Fostering an inclusive science-based approach to ocean governance in Brazil

Mariana Martins de Andrade

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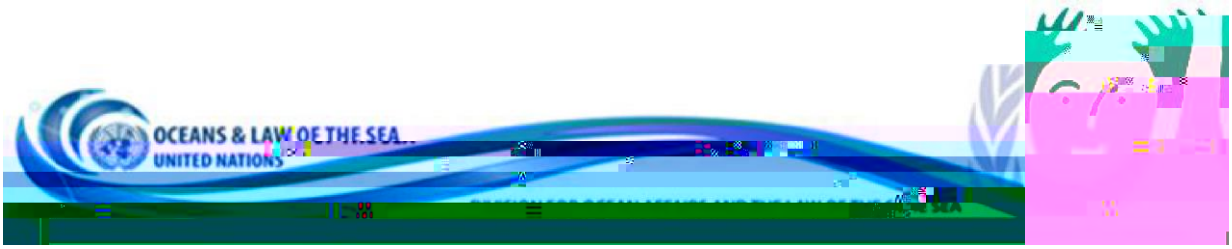

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ABSTRACT

In the last decade, unparalleled ocean discoveries have expanded scientific frontiers, demanding governance systems of increasing complexity. The growing awareness of the urgent need for sustainable ocean management underscores the crucial role of science-based decision-making and a fortified science-policy interface in ensuring ocean sustainability. This thesis identifies key moments in the environmental agenda and evaluates primary their motivations driving global science-based approaches, unveiling opportunities for cohesive, integrated ocean management facilitated by international legal regimes. Science is positioned as a powerful instrument for diplomacy, fostering international cooperation, and promoting equitable approaches to sustainable development. Emphasizing the significance of investing in scientific research, the thesis highlights its role in enhancing understanding of the ocean's ecosystems, processes, human impacts, and cultural contexts, thereby shaping the trajectory of the ocean-policy agenda. The Brazilian ocean policy regime serves as a case study, illustrating its legal framework's potential to accommodate better-informed practices and policies for ocean management. This examination contributes to the broader discourse on global ocean governance and reinforces the integral role of science in navigating the challenges and opportunities inherent in sustainable ocean management.

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UNESCO	United Nations Educational, Scientific and Cultural Organization
ZOPACAS	Zone of Peace and Cooperation of the South Atlantic

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humanity's shared use[8], it contributes to planetary and human health[9], and can not be understood or governed in isolation[10]. Ocean environmental processes encompass spatial scales that transcend jurisdictions.

From climate change to the urbanization of coastal areas, the adverse impacts on ocean health are intricately linked to economic, cultural, and political domains, more or less inclined toward sustainable efforts. Managing the complex human-induced changes within a system as wide as the ocean requires governance approaches that foster environmental health, justice, and safety for future generations[11]. Consequently, there is a growing demand for pluralistic, ecosystem-based, and knowledge-driven ocean governance approaches capable of addressing social injustices and multiple pressures in the ocean ecosystems[12].

Transformative governance systems and approaches are prompted by adaptive responses to human-ocean interactions[13], fostering a culture of cooperation among ocean stakeholders committed to sustainable and socially equitable ocean use[14]. The challenge of managing shared resources also represents an opportunity for the development of democratic and participatory solutions to guide research endeavors and sharpen environmental policy at all levels[15].

The setting of agendas, treaties, and commitments to ocean stewardship over the past decades reflects an effort to create a multilateral momentum for ocean governance[16]. The demand

[8] *All-Atlantic Ocean Research Alliance A success story of ocean science diplomacy* (European Commision, 2022)
[9] *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC, 2019). H.-O. Portner, D.C. Roberts, V. Masson-

for effective and comprehensive policy has emerged in response to the rapid evolution of science and technologies capacities, influencing how ocean resources are exploited, and how sovereignty disputes unfold on a global scale.

In 1973, the United Nations (UN) engaged its member states in a global diplomatic effort to discuss and develop an international regime for all ocean areas, uses, and resources[17]. By 1982, the culmination of this effort was marked by the adoption of the United Nations Convention on the Law of the Sea (UNCLOS or the Convention)[18], establishing a delicate balance between economic, social development, and environmental preservation interests to guide its signatories. This milestone not only presented an approach to ocean governance but also solidified the UN's role as the central forum for an integrated perspective on the ocean and the law of the sea.

