

The emerging intersection between marine spatial planning and ocean accounting: A global review and case studies

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ABSTRACT

Ocean planning and management is often tasked with balancing multiple policy priorities, such as the growth of ocean-related sectors, conserving ecosystem health and biodiversity, and considerations of equity and inclusivity. Over the last two decades, aligning and operationalising such priorities has increasingly been addressed through Marine Spatial Planning (MSP), which analyses and allocates human activities within the marine domain. In parallel, Ocean Accounting (OA) is an emergent framework that extends existing international accounting standards to better measure the contribution of the ocean to society and the economy. Both frameworks are 'integrative', combining knowledge from multiple domains, to support decision-making towards ocean policy objectives. Here, we present the first analysis of the intersection between MSP and OA, to identify operational opportunities and barriers for co-development. We present a global review of OA- and MSP-related activities and perform a SWOT analysis of their implementation within five case countries (Australia, Canada, Portugal, South Africa, and Thailand). We identified 26 countries that have completed, or progressing, OA and MSP, of which only two countries demonstrated an overlap between frameworks. Within countries with completed MSP, there were no clear links between the policy use-cases of both frameworks (i.e., focus on the ocean economy or ecosystem conservation). In-depth analyses of five countries identified both opportunities and barriers through similar policy drivers, data sharing and shared implementing institutions. As high-level policy intent and investment drives the increasing use of both frameworks, an understanding of their co-development advances integrated and evidence-based ocean governance.

1. Introduction

Strategic ocean planning and management is defined by multiple

layers of governance, often requiring the alignment of several policy aims and targets. The last decade has seen growing optimism for oceans as a solution for food and energy security [41], and a source of economic

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growth and prosperity [32], leading regional and national ocean strategies to prioritise the development of the ocean economy.¹ In parallel, there is a growing recognition that the development, functioning, and continued growth of key economic sectors is contingent on the health of ecosystems and services they provide [28], evidenced by the European Union's transition from 'Blue Growth' to a 'Sustainable Blue Economy'.² To provide a coherent point of reference across ministries and departments, countries have produced strategic ocean plans (e.g., Portugal³) and policies (e.g., Fiji⁴), which provide guidance and actions towards achieving a vision of a nation's relationship with the ocean. Such strategies are influenced by international agreements and obligations (e.g., Convention on Biological Diversity, Sustainable Development Goals) and domestic priorities [31], resulting objectives concerning the ocean economy, the conservation of biodiversity and ecosystem health, and consideration of inclusivity, access, and equity to ocean benefits, space and resources.

Achieving multiple, and potentially conflicting, targets is contingent on the ability to inform and implement management actions. Ocean ecosystems, as with many common environmental assets, have long been impacted by imperfect governance, with detrimental consequences resulting from the prioritisation of economic growth [26] and siloed, sectoral management [7]. There is an acute need for 'integrative' governance frameworks that account for economic, environmental, and social considerations from multiple sectors and stakeholders. Two such emergent frameworks, discussed in this paper, are complementary as a 'data foundation' and 'implementation mechanism' towards operationalising policy goals within the ocean domain.

Marine Spatial Planning (MSP) aligns multiple policy targets through the allocation of human activities within marine space, usually through a participatory process [7]. The role of MSP is especially important in the development of ocean economies, where a 'blue acceleration' in the diversity and intensity of activities has led to the privatisation of previously common ocean space and resources, driving competition between sectors [23]. Further, activities may pose novel or intensified pressures on ocean ecosystems, which threaten their functioning and survival, impacting other economic activities and coastal communities that are reliant on them [19,49]. Marine spatial plans, therefore, provide a level of regulatory certainty to sectors through defining the allocation of space and resources, to better adapt to the changing nature of the maritime economy, within the context of a changing ocean [4,37].

As an area-based management framework, MSP is considered to address shortcomings of siloed sectoral management [8] (Fig. 1) and may even be extended to an 'ecosystem-based' management approach, which seeks to identify and incorporate the full array of interactions between components of the environment, society within planning and trade-off assessments [6,24]. Over the last two decades, MSP has become a central framework in marine governance, embedded into national and regional legislation (e.g., Maritime Spatial planning Directive, European Union), supported by international initiatives (e.g., MARISMA project, South-west Africa). Over 75 countries and 140 plans

are either in development or enforced globally [11]. A key challenge remains in ensuring social and environmental considerations are adequately weighted and integrated with economic priorities, where strategic and sectoral considerations are often prioritised during MSP implementation [22,43].

A complementary framework is Ocean Accounting (OA), which facilitates an 'integrative' understanding of ocean ecosystems, ecosystem assets and services, and their subsequent uses. The framework extends national, environmental-economic and ecosystem accounting to describe the extent, condition and services of ocean ecosystems, their relationships with the economy and society, and how these factors may change over time (Fig. 2) (see [12]). As an extension of international accounting standards, OA provides additional classifications, definitions, and testing needed to account for the dynamic and interconnected nature of the Ocean [17]. The framework provides guidance in measuring ocean economic activities, the underlying ecosystems they are dependent upon, and the subsequent pressures and impacts these activities may pose on these ecosystems. Furthermore, OA provides a means to measure the extent and condition of ocean ecosystems, providing a measure of 'ocean wealth' and its contribution to society and the economy.

The need for an ocean-centric accounting standard is seen in the endorsement of Ocean Accounting internationally, where 16 Heads of State, as members of the High-Level Panel for a Sustainable Ocean Economy,⁵ have committed to the compilation of national Ocean Accounts. Formal recognition of OA as an action within its research agenda was given by the UN Statistical Commission.⁶ The growing number of pilot activities and global community of practice is supported by the Global Ocean Accounts Partnership (GOAP), a multi-institutional collaboration mechanism, recognised as an action coalition of the High-Level Panel.

The growing implementation of both frameworks prompts the need to explore the experiences and lessons learnt within their early intersection, to better inform opportunities and barriers to co-implementation. There are clear synergies between both frameworks, explored conceptually in Gacutan et al. [15]. Operationally, however, there is a limited understanding of where both MSP and OA frameworks have been applied, and the alignment of their policy use-cases (e.g., towards informing ocean economy, ecological conservation). Further, there is a limited understanding of the operational and institutional opportunities and barriers that may influence co-development of the frameworks.

Here, we present the first global review of the emerging intersection between of MSP and OA, (i) identifying countries performing related activities and (ii) identifying their policy use-cases (Fig. 3). Further, we critically analyse 5 countries where MSP and OA have sufficiently advanced as case studies. Within each country, we explore MSP and OA activities in depth, and reviewing the ocean policy context driving the uptake of each framework. Further, through iterative expert elicitation, we analyse the opportunities and barriers for co-development within each country, using a Strength, Weakness, Opportunity, and Threat (SWOT) analysis. With increasing high-level policy focus and global investment into MSP and OA, there is a need to understand the operational aspects and consideration that may contribute to their successful co-implementation. Our exploration of early efforts identifies potential synergies, whilst highlighting the risks of future incompatibility and redundancy between processes, should they develop independently.

¹ There are varying definitions for sectors considered within strategies and policies of ocean-based economic development. For example, within the European Union (EU), aquaculture, biotechnology, offshore renewable energy, marine tourism, and seabed mining are prioritized under the EU Blue Growth agenda (COM2012/494/final). In contrast, Norway includes offshore oil and gas, and shipping within their ocean-based economic development agenda (Blue Opportunities, The Norwegian Government's updated ocean strategy, 2019).

