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Two decades of progress in Marine Spatial Planning

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A B S T R A C T

This paper reviews the key developments of ocean management leading up to and over the past decade, especially marine or maritime spatial planning and ecosystem-based management, with an emphasis on the former. From scattered seeds in a few marine places—from early marine spatial analysis and data atlases to the EU Marine Spatial Directive in 2014—MSP has grown to a world-wide movement by governments at various levels to manage comprehensively marine resources in space and time. Early efforts to apply systems thinking to marine planning, especially in oWestern/Northern Europe, have developed an extensive knowledge base of what works and doesn't work based not only on academic theory, but now on practical experience. From a few pioneering examples of the implementation of MSP by 2005, today over 75 countries are experimenting with MSP as a practical approach toward ecosystem-based marine management. The paper begins with a summary of early attempts to map the geography of the sea and to define how planning at sea began to some of the first applications of MSP from 1980 to 2005. Real-world efforts to apply MSP, especially in Western/Northern Europe and North America are identified and described. A few key milestones of MSP—the first international workshop on MSP (2006), the early work of the EC in funding pilot MSP projects in Europe, the EU MSP Directive of 2014, and the second international workshop on MSP in 2017 are noted. Current MSP activities in world regions are summarised and characterised. Finally, a target for MSP outcomes by 2030 and future challenges for MSP are identified.

1. Introduction

Societal demand for marine goods and services, such as food, energy, and habitats, is rising and often exceeds the capacity of marine areas to meet all demands simultaneously. In many cases, users have free access to marine resources, including ocean space, that often leads to over use, conflicts, and eventual degradation of marine resources including habitats. Since many marine goods and services are not priced in the market, e.g., ecosystem services such as climate regulation and storm protection, conflicts often cannot be resolved and trade-offs made through economic benefit/cost analysis. Another public process must be used to decide what mix of outputs, or goods and services, from the marine area should be produced over time and space—that process is marine spatial planning or MSP [1].

Over the past two decades marine spatial planning (MSP) has matured from a concept to a practical approach to moving toward sustainable development of the ocean, and more recently toward a "blue economy". Initially started in Australia, then China, Germany, The Netherlands, Belgium, and England, MSP has now spread to over 75 nations—half of the 150 countries of the world with marine waters [2]. It has become the planning process of choice to determine what, where, and when human activities should take place in marine areas.

This paper defines MSP, reviews some of the historical roots of MSP, identifies the need for MSP, reviews key attempts to implement MSP in most regions of the world, summariness the current status of MSP in 2019, and outlines some challenges for the future evolution of MSP.

2. Marine spatial planning defined

Marine spatial planning has been defined most succinctly as "ecosystem-based management at sea" [3]. While not everyone would accept this definition, it does have the appeal of simplicity. Other more full definitions exist. The most widely-used one is MSP is "… a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process" [4]. MSP is a process, not a tool. It is integrated and multi-objective, not focused on a single economic sector, e.g., fishing or offshore renewable energy—or marine conservation. It is inclusive, transparent, and public, not exclusive, opaque and private, It is future-oriented, continuing and adaptive—not a one-off "master plan" or "blueprint". MSP is never "done"; it is a commitment to continue planning into the future. After all, planning can only deal with the future.

The MSP process has also been called maritime spatial planing (mostly in countries of the European Union), marine planning, ocean planning, marine spatial management, integrated ocean management, sea use management, marine zoning, ocean zoning, and a few other similar terms. Several authors have pointed out the confusion of all of the different names and acronyms [5]. However, a search of the "Web of Knowledge" of the Institute for Scientific Information—data collected by

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searching all databases and using the above terms—found that "marine spatial planning" (9300 results) or "maritime spatial planning" (2000 results) represented about 80% of all results. "Marine planning" had about 3700 results; other terms had 1000 results or less. In this paper, MSP covers all of these terms [6].

Marine zoning without planning is not MSP, although marine places that have implemented marine zoning without planning are included in this paper. A comprehensive and adaptive marine spatial management plan should be the principal product of a MSP process that develops goals, objectives and a vision for the future and that guides decision-making during implementation of the plan. Having a comprehensive plan ensures that planning precedes zoning. The comprehensive plan is insurance that zoning bears a "reasonable relation between the end sought to be achieved by [zoning] and the means used to achieve that end" [7]. Zoning is one of several management actions available to implement the goals and objectives of the comprehensive marine spatial management plan. Any zoning plan and regulations should follow and be consistent with the comprehensive plan.

Marine protected area (MPA) management is not MSP either. While many MPAs encourage multiple uses, the principal goal of MPAs is—obviously—marine protection and conservation. However, many authors (including this author) have recognised the accomplishments of the Great Barrier Reef Marine Park Authority in organising and implementing the management regime of the Great Barrier Reef, including its marine zoning plan, as an early forerunner of MSP. If the focus of goals and objectives are set aside, the planning process of MSP is very similar to the planning process of MPAs.

3. Mapping the geography of the sea: the early seeds of MSP

MSP has many of its historic roots in the policies, processes and practices that nations have been applying to marine spaces for many centuries for at least eight centuries—maps of sailing routes or navigational charts have been around, but closely guarded, since the 6th century BC [8]. At least as long ago traditional societies of the Pacific have used the concept of space and time to protect marine resources from over-exploitation. Marine areas were designated by priests as *tapu,* places that must be left alone, i.e., marine protected areas [9]. Pope Alexander's papal bull of 1493 and the Treaty of Tordesillas of 1494 divided the vast newly discovered ocean area between the Crown of Castile and the Crown of Portugal—an audacious application of ocean zoning at a global scale that was largely ignored by other European maritime nations [10].

Thematic maps, or maps that show the geographic distribution of a specific theme or subject, are widely used in MSP today. This type of map did not exist until the mid-17th century because accurate base maps were not available. Once they became accurate enough to display coastlines and other boundaries correctly, the first marine-themed chart was created. Edmond Halley's *"New and Correct Chart Shewing the Variations of the Compass"* was the first chart in 1701 to show lines of equal magnetic variation [11]. A century and a half later, Matthew Fontaine Maury, the first Superintendent of the U.S. Naval Observatory (1842–1861) became known as the "pathfinder of the seas" and the "father of modern oceanography" because of his compilation and publication of global, data-based thematic maps of wind and currents developed from ship logs [12]. Maury also used data from the logs of whaling ships to chart the migration of whales and to publish a global chart in 1851 showing the seasonal distribution of several species of whales. The chart provided a competitive advantage to the New England commercial whaling industry for locating sperm whales its favoured prey in the Pacific [13].

In 1883 Ole Theodor Olsen, a Norwegian who settled in England, published a *Piscatorial Atlas of the North Sea, English and George's Channels, illustrating the fishing ports, boats, gear, species of fish (how, where and when caught) and other information concerning fish and fisheries* [14]. Olsen had worked with Maury collecting oceanographic data around the British Isles and had collected data from fishermen for over a decade. His *Piscatorial Atlas* contains fifty coloured maps of North Sea fisheries showing the distribution and abundance of each species. Olsen's atlas is one of the first publications on the North Sea fisheries that was based on comprehensive statistical information collected over many years.

In 1975 Arthur Lee, former Deputy Director of Fisheries Research for England and Wales, and John Ramster from the Lowestoft Laboratory of the UK Fisheries Research Directorate, produced the first modern version of a comprehensive marine atlas, *An Atlas of the Seas Around the British Isles,* 23 black-and-white charts reproduced on an office copy machine for the Ministry of Agriculture, Food and Fisheries (MAFF). Their atlas brought together for the first time information normally scattered over scientific publications. An updated and more-refined atlas of the same name was published by MAFF in 1981 [15].

Anticipating the proclamation of the world's first exclusive economic zone (EEZ) by the United States of America in May 1983, from 1978 to 1986 the National Oceanic and Atmospheric Administration (NOAA) published a series of data atlases that synthesised existing information on the characteristics of its potential EEZ. The NOAA data atlases were partially based on a previous data atlas of Ray, Salm, and Dobbin in the Caribbean Sea [16]. The first output of NOAA's atlas series was the *Eastern United States Coastal and Ocean Data Atlas* [17]. On a common base map NOAA mapped the life histories of hundreds of marine species and their habitats to identify important biological and ecological areas, as well as maps of oceanographic conditions and economic activities. With little data available particularly on the life history of many marine species in space and time, NOAA organised groups of academic and governmental species experts to synthesise and map their collective knowledge into maps—long before the power of today's geographic information systems and data portals—Arcinfo was first released in 1982. Other NOAA regional data atlases were published for the Gulf of Mexico [18], the Bering, Beaufort and Chukchi seas [19], and an unpublished atlas of the Pacific West Coast.

A marine data atlas symposium organised by Ramster and Lee in 1985 and held at the Royal Geographical Society in London brought together marine data atlas developers and marine planners from Western Europe and North America to share early experiences and discuss applications of mapped marine information [20]. Marine atlases have since become common first outputs of MSP processes of many countries, including Belgium [21], Canada [22], and Scotland [23].

4. Establishing the need for MSP

MSP as we know it today was not born in a specific time and place. Like other approaches it grew out of a convergence of interests to a particular challenge—in this case managing the balance of conservation and development of three-dimensional marine space over time (a fourth dimension)—and the development of processes, techniques and tools to avoid or manage conflicts among activities that use marine space.

The first UN Conference on the Human Environment (the Stockholm Conference), held in 1972, is widely acknowledged to have laid out the framework for all subsequent global environmental actions including concepts and principles that eventually became "sustainable development", but the means to achieve sustainable development were not identified [24].

The Law of the Sea negotiations that began in 1973 and ended with the 1982 Law of the Sea (LOS) Convention influenced the idea of MSP today. The LOS Convention enshrined the concept that "… all problems of ocean space are closely interrelated and need to be addressed as a whole …" or the idea of integrated ocean management [25]. It laid out a geographic framework for integrated ocean management—the territorial sea and the exclusive economic zone—but did not identify how ocean management could be carried out. No reference was made to any place-based or areawide planning, to marine or maritime spatial planning, to integrated ocean planning or management, or to sea use

planning. However, some early attempts about how to address ocean problems "as a whole" were beginning in the early and mid-late1970s.

