Greek seas and to achieve sustainable "blue" development. However, Greece was only beginning to recover from a decade-long economic crisis, that had taken a fourth off its GDP, when the COVID-19 pandemic erupted. Although the pandemic has slowed the country's recovery, it has also provided policymakers with the opportunity to focus on how to bring the economy back on track with more sustainable post-COVID development. The National Recovery and Resilience Plan, called Greece 2.0, is the government's response to tackle similar issues, an extensive package of investments and reforms in major sectors of the economy. The plan includes the development of urban plans and the development of new spatial planning for renewables, industry, tourism, and aquaculture, as well as marine spatial planning in general [52].

According to the Hellenic Federation of Enterprises (SEV) research on MSP [3], marine spatial planning should strike the correct balance between the country's marine ecosystem's sustainability and the large investments that can be made at sea and shore. At a time when the country is progressively returning to the focus of investment, the state must establish the groundwork for an efficient MSP that avoids duplication and conflict with existing marine and coastal policies (local spatial plans, regional spatial plans, special spatial planning and sustainable development frameworks for industry, tourism, renewable energy, and aquaculture). It is also critical to provide enhanced project coherence and coordination in order to minimize duplication and/or contradictory spatial approaches between different levels of planning. Marine spatial planning shall be [3,24]:

- Multi-objective and integrated, embracing all main economic sectors, having economic, social, and environmental targets.

- Strategic and forward-thinking, exploring different methods of achieving a vision.
- Ongoing and adaptable, with a focus on performance assessment and acquiring knowledge upon doing.
- Participatory, building a diverse stakeholders base to guarantee long-term management commitment.
- Ecosystem-based, with an emphasis on long-term environmental resource preservation.
- Geographically focused, with an emphasis on marine zones that people could understand, connect to, and be concerned about.

In order to achieve the aforementioned objectives, the necessary reforms and investments in Greece shall include the establishment of a marine cadastre and an MSDI. Both facilitate MSP and ICZM processes in making marine ecosystem-based management a reality, such as, for instance, in designating marine protected areas [53]. MSDI shall provide timely access to data from public and private organizations in marine-related disciplines such as hydrography, oceanography, meteorology, and maritime economic sectors [42]. Furthermore, within a marine cadastre, being a well-built geographic information system (GIS), shall be recorded the boundaries of maritime rights and interests, spatially managed and physically defined in relationship to the boundaries of other neighboring underlying rights and interests. A marine cadastre shall be a base layer in the MSDI that public authorities shall rely on as the official infrastructure to access and integrate multi-source marine spatial data.

9. Conclusions

Smart marine ecosystem-based planning (SMEP) has been introduced in this study as a framework for more participatory and responsive maritime administration, aiming at safer marine ecosystems, and better fulfilling the needs of the marine stakeholders through "smart" hydrospatial data services. According to the World Wildlife Fund (WWF) [54], identifying trends in marine species and activities, as well as accounting for ecosystem capability and the possibility for recovery from human-caused changes, necessitates long-term data on environmental variables and human activities. The SMEP strategy and the MSDI realization [24] are key success factors towards this direction that could guarantee greater legal certainty and unleash sustainable growth momentum. SMEP is an adaptive strategic framework to incorporate changes, being driven by the environment and the climate change forces, the blue growth economy targets of the respective EU programming periods, and the implications from the geopolitical chess of the East Mediterranean Sea basin. All these factors require deep knowledge and rational decisions for achieving collaboration for the Eastern Mediterranean's long-term sustainable development, that SMEP strategy and MSDI realization aim to provide. Nautical cartography standards such as S-121 and S-122, as well as hydrospatial and maritime data services have been recently defined by IHO and IMO, respectively, to guide the recording, planning, and management processes, where the spatial extent of rights, restrictions, and responsibilities in the marine environment need to be defined.

Author Contributions: Conceptualization, S.C.; methodology, S.C. and A.P.; investigation, S.C.; writing—original draft preparation, S.C.; writing—review and editing, A.P. and B.N.; visualization, S.C.; supervision, B.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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