² Sustainable Blue Economy, European Commission: https://ec.europa.eu/oceans-and-fisheries/ocean/blue-economy/sustainable-blue-economy_en

³ 2021–2030 National Ocean strategy (released 6 May 2021), <https://www.dgpm.mm.gov.pt/agenda-2030-en>

⁴ Republic of Fiji National Ocean Policy, Ministry of Economy (12 May 2020), <https://library.sprep.org/sites/default/files/2021-05/Fiji-National-Ocean-policy-2020-2030.pdf>

⁵ High Level Panel for a Sustainable Ocean Economy, Action coalitions: <https://oceanpanel.org/action#live> (Accessed 12/05/2021)

⁶ United Nations Statistical Commission, Report of the Committee of Experts on Environmental-Economic Accounting, Item 3(f) (E/CN.3/2021/10)

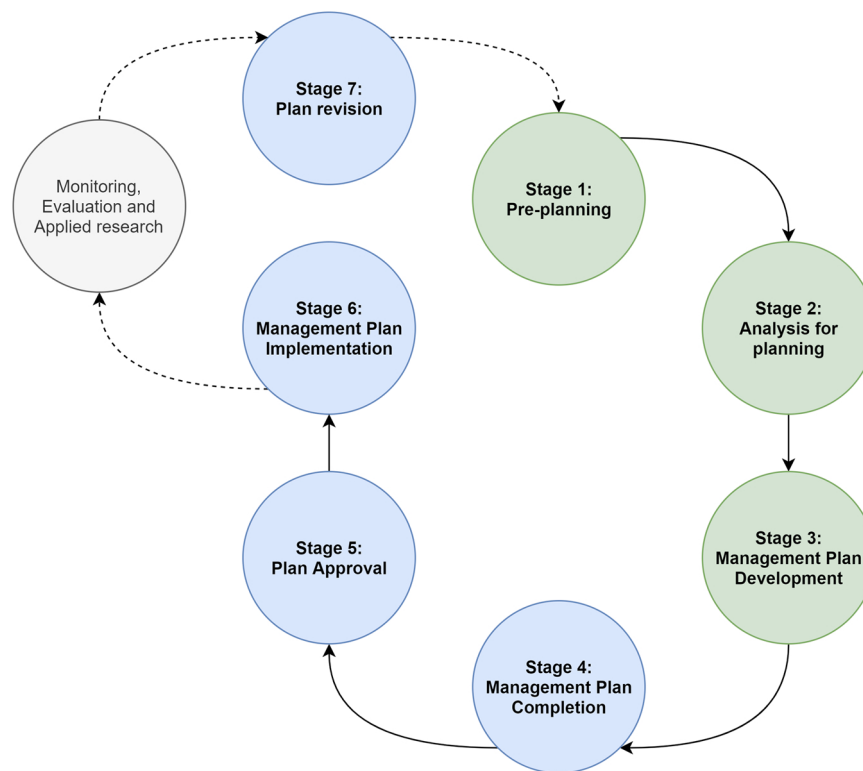


Fig. 1. Generalized flow of stages within a marine spatial planning (MSP) process, based on best practice by Ehler and Douvère [10], and country reporting to IOC-UNESCO.

2. Methods

2.1. Scoping ocean accounting activities globally

We explore the political, institutional, and legal frameworks related to marine and coastal governance in countries conducting both OA- and MSP-related activities (Fig. 3). OA activities included the development and testing of the OA framework, as described by the Technical Guidance on Ocean Accounting (GOAP, 2021a). Since accounting activities vary with policy demand, OA activities included the production of any accounts detailed in Fig. 2, which include the disaggregation of ocean activities from the SNA (considered Ocean Economy Satellite Accounts, OESA), ecosystem accounts, (following the System of Environmental-Economic Accounting, SEEA) and disaggregating coastal and marine tourism statistics via Tourism Satellite Accounting (TSA), with account definitions provided in the Supplementary Materials (SM, Table SM1). We also considered activities that linked statistics between accounting standards, within the context of ocean ecosystems, space, and resources.

A diagnostic tool developed by the UN Economic Social Commission for Asia and the Pacific (UN-ESCAP) (SM, Table SM2) was used to (1) identify if OA activities were conducted and (2) identify policy priorities, relevant institutions, available knowledge (and data) and the potential constraints in progressing towards an ocean accounting approach. A global search was conducted by region (Africa, the Americas, Asia, Europe, and Oceania), with relevant countries with known activities identified through expert elicitation, primary literature, and government reporting. For each country, relevant government reports and documentation were accessed via department webpages and critically analysed for the presence and nature of MSP and OA activities. Most documentation assessed was in English or included summaries translated into English. The study also assessed documentation in French, Portuguese, Spanish and Thai.

The policy priorities for completed OA activities were thematically coded in relation to their policy use, whilst ongoing pilot activities were

coded through a discussion amongst the authors, guided by findings from the diagnostic. The diagnostic tool also noted the presence of an MSP process, the progress of which was assessed via the seven stages identified within the IOC-UNESCO database (see Fig. 1). This study sourced information of MSP progress in Europe and Northern America using reporting to IOC-UNESCO⁷ and the MSPglobal2030⁸ roadmap. Progress in Asia and Oceania were also sourced from a review by Nakornchai et al. [30], which reported progress using IOC-UNESCO stage classifications.

2.2. Case studies

In identifying countries with both MSP and OA activity, the study selected countries with the potential to inform the intersection of both frameworks, containing any of the following criteria:

- Available documentation on both OA and MSP,
- Dedicated mandates or policy plans towards the development of both frameworks,
- Completed works and outputs for either MSP or OA,
- Explicit mention of both frameworks in a pilot, and
- Knowledge of the authors of individuals in a country engaged in MSP and OA.

Countries were further selected for regional representation.

An analysis of the policy and legislative context for MSP and OA development was conducted for the five countries selected as case studies. A Strengths, Weaknesses, Opportunities and Threats (SWOT)

⁷ http://msp.ioc-unesco.org/world-applications/status_of_msp/ (Accessed 10/04/2021)

⁸ <https://www.mspglobal2030.org/msp-roadmap/msp-around-the-world/> (Accessed 12/04/2021)