In the United States in 1969 the Stratton Commission issued its influential report, *Our Nation and the Sea,* that emphasised three major issues: the oceans as the "New Frontier," the need to protect the coastal environment from overexploitation and pollution, and a detailed plan to reorganise US marine and coastal authorities [26]. The report led to the creation of the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency in 1970. In 1972 the United States passed a Coastal Zone Management Act that hinted at MSP [27]. However, the act limited its definition of the coastal zone as "seaward to the outer limit of State title" or three nautical miles in most cases. Implementation of the act was delegated to individual coastal states. With only a few exceptions noted later in this paper, MSP in the USA was not considered until more than 30 years later. A comprehensive overview of the developments of this formative period are well documented in Cicin-Sain and Knecht [28].

In 1975 the concept "sea use planning" was introduced for the first time in a little-known pamphlet of the Fabian Society in London. Written just after that start of North Sea oil and gas development, the authors including geographer Hance Smith laid out the case why "**…** comprehensive sea use planning will provide better results for the British people than the continued operation of the present commercial and bureaucratic scramble. There is no time to loose"—written 45 years ago [29].

A discussion of the new frontiers of marine geography considered the emerging geographical implications of increasing uses of the sea and their management at a 1986 conference of the International Geographical Union in Barcelona. Hance Smith summarised the state-of-the art of the theory and practice of sea use management, including increasing conflicts among uses, increasing environmental impacts of uses of the sea, and the concentration of these impacts within the territorial sea. He noted that individual use management systems have their own objectives that are sometimes shared among uses—and that spatial allocation among conflicting uses could be an emerging management objective by itself. He concluded that integrated sea use management provided an opportunity to formulate a practical management framework for future work. At the same meeting, Hanns Buchholz, a German geographer, proposed an extension of land-based regional planning into maritime zones including national exclusive economic zones [30].

In 1996 the 4th Conference of [Baltic Sea] Ministers for Spatial Planning and Development introduced *Recommendations for Spatial Planning of the Coastal Zone in the Baltic Sea Region*). The recommendations focused on the immediate coastal strip [31]. A later ministerial conference in 2001 passed the *VASAB 2010 + Spatial Development Action Programme* where the sustainable development of coastal zones and islands was one of the six key themes for transnational spatial planning cooperation—extending spatial planning to marine areas. Between 2002 and 2005 the BaltCoast project (A Systems Approach Framework for Coastal Research and Management in the Baltic) developed recommendations on the role of spatial planning in integrated coastal zone management. Based on these recommendations the VASAB Gdansk Ministerial Conference in 2005 suggested "sea use planning" as a tool to prevent conflicts in intensively used offshore areas of the Baltic Sea [32].

In a 2002 report to the Parliament and European Parliament, *Towards a Strategy to Protect and Conserve the Marine Environment,* the European Commission announced that it would "address the integration of nature protection measures and the various sectoral activities impacting on the marine environment including spatial planning" [33].

Finally, in the USA from 2005 to 2006 a working group organised at the National Centre for Ecological Analysis and Synthesis at the University of California Santa Barbara considered the role of ocean zoning and MSP in marine ecosystem-based management. The working group identified several key weaknesses in oceans governance and proposed ocean zoning and MSP to replace the current "mismatched and fragmented approaches" and ad hoc decision-making in ocean governance. The working group published the first paper on MSP to appear in a major scientific publication that summarised the need for place-based MSP and was influential in advocating the development of MSP in the USA [34].

After 30 years of meetings and workshops a general recommendation on using place-based, integrated MSP been to emerge in Europe, North America, Australia and China. The next section summarises first attempts to put MSP into practice.

5. Early applications of MSP, 1975–2005

5.1. Australia

The Great Barrier Reef Marine Park (GBRMP) is often cited as the earliest example of MSP—or ocean zoning in this case. The GBRMP stretches along 2300 km of the northeastern coast of Australia. It is one of the world's richest and most diverse marine ecosystems. The area of the GBRMP is approximately 344,400 km^2 at the time of its designation the largest MPA in the world. The Great Barrier Reef Marine Park Act of 1975 established the GBRMP and created the Great Barrier Reef Marine Park Authority "… to provide for the long-term protection, ecologically sustainable use, understanding and enjoyment of the Great Barrier Reef for all Australians and the international community through the care and development of the Great Barrier Reef Marine Park" [35]. Concern about protecting the Great Barrier Reef from offshore oil drilling and phosphate mining was a key driver for establishing the marine park in the late 1960s and early 1970s. Other threats included pollution from shipping, land-based sources of pollution, especially agricultural runoff, and increased fishing and tourism. Ocean zoning was the cornerstone of the original management strategy for protecting the Great Barrier Reef.

The initial focus of the GBRMPA was to zone the marine area, especially coral reefs. Reefs were mapped, regional plans were formulated, public participation was considered innovative and imaginative, and the work had a tangible output, a series of four sectional zoning plans [36]. The initial zoning plans and regulations, implemented sequentially from 1981–87, evolved and changed considerably in response to the dynamic nature of both the marine environment, its uses and perceived effectiveness of the plans. About 4.5% of the Great Barrier Reef Marine Park was designated as "no-take areas" in the initial plans. When in the late 1990s monitoring results showed ecosystem protection goals were not being achieved, an extensive re-zoning process, the Representative Areas Program (1998–2003), increased the no-take areas, to about a third of the area of the Great Barrier Reef Marine Park [37].

Although few parallels can be drawn between the context of the Great Barrier Reef Marine Park and densely-used areas such as the Baltic Sea, the North Sea, and numerous other places in Europe, Asia and North America, some important lessons can be learned about the process of MSP from the experience of the Great Barrier Reef Marine Park. Its long-standing experience illustrates the need to conduct MSP in a continuous, adaptive manner, one that allows monitoring and evaluating initial plans and adapting them to changing circumstances. It also shows that stakeholder involvement and sustainable financing are critical to successful outcomes of MSP over time.

In 1998, *Australia's Oceans Policy (AOP)* was released with the broad goal to achieve full integration across economic sectors and jurisdictions through ecosystem-based approaches to implementation [38]. Its EEZ was divided into five regions: the South-east; South-west; North-west; North; and Temperate-East. It was one of the first countries to complete an integrated marine spatial plan—the South-east Regional Marine Plan—developed from 2000 to 2004 and covering 2,000,000 km^2 [39]. It was arguably the first MSP plan in the world, but was never implemented.

5.2. China

Until fairly recently MSP activities in China were little known in the

Western world, but it was the first country to implement marine functional zoning (MFZ) at the national level and is currently in its third generation of marine zoning. Initially developed from 1989 through 1995, China's first generation of MFZ identified the "dominant functions" for designated sea areas. The first generation of MFZ had no legal authority; it was a pilot undertaking that was not implemented. However, it laid the foundation for the next round of MFZ plans [40].

A revision of the first generation of marine functional zoning was carried out from 1998 to 2003 and became the second generation of marine zoning, building a MFZ architecture at the national, provincial, and municipal or county levels. The State Council approved *National Marine Functional Zoning* [41] in 2002 after the zoning system was acknowledged in the *Law on the Management of Sea Use* also In 2004 [42]. The State Council approved MFZ plans in coastal provinces, autonomous regions, and municipalities (except Shanghai) and set a time limit for implementation of plans by 2010.

5.3. Canada

Canada was the first country in the world to adopt comprehensive legislation for integrated ocean management. Through its Oceans Act of 1996, Canada committed to conserve, protect and develop the oceans in a sustainable manner. The Oceans Act called for the Minister of Fisheries and Oceans to "… lead and facilitate the development and implementation of plans for the integrated management of all activities or measures in or affecting estuaries, coastal waters and marine waters …. " [43].

A *Canadian Ocean Action Plan, 2005–2007* identified four pillars, including integrated ocean management for sustainable development [44]. The creation and development of five Large Ocean Management Areas (LOMA's) was a central strategy in the implementation of Canada's integrated ocean management responsibilities. The five LOMA's were [1]: the Eastern Scotian Shelf Integrated Management Area (ESSIM) [2]; Placentia Bay and Grand Banks [3]; Gulf of St. Lawrence [4]; the Beaufort Sea; and [5] the Pacific North Coast Integrated Management Area (PNCIMA). Progress on developing and implementing integrated management plans for these five areas has been slow, but steady.

The first regional marine plan was developed for the Eastern Scotian Shelf in northeast Canada—325,000 km^2. A draft integrated ocean management plan was completed in 2005 and the final plan in 2008—almost 10 years after it was initiated. However, formal approval by DFO, funding and implementation of the ESSIM plan has not moved forward since the plan was completed [45].

5.4. Belgium

The Belgian part of the North Sea covers about 3600 km^2 and its coastline is only 66 km in length, but despite its small size, the Belgian marine and coastal area is one of the most intensely used marine areas in the world. The GAUFRE project (2003–2005) and its resulting reports were the first attempt to deal with the high level of use in the Belgian part of the North Sea (BPNS). The project was made up of an interdisciplinary team at the University of Ghent that worked together for three years. Although the information baseline was kept as science-based as possible, the team was extended to incorporate professional experts from the terrestrial spatial planning fields. The collation of the spatial scientific data on GIS maps and the use of interpretative maps (structural maps) provided a solid starting point for the project [46].

In the context of the GAUFRE project an innovative and comprehensive method was outlined to develop alternative spatial sea use scenarios—defined as "a vision that projects the future use of ocean space based on a core set of goals and objectives and assumptions about the future". By developing alternative spatial scenarios, future possibilities and conditions of the ocean area were visualised clearly, as a basis for grounded, proactive decisions by the Belgian government [47]. The GAUFRE project, because of its focus on methods development and clear communications of project results has had an inordinate influence of subsequent European and global MSP projects and plans.