UNCLOS provides the overall legal framework within which all activities in the ocean must be considered[19]. Its comprehensive approach represents the first international legal framework to delineate States' property rights and provide guidance in the use of international waters. While this notion of property concentration entails power dimensions, it can also serve as a motivational force for resource management and protection[20]. In its preamble, the Convention emphasizes the goal of promoting equitable and efficient utilization of ocean resources, the conservation of living ocean resources, and the study, protection, and preservation of the marine environment.

Research, practice, and policy are at the heart of ocean governance, and they can play a role in defining tools to achieve sustainability goals[21]. The decisions related to the allocation of rights and establishment of policies hinge on information. UNCLOS introduced innovation by

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Katharina Hornidge eds (MARE Publication Series, volume 25; Cham, Switzerland, Springer Nature, 2023). Available at: httpQ Β/er /lnΕaw 9(proe 792 reWI9[1l8Tf1 0 0 1 166.64 460.36 Tm0 g0 G[eat)-3(e)4( )-104(Stat)-3(es')-f1 0 0Β/er /lng)-k [e((-20

presenting a framework for the conduct of marine scientific research (Part XIII) and the development and transfer of marine technology (Part XIV) to support both domestic and

administrative structures hinder the ability to balance management decisions that affect the diverse stakeholders involved in ocean use, science, and policy design[27].

Fundamental to addressing these challenges is the coordination and cooperation at both intergovernmental and inter-agency levels. UNCLOS recognizes that issues related to the ocean space are closely interconnected and need to be considered comprehensively. When international conventions, treaties, agreements, and commitments advocate for science-based and informed decision-making, countries assume the responsibility to cooperate to collect, control, share, and preserve data and information in ocean science[28]. Elements such as international cooperation, technical assistance, advanced scientific knowledge, funding, and capacity-building are important for realizing the benefits envisioned by UNCLOS[29].

The governance arrangements that are inclusive, participatory, and decentralized have the potential to induce the behavioral change necessary for the development and ownership of more sustainable practices[30]. However, the international governance regime remains fragmented, a challenge experienced not only by States at the national and regional levels but also within the broader UN ecosystem. There are a multitude of UN entities with mandates influencing the ocean agenda (Figure 1) reflecting the wide and multidisciplinary nature of the domain, but also introducing complexity to the implementation of the international ocean governance regime.

While all UN entities support the implementation of UNCLOS, their efforts are often dispersed in implementing and regulating specific thematic provisions separately. Despite contributing to international and intergovernmental cooperation with a focus on diplomacy and multilateralism, Member States have long advocated for improved coordination and coherence in addressing ocean and coastal issues within the United Nations system. In response to this, the High-level Committee on Programmes of the United Nations System Chief Executives Boaves Boav:2ea16(Bog

UN-Oceans, through ad hoc task forces and collaboration with international stakeholders, coordinates efforts related to ocean and coastal issues[32]. While continuous improvement is apparent, this mechanism is crucial for bridging gaps within the global ocean governance framework, leveraging partnerships based on institutional knowledge. It plays a fundamental role in recognizing the specificities of its member entities and positioning science at the center stage of joint action and cooperation across diverse mandates. This collaborative approach is vital for implementing various treaties, conventions, and commitments that benefit from an ocean insight grounded in the best available knowledge.