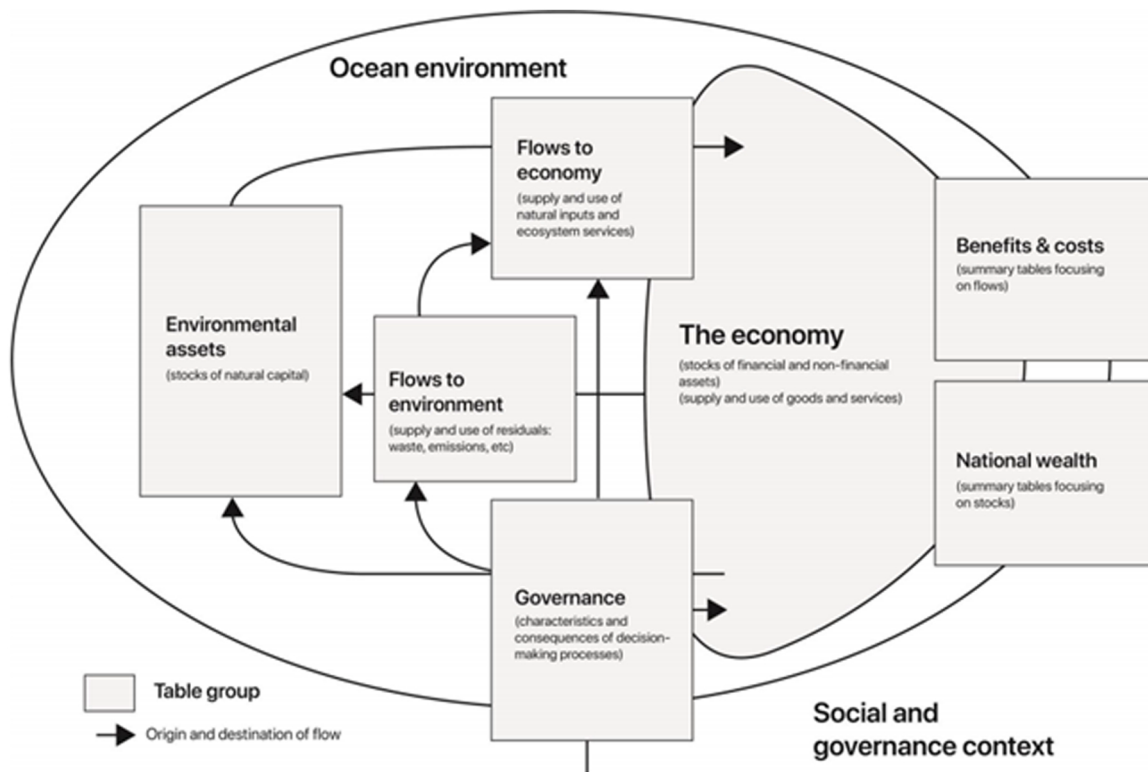


Fig. 2. General structure of the Ocean Accounts Framework adapted from the Technical Guidance on Ocean Accounting [17]. An environmental asset account could be compiled through ecosystem accounting, with flows to the economy measured through ecosystem services. Statistics related to the ocean economy could be contained within an Ocean Economy Satellite Account. Details for governance accounts are described in Supplementary Materials.

analysis [3] was used to assess the potential or realised co-implementation of both MSP and OA frameworks. The assessment was conducted recognising the differing use-cases for environmental-economic accounting and spatial planning generally. Environmental-economic accounting, including OA, is used to inform strategic planning, and performed to align with national accounts maintained by national statistics offices and finance ministries. Spatial planning, however, is a management use-case, performed predominantly by place-based institutions. Therefore, recognising their differing uses within ocean governance the comparison between the frameworks was used to identify synergies and potential conflicts.

The SWOT analysis was performed by the multidisciplinary team of authors, from the fields of marine ecology, marine spatial planning, environmental economics, national accounting, and ocean governance. Each case study was assessed, and qualitative statements were procured through expert elicitation, which were iteratively discussed and adapted until a consensus was reached. When applied to the intersection between MSP and OA, ‘strengths’ were the present operational synergies between both frameworks, while ‘weaknesses’ were present knowledge gaps, redundancies, and conflicting processes limiting the use of both frameworks. ‘Opportunities’ were identified as compatible policies, legislation, and strategic objectives furthering the co-development of MSP and OA. By way of contrast, ‘threats’ were external barriers for the co-development of both frameworks.

3. Results

3.1. Countries with ocean accounting-related activities

The ‘Global Progress Assessment’ in Ocean Accounting [18] identified 36 countries conducting OA activities, of which, 26 countries were also conducting MSP activities. A summary of the diagnostic for each country identified are listed in the Supplementary (Table SM3), with the

respective data sources presented in full in the ‘Global Progress Assessment’ in Ocean Accounting [18].

In general, OA activities were determined to pursue four interconnected themes: (1) monitoring ocean ecosystems, (2) informing strategic planning, (3) measuring the ocean economy, and (4) measuring the ocean-tourism nexus. Although marine and coastal tourism is a significant component of the ocean economy to many States, explicit mention of tourism within strategic priorities and accounting efforts warranted a separate theme. In terms of policy focus, monitoring of ocean ecosystems was the most common motivating factor ($n = 20$), followed by measuring the ocean economy ($n = 16$). As an emerging framework, only two countries (i.e., Thailand and Australia) were identified as having existing overlaps between OA activities and spatial planning activities (including MSP and marine protected area zoning). Breakdowns per region for the number of countries and thematic policy motivation are presented in Table 1.

3.2. Intersection between ocean accounting and marine spatial planning

Five countries (Australia, Thailand, South Africa, Portugal, and Canada) were identified using the criterion listed in Section 2.2, as an opportunity to further explore the synergies between the two frameworks and opportunities for their co-development and potential barriers for implementation via a SWOT analysis. An overview of the status of MSP and OA are presented in Table 2.

3.2.1. Australia

Australia’s ocean resources are managed through a combination of policy and legislation limiting pollution, sectoral resource management regimes, and spatial protection (marine parks) [48]. Australia’s network of commonwealth, state, and territory-managed marine parks cover 3.3 million km², or 37% of Australia’s marine jurisdiction. The overarching objective of all marine parks are healthy and resilient ecosystems which

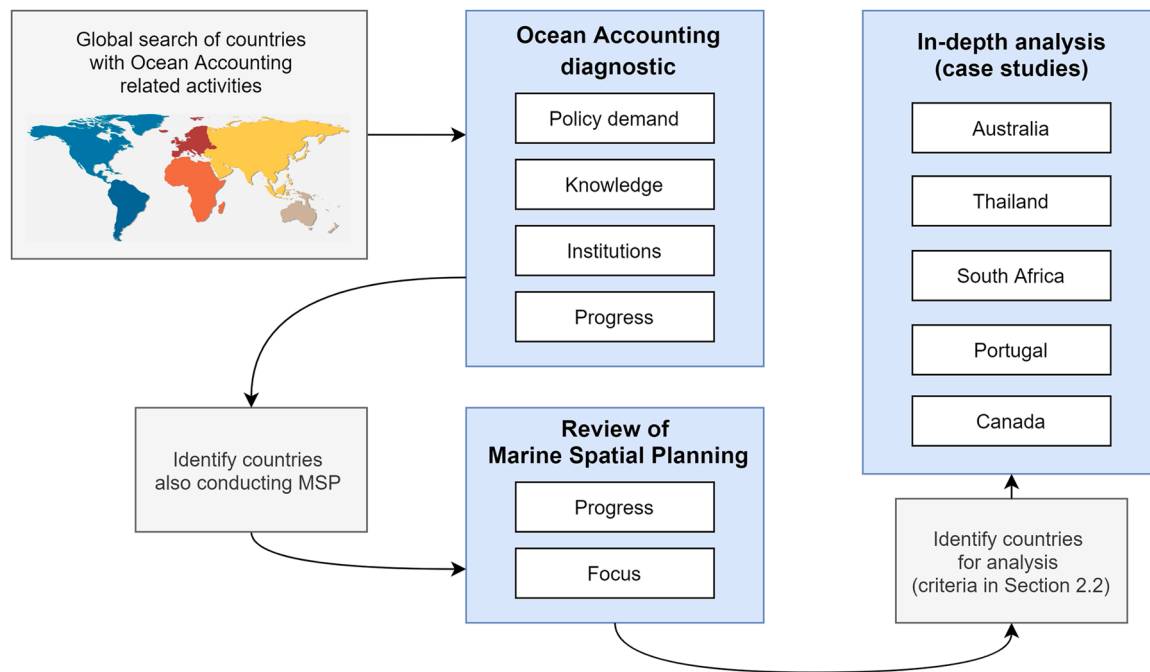


Fig. 3. Structure of the study, from scoping and assessing Ocean Accounting-related activities globally (Asia, Africa, Oceania, Europe, and the Americas), identifying countries also conducting MSP and identifying five countries as case studies for further analysis.

enhance Australia's wellbeing, coordinated through six 'bio-region' plans and an additional plan for the Great Barrier Reef [47]. The Great Barrier Reef Marine Park Zoning is considered one of the first marine spatial plans and influenced the theoretical basis for MSP globally [48]. Australia's MSP instruments, however, differ to other processes (e.g., within the European Union) in that conservation focused Marine Protected Areas (MPA) are also within scope of the plan.