Belgium was among the first countries to implement in 2003–2004 an operational, multiple-use zoning plan that covers its territorial sea and EEZ. Belgium initially used zoning (the output was called a 'Master Plan') to allocate marine space for specific maritime uses [48]. A second planning phase determined sites for marine protected areas. The plan allowed permits for economic activities only within the identified zones and were subject to monitoring and evaluation. The zoning plan was not regulatory.

5.5. Netherlands

The Dutch part of the North Sea, covering an area of about 58,000 km^2, is also one of the most intensely used marine areas in the world. From one kilometer off the coast and beyond, the national government is the only authority responsible for the North Sea policy and planning. In 2005, the Dutch Ministry of Housing, Spatial Planning and the Environment (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieu or VROM) published for the first time a marine chapter on the North Sea in its national *Spatial Planning Policy Document* [49]. The Dutch marine spatial planning policy was aimed at preventing fragmentation and promoting the efficient use of space, while giving private parties the scope to develop their own initiatives in the North Sea. This overall goal was elaborated in more detail in the *Integrated Management Plan for the North Sea 2015 (IMPNS)* where it is translated into spatial management to foster [1]: a healthy sea [2]; a safe sea; and [3] a profitable sea [50].

In 2005 The Dutch government used a MSP approach that defined use zones only where necessary, e.g., shipping routes, military exercise, and ecologically-valuable areas. This approach allowed a considerable amount of freedom to the private sector by giving them the latitude to develop initiatives within certain constraints. Spatial planning was considered as a means of fostering sustainable use while simultaneously allowing as much scope as possible for private sector initiatives. In the Netherlands, marine spatial plans are revised every six years.

In 2009 a more strategic and forward-looking plan was made with a greater focus on spatial development—the *Policy Document on the North Sea 2009–2015* [51]. This policy document is now part of the *National Water Plan (NWP)* and should be read with it [52]. It details and substantiates the policy choices about human uses of the North Sea and their implementation in the NWP.

5.6. Germany

Spatial plans for the German territorial sea (0–12 nm) have been developed and approved by the three coastal länder (federal states)—making Germany one of the only countries in the EU that has the authority to address the management of coastal-marine interactions in an integrated manner at the länder level. The Spatial Development Plan for Mecklenberg-Vorpommern was extended to the 12-nm territorial sea between 2003 and 2005 and adopted in 2005—the first government-approved marine spatial plan in Europe [53]. Between 2013 and 2015 the plan was updated and became a legally-binding act in 2016. The Development Plan for Schleswig-Holstein was completed in 2010; consultation on the amended plan began in late 2017 [54]. The Spatial Planning Programme of Lower Saxony has been revised and amended in 2008 and 2012.

From 2005 to 2009 the German Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie or BSH) drafted multiple-use marine spatial plans (and associated environmental reports) for the German exclusive economic zones in the North Sea and the Baltic Sea. The EEZ of Germany covers about 33,100 km^2–28,600 km^2 in the North Sea and 4500 km^2 in the Baltic Sea.

MSP in Germany is based on the Federal Land Use Planning Act that

was extended to the exclusive economic zone. The German plans are regulatory and enforceable. The federal plan for the North Sea went into effect in September 2009 and the federal plan for the Baltic Sea in December 2009. Both plans were revised in 2017 [55,56]. Currently the BSH is preparing a status report on the first set of plans from 2009, including evaluation, context analysis, updated data and evidence, and requirements for the process for the revised plans. The report and a set of planning pre-drafts will be developed and consulted nationally and internationally, followed by the development of full first drafts. The revised plans are scheduled to be completed in 2021.

5.7. Norway

A 2002 policy paper *Protecting the Riches of the Sea* to the Norwegian Parliament stated that the expected increase in the use of coastal and marine areas would make it difficult to strike a balance between the various user interests and environmental considerations, and that the use of spatial management in marine areas will be important [57]. The policy paper noted that a differentiated and sustainable spatial management regime must be based on knowledge of ecosystems and the impacts of different forms of use.

The governmental plan was to have integrated management plans for the Norwegian waters that would establish clear basic conditions for the use and protection of the coastal and maritime areas. The plans would have sustainable development as a central principle, and management of the marine areas based on the precautionary principle and implemented with respect for the limits that nature can tolerate. An important element was to be the ecosystem approach including the establishment of environment quality objectives. The EEZ of Norway—about 2,300,000 km^2—was divided into three spatial management regions: the Barents Sea and the Sea Areas off the Lofoten Islands; the Norwegian Sea; and the North Sea and Skagerrak.

From 2002 to 2006 the Norwegian Ministry of Environment led an inter-ministerial-level steering group that developed an *Integrated Management Plan of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands* [58]. The plan was approved by the Norwegian Parliament in 2006. It covers areas of the Norwegian EEZ outside of the baseline (one nm off the coast)—about 961,000 km^2 of marine waters—as well as the fishery protection zone around the Svalbard archipelago.

The plan addresses important marine economic sectors in Norwegian marine waters including oil and gas development, fisheries, marine transport, and marine conservation—all assessed through 2020. It is one of the few national marine spatial plans anywhere that integrates fisheries management actions with those in other marine sectors.

The plan is advisory only and does not provide detail on managing specific human activities; implementation of the plan was the responsibility of the relevant ministries and management bodies that are expected to manage their sectors consistent with the integrated management plan. Socio-economic effects of the plan were not assessed; economic impacts on communities, region, and nation will be better assessed in future rounds of planning according to the authors of the first plan. The 2006 Barents Sea-Lofoten Islands management plan was revised in 2010–11.

A plan for the *Integrated Management of the Marine Environment of the Norwegian Sea* was developed from 2007 to 2009, modeled after the Barents Sea plan, and approved by the Parliament in May 2009 [59]. The plan covers about 1,170,000 km^2. Its purpose is to both create value to the Norwegian economy and maintain the high environmental value of the area.

The plan continued the process of identifying geographically-defined areas within the Norwegian Sea that contain particularly valuable environmental assets that was introduced in the management plan for the Barents Sea. The main criteria for selecting the areas were that the area was important for biodiversity or for biological production. Secondary criteria were economic importance, social and cultural importance, and scientific value. Eleven particularly valuable areas were identified and their vulnerability assessed. The need to maintain ecological goods and services in these areas determined the choice of spatial management actions.

5.8. United Kingdom

The creation of the Department of Environment Food and Rural Affairs (Defra) in 2001 brought together into one governmental department interests in policy and science functions to support marine conservation, environmental protection, fisheries, and coastal management objectives. In one of its first policy statements, *Safeguarding Our Seas,* Defra outlined interest in exploring *"the role of spatial planning for the marine environment"*—certainly one of the first naming of the concept of MSP [60].

Defra funded an Irish Sea Pilot project in 2002 to test the potential for an ecosystem approach to managing the marine environment at a regional sea scale and to develop a framework for coastal and MSP [61]. Among the recommendations of the final report were [1]: MSP should be a statutory process in the UK [2]; MSP should be carried out at the national and regional scale [3]; a marine and coastal policy statement should identify national marine planning principles. The report warned presciently that one of the greatest challenges for MSP would be how to engage the public and how to ensure that relatively large, regional plan-making and regulatory bodies are adequately accountable to the public.

Rather than use existing authorities to initiate marine planning, the UK took five years (2004–2009) to pass national legislation, *the Marine and Coastal Access Act of* 2009 that authorised marine planning [62]. The Act also established the Marine Management Organisation (MMO) that has responsibility for marine planning in English territorial waters. The structure and detailed content of marine plans are not prescribed by the Act. The MMO was given authority to set out the final structure and content of marine plans.

6. Early MSP initiatives in North America

Early initiatives in Canada have already been described (5.3). Compared to Western Europe the USA was slow to initiate MSP at the national level. However, a few coastal states were early adopters of MSP—as early as 1994. Mexico began MSP in the Gulf of California in 2004.

6.1. United States of America

6.1.1. Oregon

The state of Oregon *Territorial Sea Plan (TSP)* was first adopted in 1994 and provided guidance to state and federal agencies to manage uses within the state waters of Oregon (0–3 nautical miles offshore) a surface area of about 3250 km^2 [63]. Previously Oregon ocean resources were governed by a tapestry of authorities at multiple government scales. The TSP was a coordinating framework from which individual agencies could implement regulations and management actions in the territorial waters of Oregon. In 2013 the plan was amended to cover the development of renewable energy facilities in the Oregon territorial sea.

Oregon also designated an "Ocean Stewardship Area" that extended from shore seaward across its relatively shallow continental shelf then down to the toe of the continental slope some 24–65 km offshore—an area of about 41,000 km^2. While Oregon had no jurisdiction beyond three nautical miles, this area was the most biologically productive, where human uses and effects were most intense, and where the need for management and protection was greatest. The Ocean Stewardship Area was first expressed as a recommended state policy in the 1990 *Oregon Ocean Resources Management Plan* and was adopted as a state-wide planning goal in 2000 [64]. While neither of these plans was a marine spatial plan, they both used an innovative approach to defining marine

planning boundaries that helped establish today's marine spatial plans.

6.1.2. Massachusetts

Around 2000 the state of Massachusetts was increasingly facing new proposals for major ocean-based development such as liquefied natural gas (LNG) pipelines and terminals as well as renewable wind and wave energy projects. At the same time, it was seeing the deterioration of marine habitats and ocean resources, including loss of eelgrass beds, major declines in many commercial fish populations, increases in the frequency and duration of harmful algal blooms, and rises in beach closures from bacterial water quality standard violations. Recognising the range of existing and proposed ocean uses in the state, the governor of Massachusetts announced an Ocean Management Initiative in March 2003.

From 2003 to 2004, an Ocean Management Task Force—comprised of ocean users and other stakeholders evaluated the adequacy of the existing legal and policy framework, assessed the science and information base available, and developed principles and recommendations to guide statewide planning and governance efforts for ocean public trust resources. In 2004, the Task Force released its report *Waves of Change* that included 16 recommendations for improving ocean management [65], including a call for new, comprehensive legislation that would mandate proactive ocean management planning and establish objectives and strategies for ocean planning areas and activities within state waters. From 2005 to 2008, an ocean planning bill made its way through the legislative process and in May 2008, the governor signed the Massachusetts Oceans Act—the first comprehensive ocean planning legislation in the USA.

A 17-member commission advised the Secretary as the Executive Office of Energy and Environmental Affairs (EEA) developed an ocean management plan. The commission included state legislators, agency heads, representatives from a commercial fishing organisation, and an environmental organisation, an expert in the development of offshore renewable energy, and representatives from the coastal regional planning agencies. The Secretary also received assistance from a council of nine scientists. The deadline for a comprehensive ocean management plan was set only 18 months after the act was signed into law.

The plan took a streamlined regulatory approach with implementation through existing authorities and processes and required close coordination among state agencies.The law stipulated that all state license and permit approvals for ocean-based projects had to be consistent with the plan to the maximum extent practicable. In 2011 the plan was formally incorporated by the Office of Coastal Zone Management (CZM) into the Massachusetts Coastal Program. The *Massachusetts Ocean Management Plan* was he first regulatory marine spatial plan In the USA [66]. The Massachusetts Oceans Act requires that at least once every five years, the ocean plan is assessed and amended as necessary to ensure that the Oceans Act goals are met. The plan was amended in January 2015. Substantial funding for planning was provided by the Gordon and Betty Moore Foundation.

6.1.3. Rhode Island

Begun in 2007, the state of Rhode Island's *Ocean Special Area Management Plan (Ocean SAMP)* was the first marine spatial plan in the United States to be formally approved by the federal government as an element of a state's coastal management program [67]. The 3800 km^2 planning region includes waters under both state and federal jurisdiction. The Ocean SAMP was prepared over a 3-year period of information generation, analysis, consultation, planning and policy making prompted by the need to identify potentially suitable sites for anticipated offshore wind farms. Its highly consultative approach built upon the 30 years of experience of the Rhode Island Coastal Program in developing and implementing special area management plans (SAMPs) for coastal and marine areas where conflicts over the need for both development and conservation demand special attention and negotiation among stakeholders with different interests. The preparation of the plan was triggered by an initiative led by the governor of Rhode Island designed to attract proposals for the construction of wind farms off the Rhode Island coast that would produce both a source of renewable energy and a new industry anticipated to generate high-paying jobs in a state with particularly high unemployment and low economic growth. The plan was adopted by the state's Coastal Resources Management Council, the lead Rhode Island governmental agency for coastal management, in 2010 [68].

6.1.4. Mexico

The exclusive economic zone and territorial sea of Mexico covers about 3,150,000 km^2—the 13th largest in the world. The Ministry of Environment and Natural Resources (SEMARNAT) is in charge of formulating, issuing and executing MSP along with other federal agencies, and agencies at the state and municipal levels. Four marine planning regions have been identified based on ecosystem considerations [1]: the Northern Pacific [2]; the Southern Pacific Ocean [3]; The Gulf of California; and [4] the Gulf of Mexico and Caribbean Sea [69].

Two regional marine spatial plans have been completed and approved and are currently being implemented—the Gulf of California, begun in 2004 and completed in 2006 and the Gulf of Mexico and Caribbean Sea, begun in 2006 and completed in 2012. The Gulf of Mexico and Caribbean Sea plan focuses on regulation of activities of the energy, maritime and fisheries sectors, while the plan in the Northern Pacific considers the interactions among the tourism, conservation, and fisheries sectors [70]. The Northern Pacific plan was started in 2009 and was completed in 2018 [71]. A plan for the Southern Pacific begun in 2011 will be completed in 2020.

7. MSP goes international at the Intergovernmental Oceanographic Commission of UNESCO in 2006

In early 2006 recognising the need for an international meeting to pull together an increasing number of nationally-focussed MSP initiatives to share experiences and to develop a consistent MSP terminology and framework, the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Educational Organisation (UNESCO) sought funding from the International community. Financial support for a workshop was provided by six national governments, three non-governmental organisations, and two U.S. charitable foundations the Gordon and Betty Moore Foundation and the Packard Foundation. The workshop was held in Paris in November 2006 and attended by about 50 marine scientists, marine planners, marine resource managers, and decision makers from 20 countries. The results and conclusions of the workshop, *Visions for a Sea Change,* were published by IOC-UNESCO [72] and a 2008 special issue of the *Marine Policy* journal published papers from the workshop [73]. Among the recommendations of the workshop were [1]: continue to develop an international community of MSP researchers and practitioners [2]; develop and maintain a UNESCO MSP website to continue to follow developments in different countries and regions [3]; communicate with and learn from terrestrial and coastal zone management examples and planning processes for ecosystem-based spatial planning [4]; work to integrate the human dimensions into MSP in more complex and complete ways [5]; develop a common vocabulary of MSP terminology; and [6] develop guidelines of best practices to assist practitioners in the implementations of MSP. Thirteen years later, most of these recommendations have been implemented. The workshop was later characterised as "… *the starting point for the spread of MSP internationally* …. " [74]. IOC-UNESCO launched a website on its MSP Programme in 2008 that has been updated regularly over the past 11 years [75].

An important output of the first IOC-UNESCO international workshop was the development of a comprehensive, operational guide to ecosystem-based MSP written in clear language for use by marine planners who were initiating MSP. The project was also funded by the Gordon and Betty Moore and the David and Lucille Packard foundations.

Work began in 2007 and finished with the publication of the IOC-UNESCO guide to *Marine Spatial Planning: a step-by-step approach to ecosystem-based management* in 2009 [76]. The widely-used guide has been translated by national governments and non-governmental organisations into six languages. A third IOC-UNESCO guide to *Evaluating Marine Spatial Plans* was published in 2014 [77].

8. Enter the European Commission and its MSP directive of 2014

Taken together the 22 countries (Member States) of the European Union with marine waters have collectively the largest EEZ in the world—about 20 million km^2—including their overseas territories. In October 2007 the European Commission published its *Integrated Maritime Policy (IMP)* document and a related action plan that provided an approach to maritime issues and increased coordination among different policy areas—MSP was identified as one of the pillars of its new EC maritime policy [78]. The EC announced it would propose a "road map" for MSP in 2008. Integrated maritime spatial planning across EU waters is a fundamental requirement for the continued sustainable development of maritime economic activities, because it provides a neutral process to arbitrate between conflicting or competing activities or interests. However, it will yield its full benefits only if all coastal Member States introduce such systems, that they use compatible and comparable systems, and learn from each other's experiences.

As promised the EC published in 2008 a *Roadmap for Maritime Spatial Planning: achieving common principles in the EU* that outlined 10 "key principles" for MSP [79]. In 2012, the Commission adopted a *Communication on Blue Growth, opportunities for marine and maritime sustainable growth* [80]. The objective was to launch a joint initiative with Member States, regions, and all relevant stakeholders to "unlock the potential of the blue economy".

Having established itself as the centre of innovation in MSP by 2014 through a decade long programme of substantial investments in pilot MSP projects, research, and education, the European Union took the bold step of proposing and passing EU-wide legislation on MSP—a game changer in the advance of MSP in Europe and the world. Under the MSP Directive [81], MSP is now compulsory in the 22 Member States of the EU. Member States were required to incorporate the requirements of the MSP Directive into their national legislation and designate the relevant authorities by 2016. The establishment of maritime spatial plans in marine waters of Member States must be completed by March 2021.

The EC has funded €18 million of cross-border planning projects over the past three years. In 2016 the EC launched an "assistance mechanism" to provide administrative and technical support to EU countries in implementing the MSP legislation. Part of this initiative includes the *European Maritime Spatial Planning Platform*, a useful website on the progress of MSP within EU Member States [82]. The evolution of MSP in the European Union is described in more detail in a paper by Friess and Gremaud-Colombier in this special issue [83].

9. A National Ocean policy and regional MSP in the USA

In June 2009 U.S. President Obama sent a memorandum to the heads of executive departments and federal agencies establishing an Interagency Ocean Policy Task Force, led by the White House Council on Environmental Quality. The Task Force was charged with developing a recommendation for a national policy that would ensure" protection, maintenance, and restoration of oceans, our coasts and the Great Lakes." It would also recommend a framework for improved stewardship, including coastal and marine spatial planning [84].

A year later the task force issued its final recommendations [85]. Coastal and marine spatial planning (CMSP) was one of the nine priority objectives in the recommendations. Its report described a national framework for CMSP, provided a definition of CMSP, identified the reasons for engaging in CMSP, and described its geographic scope. Under the framework, the USA EEZ was subdivided into nine regional planning areas based largely on the boundaries of large marine ecosystems. Each region would have a corresponding "regional planning body" consisting of federal, state, and tribal representatives to develop regional goals, objectives, and ultimately regional coastal and marine spatial plans. President Obama signed an *Executive Order on Stewardship of the Ocean, Our Coasts, and the Great Lakes* in July 2010 [86]. The term "coastal and marine spatial planning" was defined as "a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science, for analysing current and aI nticipated uses of ocean, coastal, and Great Lakes areas."

10. The second International Conference on MSP in March 2017

In 2017 the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the Directorate-General for Maritime Affairs and Fisheries (DG MARE) of the EC organised jointly the 2nd International Conference on Maritime/Marine Spatial Planning (MSP) in Paris. The main objective of the conference was to review the status of MSP—about a decade after the first International MSP Conference organised by the IOC—and to identify a path forward that addresses the multiple global challenges for MSP from 2017 onward. More than 350 experts from around the world participated. A final report of the conference is available [87].

The principal output of the conference was a joint roadmap [88]. The roadmap identified five priority areas [1]: transboundary MSP [2]; the "blue economy" [3]; ecosystem-based MSP [4]; capacity building; and [5] building mutual understanding and communicating MSP. To highlight the contribution of MSP to the implementation of the UN Agenda 2030, IOC-UNESCO and DG MARE submitted the roadmap as part of their joint voluntary commitment to Goal 14, conserve and sustainably use the oceans, seas and marine resources for sustainable development, at the UN Conference on the Sustainable Development in New York in June 2017. In 2018 the EC-DG MARE provided a 1.4 million euro (US$ 1.5 million) grant to IOC to implement the joint roadmap.