In 2018, the Australian Government established a National Strategy and Action Plan¹¹ to implement a nationally consistent approach to environmental-economic accounting. An interjurisdictional steering committee for environmental-economic accounting (Table 3), including the lead policy agency, national statistical agency and all states and territories, oversee the national approach. To understand the contribution of ocean ecosystems within marine parks, the then Department of Energy and Environment commissioned ocean accounts for Geopraphe Marine Park, Western Australia [21]. The pilot focused on the extent and condition of seagrass ecosystems in Geopraphe Bay, which form the largest continuous beds within Australia [25]. It further extended analyses to the services provided to economic activities (commercial fishing, whale watching tourism), local communities (recreational fishing), and potential pressure of medium-large vessels on environmental assets.

The OA approach organised components of the system into assets (and their condition), services and benefits, which were used to organise and relate a diverse range of data. Key findings of the pilot included:

—Ecosystems in Geopraphe Marine Park contributed \$AUD 316,000 in 2019 to the gross operating surplus of the local economy through whale watching (\$AUD 254,000) and commercial fishing (\$AUD 62,000).

—Recreational fishers took more than 12,000 fishing trips in 2018, which is valued at over AUD2.2 million (consumer surplus).

—Seagrass meadows in Geopraphe Marine Park were estimated to store 6.2 million tonnes of carbon in soil, and each year sequester a

further 27,569 tonnes (net).

—The annual amount sequestered is equivalent to 1500 households' average carbon emissions per annum, with an estimated dollar value of AUD443,865 (assumed AUD16.10 per tonne).

The resulting accounts can inform risk assessments for prioritising national scale monitoring and compliance of regulated activities across park management zones. The accounts also present a supporting narrative for the contribution of environmental assets within the Marine Park and can inform the national Monitoring, Evaluation, Reporting, and Improvement system. The process also required the compilation of a data inventory, which took stock of all data available for analysis and allowed the identification of knowledge gaps, to scale the OA framework. Table 4, Table 5, Table 6, Table 7.

3.2.2. Thailand

Thailand's vision for ocean space, resources and activities are guided by the 'sufficiency economy philosophy,' in maximizing the interests of all stakeholders and having a greater focus on long-term profitability as opposed to short-term success [45]. Thailand's 20-Year National Strategy (2018 – 2037)¹² contains components that prioritise competitive enhancement (National Strategy II), social cohesion and equity (National Strategy IV) and Eco-Friendly development and growth (National Strategy V). Thus, the drive towards economic development via marine and coastal sectors is weighed by the need for equity and sustainability in the conservation of ocean ecosystems and their resources, enshrined into law via the Marine and Coastal Resources Promotion Act (2015) and the Fisheries Acts (2015). Within this context, Thailand has piloted area-based planning in several regions, including Surat Thani and Chon Buri provinces,¹³ in addition to several islands. Area-based measures for conservation and planning have long been used in Thailand, including Integrated Coastal Zone Management (ICZM) and Marine Protected

¹¹ Australian Government (2018). Environmental Economic Accounting: A common national approach strategy and action plan. Canberra: Australian Government, accessed: <https://eea.environment.gov.au/about/national-strategy-and-action-plan>

¹² Thailand 20-year National Strategy, 2018–2037: <http://nscr.nesdb.go.th/wp-content/uploads/2019/10/National-Strategy-Eng-Final-25-OCT-2019.pdf> (Accessed 10/04/2021)

¹³ Chonburi Province MSP: https://www.jetro.go.jp/ext_images/thailand/pdf/chonburi_enpro.pdf (Accessed 12/05/2021)

Table 1

Number of countries identified to contain both Ocean Accounting and Marine Spatial Planning results by region. Further breakdown of the ocean accounting focus of countries, and the number of completed marine spatial plans, per region.

Region	Number of countries	Ocean Accounting focus				Marine Spatial Planning
		Ocean ecosystems	Linked to Spatial Planning	Ocean economy	Ocean-tourism nexus	Completed plans ^a
Africa	4	4	–	2	–	–
Asia	8	7	1	4	4	4
Europe	6	5	–	4	1	3
Americas	5	3	–	5	1	3
Oceania	3	2	1	1	2	1
Total	26	21	2	16	8	12

^a The presence of completed plans for one country, c.f. the sum of all plans within a country.

Table 2

Overview of the five selected case studies of the emerging intersection between Ocean Accounting and Marine Spatial Planning.^{9,1102}

Country	National policy priorities			Marine Spatial Planning		Ocean Accounting	
	Environmental sustainability policies	Ocean-based development strategies	Ecosystem-based management	National MSP activity	MSP situation	Ocean Accounts theme (s)	OA pilot objectives
Australia	100% sustainably managed oceans by 2030, Ocean Policy (1998), Global Ocean Alliance (30 ×30 initiative), Convention on Biodiversity (Aichi targets)	Contains a definition of the ocean economy, although no national strategy.	Yes (Fisheries, MPAs)	Yes, under 6 marine bioregion plans and Great Barrier Reef Marine Park	7 plans in force, with plans concerning the conservation of bioregions through a network of marine protected areas.	Marine ecosystems, Spatial planning	Assess the services and benefits present within Geographie Marine Park.
Thailand	National Strategy V (Eco-friendly development and growth), Marine Park legislation	No direct mention, although National Strategy II concerns national competitiveness and economic growth.	Yes, ongoing MSP are required by the Department of Marine and Coastal Resources (DMCR) to be ecosystem-based.	Development ongoing, estimated delivery in 2025.	Pilot completed for Koh Tao. Plans are in development for Koh Larn, Koh Krok and Koh Sak islands, with another plan initiated in Phang Nga Bay in 2021.	Ocean-tourism nexus, Spatial planning	Assess the sustainable development of tourism and its impacts on natural resources in 5 provinces. Further support ongoing MSP efforts.
South Africa	Convention on Biodiversity (Aichi targets), Global Ocean Alliance (30 ×30 initiative), Operation Phakisa (habitat representation and size of MPAs).	Yes, under Operation Phakisa (prioritising marine transport, offshore oil and gas, aquaculture, and marine protection services)	Yes, termed ‘ecosystem-based adaptation,’ endorsed by the Department of Environmental Affairs.	Development ongoing	The MSP process will deliver four plans, with three covering continental areas, with a fourth offshore marine area.	Marine ecosystems	Extensive history of environmental accounting, with efforts covering some ocean ecosystems.
Portugal	Convention on Biodiversity (Aichi targets), 100% sustainably managed oceans by 2030, Global Ocean Alliance (30 ×30 initiative), Habitat, Birds, and Marine Strategy Framework directives	Yes, under the EC ‘Blue Sustainable Economy’ (2021) and ‘Blue Growth’ agendas (2012)	Yes, endorsed by the Maritime Spatial Planning Directive (2014/89/EU)	2010 (Continental), Ongoing	MSP is embedded within legislation and plan development is underway. The subdivision of marine areas was approved in 2019.	Ocean economy	Maintains an Ocean Economy Satellite Account (OESA), in addition to developing SEEA accounts.
Canada	Convention on Biodiversity (Aichi targets), 100% sustainably managed oceans by 2030, Global Ocean Alliance (30 ×30 initiative)	Yes, Blue Economy Strategy (in development)	Yes, evolving from Integrated Management under the Oceans Act (1996)	Development ongoing, estimated delivery in 2024	The MSP process has been initiated in five marine bioregions.	Marine ecosystem, Ocean economy	Maintains an Ocean Economy Satellite Account (OESA), in addition to developing SEEA ecosystem accounts.