11. The status of MSP in 2019

Over the past 20 years, MSP has gained considerable importance around the world. Various countries have started to use MSP to achieve sustainable development, including the goal of developing a "blue economy" or "blue growth" and biodiversity conservation in ocean and coastal areas. About 75 of 150 countries (Fig. 1) that have marine waters now have MSP initiatives, ranging from early stages such as establishing new authority, new funding and institutional arrangements to advanced stages such as plan revisions and adaptation A summary of countries with MSP activities by world region follows. More detailed information on these activities can be found at the IOC MSP website [89].

11.1. Africa

Over the past five years, Africa has become a centre of MSP initiatives, particularly as a process to develop a "blue economy" [90]. At least ten African countries now have MSP initiatives, most in early stages of development, including Angola, Coˆte d'Ivoire, Kenya, Madagascar, Mauritania, Mauritius, Morocco, Namibia, Seychelles, and South Africa. Angola, Namibia and South Africa are especially promising, due to substantial funding from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under its MARISMA Programme (Marine Spatial Management and Governance). South Africa passed a Marine Spatial Planning Act in 2018 [91] and has published a National Framework for Marine Spatial Planning in South Africa [92]. Namibia has formed a national MSP Working Group, held a national MSP workshop, and produced a National Overview for Marine Spatial Planning [93]. Namibia has made a special effort to involve stakeholders in its MSP process. When these three countries eventually develop an integrated marine spatial plan, it will be one of the few in the world developed at the scale of a large marine ecosystem—the Benguela Current LME.

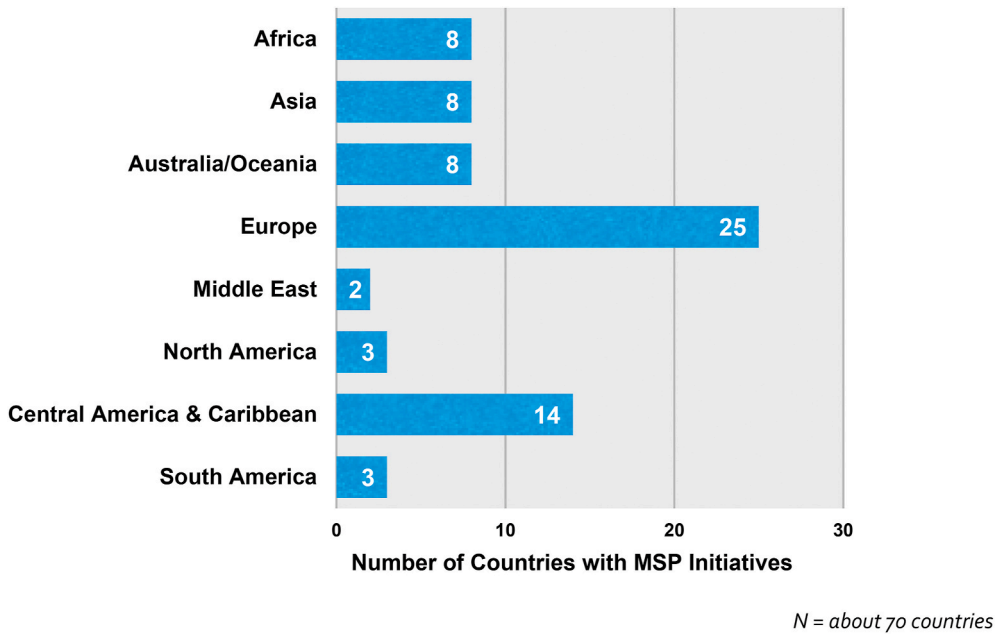

Fig. 1. Number of countries by region with MSP initiatives in 2018.

A Seychelles MSP initiative, conceived in 2014 and covering 1.37 million km^2 of marine waters, is one component of an innovative government-led "Debt for Climate Change Adaptation" swap organized by the Seychelles government and the Nature Conservancy (TNC). A related initiative is the creation of a Seychelles Conservation & Climate Adaptation Trust, a trust that was implemented in November 2016 to fund climate change adaptation and conservation projects in Seychelles. An estimated US$ 13 million will be invested in conservation activities. The trust will also provide partial funding to implement the Seychelles marine spatial plan. The Seychelles MSP has three goals to [1]: expand marine protection to 30% of its marine waters including 15% in high protection status [2]; address climate change adaptation; and [3] support the Blue Economy Roadmap [94]. Completed from 2014 to 2018 the first phase of the plan laid the foundation for planning by organising the process, developing planning tools, and developing a broad-scale zoning plan in deep waters of the Seychelles. A second phase will identify the remaining marine protection and sustainable use zones in both deep and shallow waters to meet the planning objectives, and identify multiple use zones. Phase 2 will also address climate change adaptation objectives, and include an implementation plan [95]. About US$ 13 million will be invested in conservation activities. A *Seychelles Marine Data Atlas* was completed in 2019 [96].

11.2. Asia

Eight Asian countries have MSP initiatives including Bangladesh, Cambodia, China, Indonesia, Myanmar, Philippines, Thailand and Vietnam.

China's State Oceanic Administration launched the design of the third generation of zoning in 2010. The State Council approved *National Marine Functional Zoning (2011–2020)* in 2012 [97] and another 11 provincial MFZ plans, with the implementation deadline to 2020. Today all 11 coastal provinces in China have implemented MFZ to protect natural shorelines, to restore shoreline and other marine resources, approve project-level sea use and coordinate sectoral sea use activities. China's MFZ has now become an integral part of national spatial planning after nearly 30 years of evolution. As the basic framework and governing principles, China now uses MFZ as the basis to develop marine-related policies and plans to implement comprehensive marine management [98].

Indonesia has the sixth largest EEZ in the world covering 6,159,000 km^2. MSP evolved in Indonesia from its early attempts to build experience in the application in integrated coastal management from 2002 to 2007, especially through developing marine zoning plans at the municipal, regency, provincial, and regional levels [99]. Impressively under the Directorate-General of Marine Spatial Management in the Ministry of Marine Affairs and Fisheries, it has recently implemented a national MSP regulation (2019) and already completed three (North Natuna and Natuna Sea, Sulawesi Sea, and Malacca Strait) of the seven inter-regional zoning plans that will eventually help cover all of its EEZ. It has also completed 16 of 34 provincial-level zoning plans [100].

MSP has been incorporated into Viet Nam's Law of Planning in 2018. The other Asian countries are still in the early stages of their MSP initiatives.

11.3. Australia/Oceania

Eight countries in the Australia/Oceania region have MSP initiatives.

In addition to on-going planning work at the Great Barrier Reef Marine Park, MSP activities have been completed in five bioregions of Australia as described in section 5.0.1 of this paper. After the Australian Ocean Policy's first five-year review, its focus changed from a broad multiple-use planning perspective to an environmental one. The most significant change was the replacement of Regional Marine Plans with Marine Bioregional Plans that were completed for the South-west, North-west, North, and Temperate East in 2012. The new focus of the bioregional plans establishi a national network of marine reserves—the largest in the world—but not the regional multi-use marine spatial plans as first promised by the AOP [101]. Although it did not achieve its original goal, the AOP did establish a marine planning process for the entire Australian marine jurisdiction—about 6,000,000 km^2—the third largest EEZ in the world.

New Zealand's first marine spatial plan was completed for the Hauraki Gulf/Ti¯kapa Moana region near Auckland from 2013 to 2017 with active participation from the Maori people [102]. However, New Zealand has no national marine spatial plan for its EEZ, the eighth largest in the world.

Six Pacific Island countries—Fiji, Kiribati, Palau, Solomon Islands, Tonga and Vanuatu—have MSP initiatives, most with financial support of the GIZ under its Marine and Coastal Biodiversity Management in

Pacific Island Countries project (MACBIO) [103].

11.4. The Middle East

Only two countries of the Middle East have initiated MSP. While Israel stillhas no official national marine spatial plan, the Technion-Israel Institute of Technology led a MSP initiative from 2013 to 2015 that completed a pilot national marine spatial plan [104]. Although government professionals participated in The Technion MSP process, it s uncertain whether the government will adopt any aspect of the Technion plan. A thorough summary of marine policy and planning progress in Israel, Lebanon, Egypt, Cyprus, and Jordan is provided by Teff-Seker et al. [105].

Begun in 2013, development of the Plan Maritime in Abu Dhabi, United Arab Emirates, closely followed the step-by-step approach outlined in the IOC guide to MSP. Extensive stakeholder engagement was an important part of the overall MSP process. A draft of the Plan was completed in May 2016. The draft *Plan Maritime 2030: Abu Dhabi Coastal and Marine Framework Plan* [106] and its *Implementation Plan* [107] were tentatively scheduled to be released in April 2017, but the government has not released the plans publicly.

11.5. Europe

Under the Maritime Spatial Planning Directive of 2014, all 22 Member States of the European Union with marine waters now have MSP underway—at minimum establishing MSP authority in their national legislation. Poland was one of the first countries in Europe to introduce MSP into its legal system in 2013 [108].

As described earlier in this paper, Belgium (section 5.0.4), the Netherlands (section 5.0.5) and Germany (section 5.0.6) have all been at the forefront of MSP in Europe—all have approved national plans, and all three have revised initial MSP plans.

In March 2014 Belgium approved a revised maritime spatial plan for the Belgian Part of the North Sea by Royal Decree [109]. In 2010, the Belgian State Secretary for North Sea Policy stated that "… initiatives should be taken to keep [the MSP] process high on the [policy] agenda." The Marine Environment Service of the Directorate-General for the Environment led the effort to develop the new plan under new authorities of the *Act on the Protection of the Marine Environment and on the Organisation of Marine Spatial Planning in the Sea Areas under Belgian Jurisdiction.*

The revised plan lays out principles, goals, objectives, and long-term vision, and spatial policy choices for the management of the Belgian territorial sea and EEZ. Management actions, indicators and targets addressing marine protected areas and the management of human uses including commercial fishing, offshore aquaculture, offshore renewable energy, shipping, dredging, sand and gravel extraction, pipelines and cables, military activities, tourism and recreation, and scientific research are included. The plan will be reviewed every six years and is legally binding.