Areas (MPAs).

In 2019, Thailand tested the OA framework, with a policy focus on sustainable tourism in the Andaman Tourism Cluster, consisting of five coastal provinces (Krabi, Phang Nga, Phuket, Trang, and Satun). The study addressed sustainable development concerns of the tourism sector, with regards to natural resources and environmental degradation both at land and sea. The study related statistics from a tourism satellite

account with environment flows from thematic SEEA-CF accounts.¹⁴

Through the resulting statistics, the study performed a spatial analysis of terrestrial, coastal, and marine areas with high risks of exceeding

¹⁴ Through Tourism Satellite Accounts and SEEA Central Framework accounts (water, waste, energy, greenhouse gas emissions).

Table 3

A SWOT analysis of the intersection between Ocean Accounting and Marine Spatial Planning activities in Australia.

Strengths	Weaknesses	Opportunities	Threats
- Scalability of approach facilitates cross-border integration through application to other marine parks and spatial planning activities. - Co-design approach, including tailoring accounts for Park Manager use, demonstrates potential for broader application of accounts by other spatial planning agencies. - Accounting areas assessed extent, condition and flows by marine park zoning, allowing comparisons between zones. - Standardization of datasets facilitated knowledge integration of diverse information. - Identified knowledge gaps for further research and scaling of OA to larger areas.	- Adjoining state marine park waters were not assessed in entirety, limiting cross-border comparisons. - Time-series of data was unavailable, limiting assessments of trends. - The interjurisdictional steering committee could strengthen its collaboration and coordination of accounting activities.	- Existing Commonwealth (Federal) and State commitments to support Environmental-economic accounting activities. - The strategies and actions of MSP include the need to consider social amenity and/or human health, aligning with the integrative nature of the OA framework. - Ability to adapt accounts with new information, facilitating temporal integration and evaluation of park management and spatial plans.	- An extensive and complex body of ocean policy and legislation may limit the compatibility of OA indicators with existing monitoring programs. - Multiple values are balanced in management of marine park, although policy targets of their condition are qualitative.

Table 4

A SWOT analysis of the intersection between Ocean Accounting and Marine Spatial Planning activities in Thailand. Opportunities and threats are informed by Thubthimsang [42].

Strengths	Weaknesses	Opportunities	Threats
- Cross-border integration of data (5 provinces). - Experience in combining TSA and SEEA accounts, to link tourism impact to the economy and environment. - Overlap between MSP and OA areas. - Data inventories have been compiled, and gaps identified. - The Department of Marine and Coastal Resources is responsible for both MSP and OA activities.	- Currently, limited spatially explicit approach to OA (i.e., aggregation by province), contrasting with MSP efforts. - Delivering department (DMCR) concentrated on conservation, lacking economic and social mandates required by national policies.	- Shared area designation, classifications and definitions between MSP and OA at the onset of plan formulation. - Long history of area-based planning measures in Thailand. - Attempt to integrate marine protected areas, defined under the same legislation (Marine and Coastal Resources Promotion Act, 2015).	- Many departments are involved, with a lack of an inter-ministerial coordinating body. - Lack of provincial administrative areas at sea. - Complexity in existing planning practices, where Marine Protected Areas lie outside 'conservation areas' (Marine National Parks, Wildlife Conservation, Fishery reserved areas etc.), due to differing legislative instruments. - Complexity in integrating MSP with MPAs, where MPAs prohibit all activities which impact 'critical resources or habitats.' - Adjacent land areas under the jurisdiction of provincial committees and not considered under MSP or MPA process.

carrying capacity for accommodating tourism activities. Results of the analysis highlighted that although only one in nine persons in the cluster were tourists, tourism-related activities used 21% of the water, 57% of the energy and were responsible for 26% of the waste and 28% of the greenhouse gas emissions.

In 2020, the Department of Marine and Coastal Resources (DMCR) initiated an ecosystem-based MSP for Phang Nga Bay, a site of ecological and economic significance, building on experiences from completed MSP pilots.¹⁵ Leveraging technical capacities and experience in OA, the DMCR launched a pilot project to create an integrated decision support information base for policies and programmes concerning the sustainable management of Phang Nga Bay through the production of a comprehensive set of Ocean Accounts, with a focus on land-ocean interactions and the vulnerability of ecosystems. MSP formulation is expected to align with the same statistical and accounting infrastructure as OA (spatial and economic boundaries, classifications, etc.). Through the coherent integration of accounting for ocean assets, ocean services and ocean governance, the information generated will inform and allow for the evaluation of future policies, spatial plans, and regulations.

⁹ Australian Government (1998). Australia 's Ocean policy. Canberra: Australian Government

¹⁰ Australian Government (2012). Australia 's Submission to the Rio+ 20 Compilation Document, Rio+ 20 United Nations Conference on Sustainable Development. Canberra: Australian Government

¹⁵ MSP plans were formulated for Koh Larn, Koh Krok and Koh Sak, Chon Buri province, and Koh Tao, Surat Thani provinces in early 2010 s

3.2.3. South Africa

Policy and decision makers in South Africa have long recognised the importance of natural capital-based approaches, culminating in the National Plan for Advancing Environmental-Economic Accounting in 2015 [36]. Implementation has been co-led by Statistics South Africa (Stats SA) and the South African National Biodiversity Institute (SANBI), with projects¹⁶ resulting in the production of environmental-economic accounts nationally (e.g., fisheries, Ecosystem Accounts for rivers and estuaries) and sub-nationally (e.g., ecosystems within KwaZulu-Natal), encompassing coastal and marine ecosystems.¹⁷

Early regional spatial planning efforts began in KwaZulu-Natal, through the SeaPlan marine conservation planning project in the late 1990 s [20]. National MSP has developed more recently, with the formal process beginning in 2014, developing a National MSP Framework in 2017 [5] and establishment of an MSP National Working Group and legislative basis in 2018.¹⁸ The MSP process draws on extensive experience from terrestrial planning and the 12-year development of a

¹⁶ Advancing Natural Capital Accounting (ANCA) project (2014 – 2016), followed by the Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project (2016 – 2020).

¹⁷ See the University of Cape Town compilation on Natural Resource Economics for access to all reports and accounts between 1980 and 2017. <https://libguides.lib.uct.ac.za/GovtPubs/NaturalResourceEconomics/GovtPubs/NaturalResourceEconomics/SouthAfrica/Statistics> (Accessed 10/04/2021)

¹⁸ Marine Spatial Planning Act, 2018 (Act 16 of 2018), The Republic of South Africa

Table 5

A SWOT analysis of the intersection between Ocean Accounting and Marine Spatial Planning activities in South Africa.

Strengths	Weaknesses	Opportunities	Threats
- Shared inter-departmental coordinating structures for existing MSP and environmental-economic accounting efforts, which advance cross-boundary integration. - Extensive ocean data gathered from previous marine protected area and MSP processes, which could inform both asset and flow accounts in OA. - Available time series data (through national biodiversity assessments) to support temporal integration and evaluation of MSP effectiveness. - Indicative political will towards ecosystem-based management in both terrestrial and marine space.	- To date, no formal works between OA and MSP community. - Limited spatial overlap of MSP and OA activities (limited to KwaZulu-Natal) - Integrated ocean economy data (outside of fishing and aquaculture) is limited for South Africa.	- MSP is supported by national legislation. - There is a strong national commitment for environmental-economic accounting. - An extensive history of testing NC approaches. - A multi-scale, multi-level MSP approach in KwaZulu-Natal bears similarities to accounting processes. - South Africa's ratification of regional and global instruments for sustainable management of the marine ecosystem.	- To date, accounting efforts have primarily been focused on terrestrial assets, with ocean ecosystems tangentially covered. - The MSP process is weakly linked to the coast, with plans limited to the high tide line. - To date, no detailed timeline for MSP implementation has been developed, contrary to recommendations in National MSP Framework.

Table 6

A SWOT analysis of the intersection between Ocean Accounting and Marine Spatial Planning activities in Portugal.

Strengths	Weaknesses	Opportunities	Threats
- Coastal planning frameworks since 1998. Marine spatial plan embedded into legislation since 2014. - Clear governmental and institutional support, with an inter-ministerial coordinating commission overseeing MSP activities. - An established and maintained Ocean Economy Satellite Account, with overlap in reporting of MSP areas.	- Terrestrial and marine planning mandates are different instruments. - No standardized monitoring and evaluation plan for MSP. - No explicit links between OA and MSP activities.	- An inter-ministerial commission facilitates communication between MSP and accounting working groups. - Data gathered through MSP activities could form the basis of an 'asset' account. - OA may be used as the basis for a monitoring and evaluation plan. - A new ocean strategy will soon be released for 2021–30, with environmental accounting included as a potential future mandate. - Political commitment to development of environmental accounts, with ongoing SEEA efforts.	- Due to differing planning instruments between coasts and marine space, land-sea interaction data is fragmented. - Differing mandates and approaches between implementing governmental agencies may hinder synergies between frameworks. - A clear prevalence stated at the MSP law of the economic vector over sustainability and nature conservancy hinder the path to an ecosystem approach to MSP and stresses the institutional conflict.

representative MPA network [29,39]. The plan is split into four zones, including the exclusive economic zone, and is expected to be delivered in 2021.

Whilst both MSP and environmental-economic accounting are still independent processes, there is strong alignment between the frameworks as many of the underlying datasets for ecosystem management are coordinated by common government departments and institutions. For example, SANBI is involved with SEEA accounting pilots but is also responsible for national assessments of biodiversity and habitat mapping using a national classification of marine ecosystem types, providing data on the extent and indicators of ecosystems condition [1].

A potential conceptual intersection between OA and MSP is the multi-scale, multi-level approach for MSP has been tested within KwaZulu-Natal, where many of the underlying data processes (in compiling, modelling, and standardising) are aligned with the OA framework [27]. The approach described by Lagabrielle et al. [27] organises data by 'planning units', which are analogous to basic spatial units within an accounting approach [46]. Thus, there is an opportunity to incorporate OA as a data foundation at a regional scale (KwaZulu-Natal) and the potential to scale the approach nationally for monitoring and evaluation of marine spatial plans.

3.2.4. Portugal

Portugal's National Ocean Strategy (ENM, 2013–2020),¹⁹ a

component of the Portugal 2020 partnership agreement with the European Commission,²⁰ called for sustained growth, guided by the European Commission's 'Blue Growth Agenda' (COM2012/494/final). The strategic plan focuses on three 'Action axes,' concerning innovation and research, exploration and use of ocean resources and the preservation of ocean environments. As part of these actions, a legal basis for Portugal's policy on marine spatial planning and management of the national maritime space (n. 17/2014/April 10) entered into force. A recent resolution (No. 203-A/2019) approved the division of Portuguese marine waters, into the mainland, Madeira and extended continental shelf, as defined in the National Maritime Spatial Planning Situation Plan (PSOEM).²¹ Finalisation of the national plan is ongoing and will result in the largest maritime plans in Europe by area. One of the challenges recognised by Portugal in implementing their strategic plan is the overlapping responsibilities of administrative departments and agencies, which is addressed through the establishment of a coordinating departmental body.

Portugal is an international leader in the implementation and maintenance of an ocean economy satellite account, led by Statistics

¹⁹ Estratégia Nacional para o Mar (ENM) - <https://www.dgpm.mm.gov.pt/enm> (Accessed 11/12/2020)

²⁰ Portugal 2020 Partnership - <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/policy-document/continente/portugal-2020-partnership-agreement-2014-2020-0> (Accessed 11/12/2020)

²¹ National Maritime Spatial Planning Situation Plan, Republic of Portugal (Portuguese) - <http://www.psoem.pt/>

Table 7

A SWOT analysis of the intersection between Ocean Accounting and Marine Spatial Planning activities in Canada.

Strengths	Weaknesses	Opportunities	Threats
• Linkage of OA and MSP to the Blue Economy Strategy strengthens opportunities for collaboration. • Early stage of MSP initiative allows for coordination with OA. Examples include: 1) early engagement in both directions between OA and MSP, 2) ability build a joint workplan, that considers the needs of both initiatives, 3) ability to be responsive and adaptive in purpose, 4) early coordination in effective data management and communications, 5) OA will help provide knowledge to MSP through early coordination on data/tools development.	• Infancy of both OA and MSP initiatives. • OA lacks real world examples on its contribution to evidence-based management at a national level. Whilst no MSP have been implemented in Canada, there are extensive international examples. • Differences in scale: OA has a focus using a national lens, while MSP focuses on a bioregional/pilot area scale. For example, MSP data may be too granular to extrapolate nationally, or MSP may be limited in spatial extent. In Canada, the national perspective of OA would mean MSP bioregions/pilot areas would be embedded in the larger analysis.	• Strong political and institutional commitment for both OA and MSP. • Early data stewardship coordination to support the production of open and accessible outputs. • Having both OA and MSP in one Department (DFO) may produce synergies while increasing visibility of work. • OA focus on existing information and data collection processes, reduces resource needs for MSP, and assists in identifying relevant information and data gaps. • Opportunities for collation of regional information at national level using national OA pilots (e.g., eelgrass) • The MSP reporting process (i.e., MSP Atlas), is an opportunity to present OA results, making results more accessible to Canadians and increase OA's profile.	• Differences in mandate, agenda, stakeholders (private vs government) and scope (OA is national and MSP is by bioregions/pilot areas) create a challenge in coordinating and building joint workplans. • The size of the Department and dispersed data holdings is a challenge in identifying, assembling, and sharing data. • The coastal and ocean waters are large, creating a challenge to implementing OA pilot projects in a meaningful way. • MSP deliverable is for 2024, but there is no commitment for implementation. • Priority indicators for national level OA may not align with bio-regional MSP reporting needs.

Portugal,²² and is the model for many accounts under development. These include a complete set of production, expenditure, and income accounts able to produce a set of balanced national aggregates for the ocean economy. The ocean economy satellite account considers 65 different products and services, capturing traditional industries (ports, shipping, and fisheries), in addition to recreational, sports, culture and tourism-related activities. The country further maintains a tourism satellite account, which distinguishes the contribution of ocean-related products and services that contribute to the economy. Thus, Portugal is well-poised to take advantage of maintained accounts for the implementation of MSP and to further the scope of existing accounts for improved management and decision-making.

3.2.5. Canada

Canada is surrounded by the Atlantic, Arctic, and Pacific oceans, which, along with their ecosystems, support human activities and the health of Canadians. In 2018, the economic contribution of Canadian maritime sectors was 1.7% of employment and 1.6% of GDP.²³ In response to increasing threats to Canada's oceans, MSP was chosen for ocean planning and management, to advance Canada's marine conservation targets, reconciliation with Indigenous peoples, and supporting its Blue Economy Strategy.