A second revised plan (2020–2026) was drafted in 2017 and has completed public consultation in 2018. The revised plan was approved as a draft in May 2019. It is now being completed and will enter into force in 2020. Over the past 15 years, MSP in Belgium has evolved from a simple zoning plan, based primarily on sectoral interests and with no legal authority, to a continuing, integrated, adaptive, multiple-use MSP process that has delivered two revised plans with strong legal authority.

The 2010 *National Water Plan* of the Netherlands, also a strategic framework based on the 2008 Dutch Spatial Planning Act, replaced certain policy sections of the *National Spatial Strategy*, including the spatial plan for the North Sea. The current *National Water Plan 2016–2021* was updated in 2015 and approved by the Cabinet. It includes as an appendix, the *North Sea Policy (Document 2016 – 2021,* that summarises the Netherlands long-term vision (2050) and includes a maritime spatial plan that complies with the 2014 *EU Directive on Maritime Spatial Planning.*

Like Belgium, the government of the Netherlands has implemented a MSP process that is continuing, integrated, adaptive, and multiple-use and has delivered three plans for its marine area from 2005 to 2018. For more information on MSP in the Netherlands see de Vrees in this special issue [110].

The four countries of the United Kingdom—England, Northern Ireland, Scotland, and Wales—all have national plans completed or near completion. A UK *Marine Policy Statement* released in 2011 provided the framework for preparing the marine plans. The Secretary of State, Scottish Ministers, Welsh Ministers, and the Department of the Environment in Northern Ireland jointly adopted the policy [111]. The MPS clearly stated that the marine planning process should be based on an ecosystem approach and competing demands on the marine area would be managed through an ecosystem-based approach. The *East Inshore and East Offshore Marine Plans,* covering about 55,000 km^2, were completed and adopted in 2014 [112]. The *South Inshore and South Offshore Marine Plans*, covering about 20,000 km^2, were adopted in 2016 [113]. Draft plans for the Southeast, Southwest, Northeast, and Northwest regions are currently undergoing public consultation.

The Scottish Government has completed a non-statutory pilot plan in the Pentland Firth and Orkney Waters region. The driver of the plan was the decision of the Crown Estate to invite bids for seabed leases from renewable energy developers that would speed the process of development and define spatial areas for wave and tidal technologies. The pilot plan has put in place a policy framework in advance of statutory regional marine planning to support sustainable decision making on marine use and management [114].

The *Marine (Scotland) Act* in 2010 introduced a new era for the management of Scotland's seas and the *National Marine Plan (NMP),* published in March 2015, established the wider context for planning within Scotland, including what should be considered when creating local and regional marine plans. The NMP covers both the territorial sea and exclusive economic zone—460,000 km^2 [115]. Eleven Scottish marine regions have been created that cover sea areas extending out to 12 nm. Regional marine plans will be developed by marine planning partnerships, allowing more local ownership and decision making about specific issues within each area. The regional marine plans will be developed in phases. Two non-binding regional plans have been completed for the Clyde and Shetland Isles marine regions. A *Marine Atlas of Scotland* was published in 2011. Marine Scotland also developed an on-line marine planning data portal—Marine Scotland Information—making spatial data available to marine stakeholders in an easily accessible form to assist with the implementation of marine planning.

A national marine plan for Wales was published in November 2019, covering 32,000 km^2 of Welsh inshore and offshore waters [116]. A MSP data portal is also operational [117]. A draft for public consultation has been prepared for the inshore and offshore marine waters of Northern Ireland in 2018 [118].

In Sweden three plans cover its territorial sea and the EEZ: Skagerrak/Kattegat, Baltic Sea and Gulf of Bothnia; draft MSP proposals were published in 2016 and final plans were submitted to the government at the end of 2019.

Finland began drafting maritime spatial plans in late 2016 after its MSP legislation came into force in October. Three maritime spatial plans are being prepared that cover both territorial waters and the EEZ: the Northern Bothnian Sea, the Quark and the Bothnian Bay; the Southern Bothnian Sea and the Archipelago; and the Gulf of Finland. Plans are being drafted by regional councils and will be completed by 2021. The first draft of the Polish maritime spatial plan was completed in 2017 with the final draft expected in 2020. Estonia produced an outline of a maritime spatial plan in 2018, Latvia developed a first draft of a maritime spatial plan in 2015, and Lithuania developed and approved its national comprehensive plan, including marine waters, in 2015. An excellent summary of MSP in the Baltic Sea region is provided by Zaucha [119].

Portugal has completed MSP pilot projects, but not yet approved its national plan. In 2008–09 the Portuguese government began developing a non-binding marine spatial plan through an initiative called *Planning and Ordering of Maritime Space (POEM)*. A public consultation process was begun in 2010–11 to review the draft POEM documents. However, soon afterward the government changed. Several agencies were reorganised or disbanded including the agency responsible for the development of POEM. In 2012 the government started drafting a MSP Framework law and in 2014 the first Portuguese MSP framework law was promulgated. In 2015, a new governmental order established the development of a Situation Plan, the Portuguese marine spatial plan, defining the responsible authorities for preparation and support of the MSP process.

In February 2019 the Regional Government of the Azores, the Oceano Azul Foundation, and the Waitt Institute (USA) signed a memorandum of understanding to create the "Blue Azores" program [120]. Goals of the program are to develop and implement marine spatial plans to protect 15% of the exclusive economic zone of the Azores (900,000 km^2) through marine reserves, to improve fisheries management, and to create a blue literacy program for schools and the community.

Spain has established an MSP Working Group and will develop five marine spatial plans, one for each of the five sea basins within its boundaries. Most countries of southern and eastern Europe lag behind their northern and western Europe neighbours in advancing national MSP in practice. However, all 22 EU Member States must have national marine spatial plans completed by 2021 under the MSP Directive.

Three other European countries not members of the EU—Norway (section 5.0.7), Iceland (the government has authorised MSP and two regional plans are underway), and Russia [121] have initiated MSP activities. In 2013 the Ministry of the Environment submitted to the Norwegian Parliament the management plan for the *Integrated Management of the Marine Environment of the North Sea and Skagerrak*—Norway's most intensively used sea area and one of the most heavily trafficked in the world [122]. Norway has announced revisions of its sea management plans to protect further biologically rich ocean areas to reduce the impact of industrial activities on its marine ecosystem. The Barents Sea-Lofoten area, the Norwegian Sea, and the North Sea and Skagerrak will revise areas for petroleum activities – including shifting oil and gas activities southward in the Barents Sea, away from the biologically rich ocean areas in the Arctic, provide stronger protection to vulnerable species in marginal ice zones. Climate change has already resulted in rising sea temperatures, shrinking ice cover, and ecological damage to Norwegian marine ecosystems.

11.6. The Americas

All three countries of North America—Canada, USA, and Mexico—have tried MSP with different degrees of success.

While strategic, "high-level" plans have now been completed for all five large ocean management areas LOMAs in Canada, only two, the Beaufort Sea plan in 2010 and PNCIMA in 2017, have been approved by the national government (Department of Fisheries and Oceans), and none have been funded for implementation [123,124,125,126]. The plans are not legally binding. While neither of the two approved plans is a marine spatial plan, MSP is recommended as a future action in all LOMA plans. Despite a comprehensive and innovative federal legislative framework, and after the high hopes of the Oceans Action Plan, the picture has again slipped back to one of relatively little progress toward fulfilling the promise of the Canada Oceans Act [127].

A separate Canadian MSP process has moved forward more successfully—the *Marine Plan Partnership for the Canadian Pacific North Coast (MaPP)*. The partnership was among 17 First Nations (indigenous peoples) and the Province of British Columbia. From 2011 to 2016 MaPP has developed and approved four sub-regional MSP plans, an overall framework plan, and an implementation strategy. For more detail see Diggon paper in this special issue [128].

A land use planning process that began in 2010 for Nunavut—the newest, largest, and northernmost territory of Canada— is now in its fourth draft. The Nunavut Planning Commission has jurisdiction over more than 3 million km^2 of land and water areas—a major portion of northern Canada, most of the Canadian Arctic Archipelago, and vast marine areas. Previous drafts were completed in 2012, 2014, and 2016; a fourth and final draft plan is now anticipated by 2022 [129].

The situation in the USA is more complicated. In 2019 only four of 35 coastal states and territories have approved marine spatial plans—Massachusetts, Rhode Island, Oregon and Washington. All are an integrated part of their respective coastal zone management programs, federally approved, and are enforceable. In June 2018 the state of Washington became the fourth state in the USA to complete and approve a *Marine Spatial Plan for Washington's Pacific Coast* [130]. The MSP process started In 2010, when the Washington State legislature enacted a marine planning legislation to foster integrated coastal decision making and ecosystem-based management. The MSP study area consisted of marine waters of the Pacific Ocean adjacent to Washington's coastline from the intertidal zone out to the continental slope, an area of about 20,400 km^2. The plan relies on existing state and local authorities for implementation.

At the national level only two of nine planning regions of the EEZ—the Northeast and Mid-Atlantic—have completed federally-approved plans. Three other regions—West Coast, Pacific Islands, and the Caribbean—have MSP underway (section 6.1 in this paper). However, in June 2018 President Trump rescinded the Obama administration executive order under which the regional plans were prepared, leaving their status and the future of MSP at the national and regional level less clear.

MSP in the planning regions of the USA was voluntary and only two of the nine regions initiated serious planning activities. A *Northeast Ocean Plan* was completed from 2012 to 2016 [131]. Covering about 250,000 km^2, the plan was overseen by a Northeast Regional Planning Body (RPB) composed of representatives from the six New England states, six federally-recognised American Indian tribes, nine federal agencies, and the New England Fishery Management Council (NEFMC). Substantial funding for the MSP process was provided by the Gordon and Betty Moore Foundation.