The Government of Canada, led by the Department of Fisheries and Ocean Canada (DFO), is undertaking MSP processes in five marine bioregions,²⁴ to integrate knowledge of a planning area and provide a decision-making tool that considers ecological, cultural, social, and economic factors towards long-term resilience and sustainability. Canada's MSP is expected to provide a predictable, stable environment that will attract growing investment in marine sectors. These efforts are

supported by a Ministerial mandate to pursue initiatives working with provinces, territories, Indigenous Peoples, and all Canadians to better co-manage Canada's three oceans.²⁵ Delivery for at least four bioregions is expected by 2024, with the MSP process anticipated to continue beyond the four individual plans.

In parallel, Canada's Ocean Accounts were initiated in 2019, coordinated by DFO and Statistics Canada. The ongoing project addresses incompatibility between datasets and fragmentation of knowledge amongst stakeholders, which limits the comprehensive mapping of ocean ecosystems extent, condition, services, and beneficiaries. Thus, a national OA is a priority for Canada to harmonize key ocean-related data, in addition to filling knowledge gaps. The OA pilot focuses on integrating spatial data on marine habitats, improving measurement of the marine economy, developing ecosystem accounts, and applying international standards to measuring market and non-market ecosystem services.

Realized progress includes the assessment of existing priorities and data to determine data gaps and priority accounts; the first inclusion of marine and coastal ecosystem accounts in Statistics Canada Human Activity and Environment report, and an EnviroStats report of Marine Economy accounts. DFO, in collaboration with University of British Columbia, is also estimating the extent of eelgrass beds and associated blue carbon stocks across the Canadian coastlines. Canada's OA also benefits from and supports the Blue Economy Strategy, aimed at guiding and supporting sustainable growth and modernization of high potential sectors and related job creation, in part through targeted indicators from OA.

Although OA and MSP in Canada are independent initiatives, the strongest potential synergy is the coordination of data. As both initiatives are at initial stages of development, there is scope for co-development through effective information sharing and coordination, avoiding the duplication of efforts. Canadian OA could provide relevant ocean-related indicators as well as information on governance, assisting MSP development, in addition to monitoring and evaluation of their effectiveness. OA could provide a national perspective to identify priority areas for MSP and illustrate their relative performance from both a socio-economic and conservation perspectives. OA in Canada is

²² Direção-Geral de Política do Mar do Ministério do Mar (DGPM) - <https://www.dgpm.mm.gov.pt/conta-satelite-do-mar> (Accessed 11/12/2020)

²³ The Marine Economy Accounts, developed by Economic Analysis and Statistics (EAS) division in the Economics, Statistics, and Data Governance (ESD) directorate of Fisheries and Oceans Canada, provide estimates of the direct, indirect, and induced economic contribution of ocean dependent activities. Details including methodology are available here: <https://www.dfo-mpo.gc.ca/stats/maritime-eng.htm>

²⁴ The 5 marine-bioregions for MSP include the Pacific North Coast, the Pacific South Coast, Newfoundland and Labrador Shelves, Scotian Shelf – Bay of Fundy, and the Estuary and Gulf of St Lawrence.

²⁵ Within Canada, the rights of First Nations, Inuit and Métis peoples are constitutionally protected.

currently limited in scope and could take advantage of extensive data-sharing amongst MSP planning partners, to expand priority indicators and broaden accounts coverage.

4. Discussion

This study explores the early intersection between MSP and OA through a global review, identifying operational opportunities and barriers for co-implementation. We identified 26 countries that have undertaken OA- and MSP-related activities, with only country presenting formal links between the frameworks (Thailand).

Of the 26 identified countries, only 10 had completed and enforced marine spatial plans, with no clear link in their policy use-cases. The implementation of MSP may focus on either conservation or intersectoral planning [43], which could be supported by accounts concerning ocean ecosystems or the ocean economy, respectively. Several countries contained OA pilots focused on ecosystem extent and condition, whilst also pursuing plans that focus on inter-sectoral planning. For example, 12 of China's marine spatial plans focus on inter-sectoral planning, although OA activities focused on mangroves and their services. Similarly, Netherlands' MSP also focuses on inter-sectoral planning, although the country compiles natural capital and ecosystem accounts for the North Sea. The lack of alignment between use-cases is initiative, as OA activities are relatively small-scale and links bridging the two frameworks have yet to be developed within national policy and legislation. It further suggests that whilst coordinating bodies for both frameworks may be the same, the institutions (or internal working groups) conducting MSP and OA are still operating separately. The diversity in the policy use-cases of OA activities globally, however, suggest that links with OA may be readily operationalised across several stages of the planning process.

4.1. Linking frameworks through existing activities

The most apparent link with MSP was the use of OA in measuring the ocean economy, which assists in understanding the relative importance of different economic sectors. Sixteen countries contained efforts to disaggregate the 'ocean' component of economic sectors, although few countries (USA, Portugal, Korea, and Canada) had developed and maintained products and services within an ocean economy satellite account (see SM1 for definition). Such accounts provide an evidence-base during cost-benefit analyses under different scenarios of space and resource allocation. As marine spatial plans tend to benefit novel and developing economic activities (e.g., offshore renewable energy, aquaculture) [9], a time-series of indicator and statistics on the ocean economy would identify the impacts of the plan on specific activities, and further determine progress towards the objectives of the plan.

Other OA activities focused on specific sectors of the ocean economy, such as the sustainability of tourism, aligning with national priorities. Eight countries measured the 'ocean component' of tourism, with Thailand and Samoa further linking tourist activities to environmental statistics by linking existing Tourism Satellite Accounts (TSA) with SEEA Central Framework accounts (e.g., waste, water, air emissions). These countries were primarily focused within Asia (Thailand, Viet Nam, Maldives, and Philippines) and Oceania (Samoa and Fiji), where each country has a substantial proportion of Gross Domestic Product (GDP) linked to the tourism sector [33]. Combining tourism indicators with environmental statistics provides a greater understanding of the resource demands of tourists (e.g., water, energy), relative to the local populace, which is a key consideration for designating areas for tourism [34].

Another focus of OA pilots was the spatial extent of ecosystems and their services, which readily informs ecosystem-based MSP processes. From the global review, most OA activities focused on a specific ocean ecosystem (e.g., mangroves, kelp, and seagrass) and related services, with several countries further attempting to link ecosystems to related

economic sectors (e.g., fisheries, $n = 6$ countries). By understanding the dependencies between economic activities and ecosystems (and their services), plans may more readily align multiple activities with the natural resources required to function [14,16]. It further assists in identifying the potential conflicts for the same resources and ecosystem services.

4.2. Identifying operational opportunities and barriers

Through the analysis of MSP and OA within five countries, opportunities, and barriers for co-implementation at the operational level were identified, related to considerations around a shared policy context, data (and data-sharing), and institutions.

4.2.1. Shared policy context

Across all five countries, several existing commitments strengthen operational links between both MSP and OA. All case studies have committed to the conservation of ecosystems and biodiversity (Table 2), in ratifying the Convention of Biological Diversity²⁶ and are thus obligated to conserve 10% of their marine domain. These efforts are furthered within Australia, Canada, Portugal, and South Africa as members of the Global Ocean Alliance, calling for 30% of the world's Oceans to be protected by area-based measures by 2030.²⁷ Australia, Portugal, and Canada have also committed to the sustainable management of all sovereign waters by 2030, as part of the High-Level Panel for a Sustainable Ocean Economy.²⁸ Marine protected areas (MPAs) are the most common mechanism for conservation, and therefore exclusion, of certain human activities. The designation of MPAs falls, in part, within the MSP processes of Australia, Canada, and South Africa, although explicitly outside MSP within most European countries [44], including Portugal. In countries where MPAs are embedded within an MSP process, OA is a means to monitor the conservation of ecosystems and biodiversity.