Covering about 332,000 km^2 of state and federal marine waters, a *Mid-Atlantic Ocean Action Plan* was developed from 2013 to 2016 [132]. A Mid-Atlantic Regional Planning Body was formed with representatives from six states, two federally-recognised tribes, eight federal agencies, and the Mid-Atlantic Fishery Management Council. Once again, substantial funding was provided by the Gordon and Betty Moore Foundation.

To improve access to ocean information, both plans were built on a foundation of thousands of new maps that are now publicly accessible through the Northeast and Mid-Atlantic data portals. This new generation of data products was developed in consultation with marine scientists and industry experts to include a wide array of marine resources information available in mapped form. The data portals have proven to be the most useful for decision making in both regions.

Both the Northeast and Mid-Atlantic regional plans were completed and rushed to approval for by the National Ocean Council in December 2016 before the Trump Administration took power in January 2017—the first federally-approved, transboundary regional marine plans in the USA. MSP work had also been underway in the Pacific Islands, West Coast, and U.S. Caribbean planning regions. However, in June 2018 President Trump issued a new *Executive Order Regarding the Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States* revoking and replacing the 2010 Executive Order of President Obama [133]. The new executive order (EO) disbanded the National Ocean Council and established a new interagency Ocean Policy Committee. While the Obama EO addressed marine conservation and climate change, the new EO is largely silent on those issues, and instead emphasised economic development and national

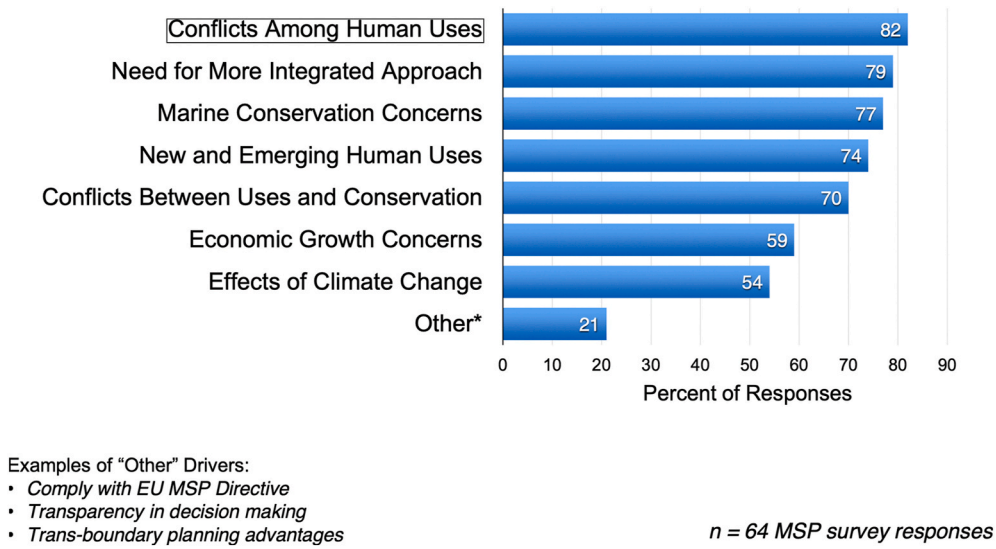

Fig. 2. Drivers of marine spatial planning.

security. It also downplayed efforts by federal and state agencies to collaborate on long-term regional management plans. No mention was made of the existing Regional Planning Bodies or the two approved regional marine plans leaving the near future of MSP in the USA highly uncertain. However, regional planning activities in the Northeast and Mid-Atlantic have continued under state leadership. Regional data portals continue to be expanded and improved with an emphasis on data needs for decision making and regulations for offshore wind farms, transmission cables, dredging, and offshore aquaculture.

Mexico has completed marine spatial plans for two of the four planning regions of its EEZ—the Gulf of California and the Gulf of Mexico and Caribbean Sea (see section 6.2). A plan for the North Pacific was completed in 2018 and one for the South Pacific region of Mexico will be completed by 2020.

11.7. Central America and Caribbean

Fourteen countries in the region have MSP activities underway. While most are new, Belize has completed, after almost two decades of work, and implemented an innovative coastal and marine management plan in 2016 that analysed three alternative development scenarios using InVEST, a spatially-explicit, ecosystem-services model [134,135].

Five Caribbean countries—Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines—have initiated MSP through the Caribbean Regional Oceanscape Project funded by the World Bank and Global Environmental Facility for US$ 6.3 million [136]. The Nature Conservancy has funded MSP work in St Kitts and Nevis, Jamaica, Saint Vincent and the Grenadines. The Waitt Foundation has funded MSP ("Blue Halo) initiatives in Barbuda, Curacao and Antigua, and Montserrat [137]. MarViva, has promoted MSP work in Costa Rica, Panama, and Colombia (In South America) [138].

11.8. South America

South American countries have been slow to adopt MSP. Ecuador has used a MSP process in the development of its management and zoning plan for the Galapagos Islands [139]. MSP in Colombia is in its early stages, as is MSP in the Falkland Islands (Great Britain). Interest in MSP still remains mostly at the academic level in several other South American countries.

12. Characteristics of MSP in 2019

About 40 marine spatial plans have been completed. Many countries have more than one plan, e.g., Norway has three regional plans that cover its EEZ, Germany has two covering its EEZ in the North and Baltic seas, China has nine plans covering its territorial sea and one plan covering its EEZ, and so on. The USA has marine spatial plans at both the regional and state levels. In 2016–17 the IOC conducted a survey to determine the characteristics of the plans that have been completed.

The principal driver of MSP in the survey responses was real or perceived conflicts among human uses (82%), followed by need for a more integrated approach (79%), marine conservation concerns (77%), new and emerging human uses (74%), and conflicts between human uses and conservation (72%). Concerns about economic growth (59%) and climate change (54%) would probably poll higher if the survey was repeated today. Other drivers that collectively totalled 21% included compliance with the EU MSP Directive, transparency in decision making, and transboundary planning (Fig. 2).

Over a third of MSP initiatives (37%) were in the pre-planning phase, I.e., obtaining authority and financing, drafting a work plan, initial engaging with stakeholders, identifying problems, principles, goals, defining MSP boundaries and planning horizon. About a third of the initiatives were in the planning phase, I.e., data collection and organisation, analysis of existing conditions, analysis of future conditions, identifying spatial and temporal conflicts and compatibilities; data atlas/data portal development, identifying management actions and performance indicators, and completing a monitoring and evaluation plan. About 20% have achieved approval at the appropriate level of government. Just over 10% have completed at least one revision, amendment, or adaptation of a first marine spatial plan.

Slightly more than half of the government-approved spatial plans were completed at the national level, i.e., covering the national EEZ (53%), 38% at the level of the territorial sea, and 10% at the municipal or local level (Figs. 3 and 4).

Forty percent of the plans were regulatory and enforceable; 60% advisory or strategic, often relying on the authority of individual sectoral agencies, e.g., fisheries or energy, to use their own authorities to implement and enforce their responsibilities within the spatial management plan. This type of "networked approach" coastal and marine management is common at the state level in the USA.

More than half of the marine plans (55%) claimed to address land-sea integration; 45% did not. For example in the USA state of Massachusetts the ocean management begins about a nautical mile offshore and

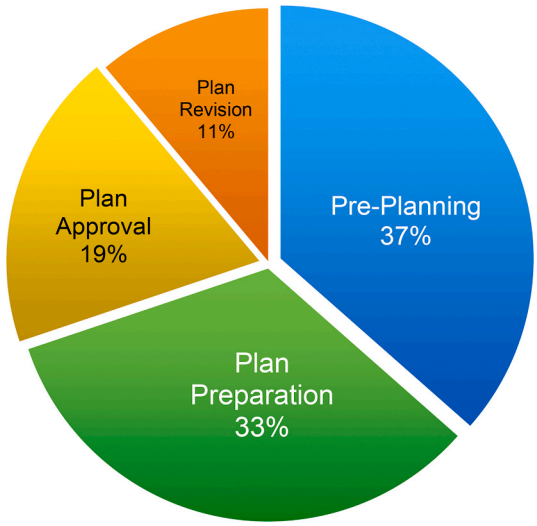

Fig. 3. Percent of plans by phase of MSP

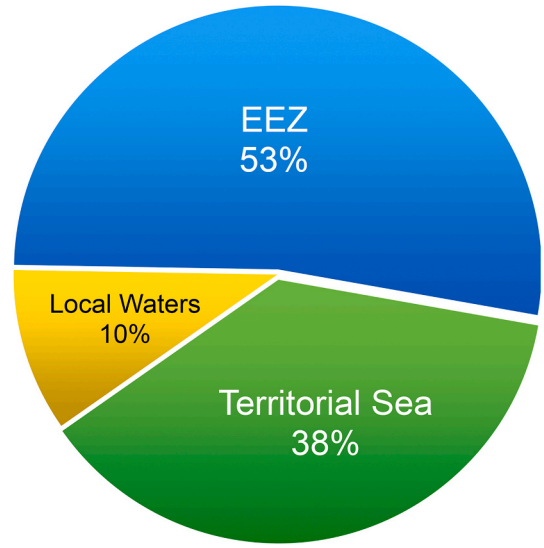

Fig. 4. Scale of MSP initiatives.

extends to three nautical miles. In Australia, national marine plans start at three nautical miles offshore. On the other hand, the marine plans for the three German coastal länders include both the terrestrial coastal zone and the marine waters of the territorial sea, making responsibilities for managing land-sea interactions within a single jurisdiction and plan (Figs. 5 and 6).

Only a handful of countries—China, the Netherlands, Belgium, and Norway, and state-level MSP in the USA and Germany—have so far committed to an on-going and adaptive planning process and have revised their first or second round of plans.

13. Where could MSP be by 2030?

.About 17% of the total surface area of the EEZs of the world is now covered by government-approved marine spatial plans. Indonesia (43%) and the Seychelles (1%) are nearing completion of their national plans. However, marine spatial plans in some of the largest EEZs in the world—the USA (8.3%), Canada (3.9%), and Australia (6.0%), for example—have had a mixed record of success, largely because of political rather than scientific or technical issues. Some other countries with large EEZs—Russia (5.3%), New Zealand (2.9%), Japan (3.2%), Chile (2.6%), Brazil (2.6%), India (1.6%)—have so far shown little interest in MSP. However, Kirabati (2.4%), South Africa (1.1%), Mauritius (0.9%), and Madagascar (0.9%)—most with EEZs of over one million km^2—should have MSP plans over the next five years.