Further, a recurring theme across the case studies was requirement of an ecosystem-based management (EBM) approach (all 5 countries). A central tenet to ecosystem-based management is the consideration of relationships between different components between the ecosystem and society [24], which is supported by the 'integrative' nature of both MSP and OA [15] in collation of data and knowledge across multiple domains. As MSP is increasingly framed within EBM, assessments of ecosystems and their services are increasingly used during MSP scenario and trade-off analyses [16]. Undertaking assessments using OA addresses the challenge of linking ecosystems to the ocean economy and society.

Three countries had developed, or are in the process of developing, ocean-based economic strategies (South Africa, Portugal, and Canada), to encourage the growth of specific ocean sectors. By guaranteeing access to space and resources, MSP could further the growth of these sectors through providing regulatory certainty, reducing administrative and planning costs, and encourage investment [9]. The maintenance of ocean economy satellite accounts provides the means to assess the impacts of MSP over time and whether progress is made towards plan objectives. The lack of economic data is considered a key barrier in measuring the direct and indirect impacts of MSP on economic sectors [9], which could be addressed through OA.

²⁶ Convention on Biological Diversity, Strategic Plan 2011 – 20, Aichi Targets: <https://www.cbd.int/sp/targets/> (Accessed 15/04/2021)

²⁷ Global Ocean Alliance (30 × 30 initiative): <https://www.gov.uk/government/topical-events/global-ocean-alliance-30by30-initiative/about> (Accessed 15/04/2021)

²⁸ High-Level Panel for a Sustainable Ocean Economy: <https://oceanpanel.org/about#100> (Accessed 15/04/2021)

4.2.2. Data (and data sharing)

Shared underlying data (economic, social, and environmental) required to implement either framework presents a clear synergy in co-implementation. The link is particularly strong for MSP processes that structure ocean ecosystems to stocks (i.e., natural capital) and flows (i.e., ecosystem services) [38], which lends to the use of an accounting structure. As MSP is more advanced, with numerous plans completed and enforced globally [11], there is an opportunity to share existing data inventories with emergent OA processes. Similarly, OA provides a rigorous and standardised structure that, maintained over time, provides a 'data foundation to develop new plans and to evaluate and adapt existing plans [15], seen in the management of marine parks within Australia. Co-development presents synergies through reduced data acquisition costs and relying on institutional expertise to gather data from specific knowledge domains (e.g., Canada, South Africa, see Section 4.2.3).

Whilst data requirements for both MSP and OA processes are similar, there is a risk of incoherence due to differing jurisdictions and mandates, especially at the land-sea interface. Most MSP processes only cover marine areas (e.g., Australia, Portugal), leaving coastal areas to other instruments [40]. The coherence between OA and MSP is limited if accounts focus on estuarine and coastal ecosystems and related economic sectors, such as the tourism-focused accounts in Thailand. Similarly, the Australian OA pilot could not produce time-series within an accounting structure, as data from the marine park area were compiled from different time periods [21]. As methods within the OA framework mature into an accounting standard, systems will require stricter standardisation, controls on data quality and data coherence.²⁹ Thus, there may be an opportunity cost in the misalignment of data procurement between the two processes.

4.2.3. Shared institutions

Within several countries, MSP and OA had shared coordinating organisations and data partners, which provides an opportunity to strengthen links and collaborations between institutions. Within Canada, the Department of Fisheries and Oceans (DFO) is responsible for MSP development and collaborating with the national statistical agency to deliver OA pilots. Similarly, the South African National Biodiversity Institute (SANBI) was responsible for coordinating environmental-economic accounting and for marine habitat mapping used within the MSP process. Thus, shared data and institutional support may already exist, overcoming departmental fragmentation, reducing redundancies in data gathering activities, and providing an existing coordinating body that allows for the streamlining co-development at the national level.

Whilst institutions may be shared for both processes, differing mandates, approaches, and relevant stakeholders between or within institutions may pose operational challenges for co-development. For example, whilst DFO, Canada is responsible for both MSP and OA, the end-users of MSP and OA differ markedly, as MSP have a 'bioregional' focus (sub-national), whilst OA is considered a national exercise. As such, the resulting statistic and indicators produced for OA may have limited applicability for the bio-regional planning process and its stakeholders. Another challenge is the lack of a coordinating ministry or department, especially when several government departments are involved in either process (e.g., Thailand), significantly reducing the ability to coordinate a join work plan.

4.3. Limitations and future research

As a largely government process, knowledge of the operational aspects of MSP and OA are limited, with information held by experts involved with the process and documentation that is either confidential

or not widely distributed. The study is skewed, therefore, towards completed MSP and OA activities and may have omitted activities that are unreported, yet underway. Another knowledge gap concerning the operationalisation of either framework is how knowledge and data is chosen and used within analysis. As explored by Chen et al. [2] and Perkiss et al. [35], the choice of the knowledge and data used within OA will bias the values represented within accounting area, with similar challenges in the inclusion and omission of perspectives within MSP [13]. Future research should directly engage MSP and OA practitioners to determine operational synergies through experiences and lessons learnt, and further determine how data availability and stakeholders influence the co-development of both processes.

5. Conclusion

The current intersection between OA and MSP is in its infancy, where only two countries demonstrate an overlap in between both frameworks. Further, the global review of use-cases for both OA and MSP did not demonstrate clear alignment, where MSP often focused on intersectoral planning, whilst OA focused on ecosystem monitoring. An analysis of the framework in five countries, however, identified shared policy drivers that provide a basis for co-development. Most countries contain policies towards the development of their ocean economy, alongside commitments towards the conservation of ocean ecosystems. MSP could be used to align and operationalise policy targets within the marine domain, supported by the statistics and indicators on ocean ecosystems and the economy produced by OA. Ecosystem-based MSP requires an 'integrative' view of the marine domain, which particularly aligns with OA.

The case studies also demonstrate the operational opportunities and barriers posed by data-sharing and shared institutions. For countries with developed MSP, existing data inventories could provide the basis for compiling ocean accounts, whilst conversely OA could provide the 'data foundation' for plan formation and evaluation. Further, both OA and MSP activities within several countries were conducted by shared institutions, which could facilitate dialogue, data-sharing, and the creation of joint work-plans. Barriers to data sharing and co-operation between institutions implementing the frameworks, however, could arise from differing mandates, jurisdictions and stakeholders and end-users.

As investment and policy intent continue to build for MSP and OA, we identify the early opportunities and barriers that would influence co-development. Institutional structures and the data needs for either framework should be considered early, to ensure compatibility and mitigate the potential redundancies and incoherence. With the maturation of activities, future work should engage MSP and OA practitioners to share experiences and lessons learnt, to overcome institutional and knowledge fragmentation in support of integrated ocean governance.

CRediT authorship contribution statement

Jordan Gacutan: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Kemal Pınarbaşı:** Conceptualization, Investigation, Writing – review & editing. **Messan Agbaglah:** Investigation, Writing – original draft, Writing – review & editing. **Ibon Galparsoro:** Investigation, Writing – original draft, Writing – review & editing. **Arantza Murillas:** Investigation, Writing – original draft. **Ibukun Adewumi:** Conceptualization, Writing – review & editing. **Teerapong Praphotjanaporn:** Conceptualization, Writing – review & editing. **Michael Bordt:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Ken Findlay:** Writing – review & editing. **Coulson Lantz:** Investigation, Writing – original draft. **Ben M. Milligan:** Conceptualization, Writing – review & editing, Funding acquisition.

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²⁹ As defined by the UN Fundamental Principles of Official Statistics (A/RES/68/261 from 29 January 2014)

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2022.105055](https://doi.org/10.1016/j.marpol.2022.105055).

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