If most of the 22 EU coastal countries that, not including their overseas territories, account for 3.4% of total world EEZ area), mainland USA (1.7%) and Hawaii (1.7%), New Zealand (2.9%), Brazil (2.6%), and one or two small island nations, Kiribati or Fiji—each about 1%) implement MSP over the next seven years, 33% of the total area of the EEZs of the world could have approved marine spatial plans by 2025 (Fig. 7).

Stretching aspirations only a little, Russia (5.3%), Canada (3.9%), Japan (3.2%), Chile (2.6%), Philippines (1.1%), and Argentina (0.8%), and several other small island/large ocean nations (Federated States of Micronesia, Maldives, Mauritius—each about 1%) could add another 20–25% to a 2025 target. This will mean around 50% of the area of the EEZs of the world could have approved marine spatial plans by 2030—and at least a large part of the ocean would be in a better place in moving toward sustainability.

More information of the world-wide status of MSP can be found at the IOC-UNESCO website on MSP (msp.ioc-unesco.org), and more detailed information on MSP activities in countries of the European Union at the European MSP Platform (https://www.msp-platform.eu). Many of the planning documents referenced in this paper can be found at: http://msp.ioc-unesco.org/references/key-msp-documents/.

14. Challenges for the future of MSP

While substantial progress has been made on MSP in many countries, much work remains to be done, for example:

Finding authority and funding. A key challenge is that MSP requires authority to be effective. Authority takes time to establish. The United Kingdom took five years to pass its enabling legislation. MSP always requires the allocation of often scarce government funds. Moreover, MSP usually requires serious decisions related to various trade-offs that this might decrease its acceptance. Win-win situations are rare in MSP.

Integrating MSP into other spatial planning and management processes. Marine spatial plans should be integrated with other spatial planning efforts at the national, regional, and local levels. How can marine planning bodies coordinate and cooperate better their efforts with authorities responsible for land use planning,

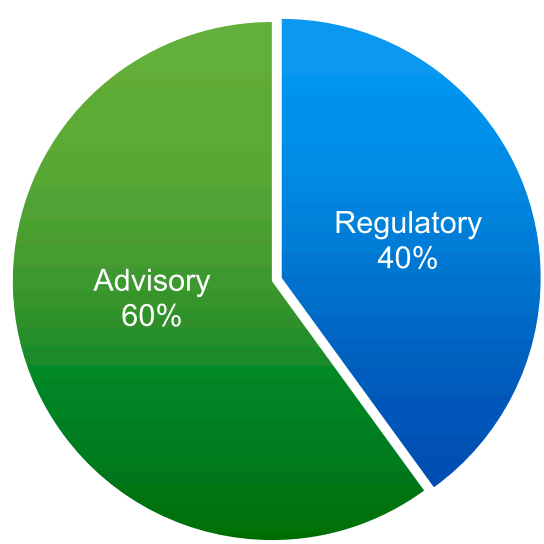

Fig. 5. Advisory or regulatory plans.

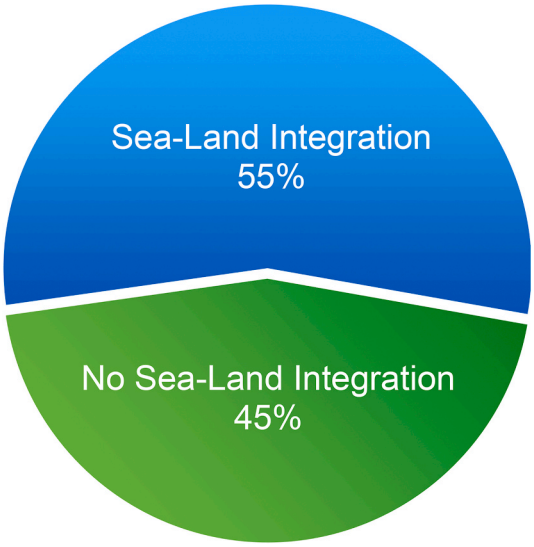

Fig. 6. Marine-Terrestrial Integration of MSP plans.

economic development, water quality management, marine protected area management, and business planning in the private sector?

Moving toward a "blue economy" while maintaining essential ecosystem services—an increasing number of MSP initiatives are focussed on stimulating "blue growth" or developing a "blue economy". Its roots can be traced back to the 1992 Rio Earth Summit and the Bruntland report. However, the "blue economy" remains an ambiguous concept used by different governments and individuals to accomplish different purposes. How is the "blue economy"" conceived in different planning contexts? How can MSP ensure that investments and other management actions toward a sustainable "blue economy" will include protecting, restoring and maintaining ecosystem services that support economic development? A deeper discussion of this challenge to MSP can be found in Yoyer et al. [140].

Incorporating the future in MSP—while the fundamental nature of any planning should be future-oriented, many marine planning efforts stop after describing "where we are" and develop a management plan that addresses only problems of today. How can MSP better think about and communicate "where we want to go", e.g., through spatial scenarios, and "how do we get there" through MSP management plans focused on future opportunities?

Integrating monitoring and evaluation of MSP plans—Considerable resources are being used for marine planning, implementation, and enforcement throughout the world, but are the results of these plans effective, are the benefits of these new marine planning and management efforts worth the costs? Who bears the costs of the plans? Who reaps the benefits? How do we know what works and what doesn't? How can we better define and measure "success"? For additional ideas on this challenge see Douvere and Ehler [141].

Filling geographical gaps in MSP—climate change is opening the Arctic Ocean to development pressures from marine transport, tourism, mineral exploration, national security—without an integrated marine spatial plan. Once infrastructure is in place, it will be difficult to change. Can we develop a *trans*-boundary marine spatial plan for the Arctic before development takes place? For other ideas about MSP in the Arctic see Ehler [142].

MSP in the High Seas—while almost all MSP plans to date have been developed within EEZs, 60% of the World Ocean lies in the High Seas or Areas Beyond National Jurisdiction (ABNJ). Looking forward, this means that ultimately, it will be important for MSP to be developed for the entire world ocean, including the High Seas and ABNJ. How can we stimulate the application of MSP as an effective area-based management process in the High Seas? How can ecosystem-based management be applied in the High Seas? For more information on MSP in the High Seas see Wright et al. in this issue [143].

For additional discussion about challenges for MSP see Santos et al. in this issue [144].

15. Conclusion

Over the past 30 years significant progress has been made by governments in their thinking about integrated planning and management of the ocean. Indeed, about half of the countries with marine waters (75 of 150 countries) has started some form of MSP initiative, and the interest in MSP continues to grow. For example, MSP is mandatory throughout an entire region—Europe—where 22 countries must have their marine spatial plans in place by 2021 according to binding EU

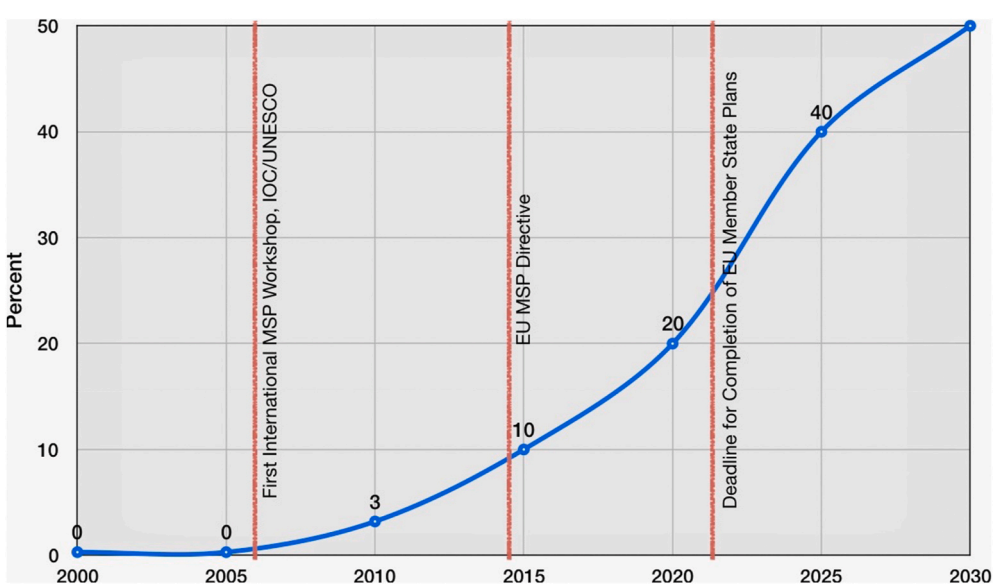

Fig. 7. Percent of surface area of EEZs of world covered by approved MSP plan.

legislation.

However, not all MSP initiatives have been successful. While it is important to realise that both "development" and "conservation" are important to accomplish, and that we need to further develop the capability and political will to do both, the balance between them has varied a great deal from place to place. In many cases, MSP has taken the form of "full-on development planning," with little thought to sustainability—conservation taking a "back seat" instead of being the foundation on which to build a sustainable future. At the same time, large investments in MSP around the world have resulted in many planning processes that have not been implemented, or will likely not be implemented, because of resource constraints or socio-political and "realpolitik" factors. Still, there are reasons to believe that people are looking critically at the challenges faced by, and the shortcomings of MSP—and that these could and should be addressed in future rounds of planning. Learrning from experience and integrating lessons learned in a continuing and adaptive manner will be key to ensure that MSP becomes truly sustainable, integrated, and operational.

Finally, the majority of the world ocean, about 60%, is not within EEZs but rather in international waters, i.e., areas beyond national jurisdiction. This means that ultimately MSP should cover the entire world ocean.

CRediT authorship contribution statement

Charles N. Ehler: Conceptualization, Funding acquisition, Project administration, Writing - original draft, Writing - review & editing, Visualization.

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