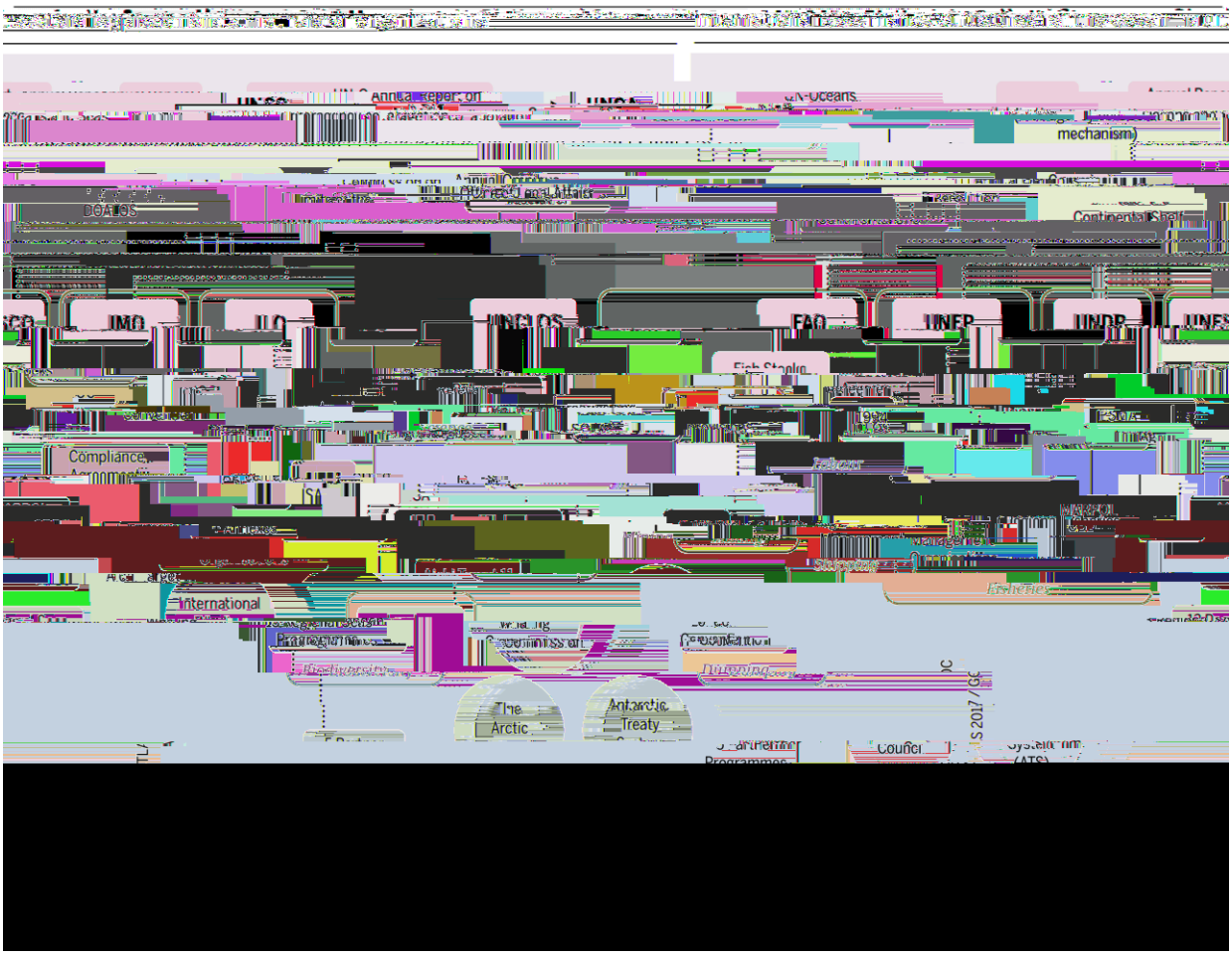

Figure 1. The multi-sectoral governance structure for ocean management within the United Nations system. Source: Ocean Atlas, 2017[33].

[32] A/67/400/Add.1.

[33] Natascha Posel and others, "The Ocean Atlas 2017", (Heinrich Boll Foundation Schleswig-Holstein, 2017). Available at: www.meeresatlas.org.

This thesis aims to elucidate the crucial role of science in shaping the recent evolution of the ocean governance framework. It identifies key moments in the environmental agenda and assesses the primary motivations driving science-based approaches on a global scale. This research explores opportunities for more cohesive and integrated management arrangements facilitated by international legal regimes. Science is recognized as a powerful instrument for diplomacy, fostering international cooperation, and promoting more equitable approaches to sustainable development. The thesis underscores the significance of investing in scientific research to enhance the understanding of the ocean's ecosystems, processes, and the impacts of human activities, thereby shaping the trajectory of the ocean-policy agenda.

Furthermore, the research delves into a regional and local perspective, specifically examining the case of Brazil. Through a comprehensive analysis of the national ocean policy regime, the study illustrates that Brazil possesses a legal framework capable of accommodating well-informed practices and policies for the ocean, engaging a diverse range of stakeholders. The thesis highlights ongoing efforts within Brazil to address imbalances and champion more equitable and inclusive ocean governance in the Global South. By harmonizing intergovernmental commitments with scientific inputs and sustainable development practices, Brazil is actively leveraging these initiatives to secure its blue growth.

Agenda 21 fostered the establishment of subregional, interregional, regional, or global frameworks and mechanisms to improve the capacities of States in achieving necessary coastal systematic observation, research, and information management systems. In line with Agenda 21's commitment, the development of scientific and technological means and research is dedicated to integrating the protection of the marine environment into relevant environmental, social, and economic development policies. Agenda 21 also recognized the presence of numerous national and international institutions, both within and outside the United Nations system, with expertise in marine issues, emphasizing the necessity for improved coordination to strengthen links among them[42]. In a context of cooperation, States, and institutions in general, are urged by Agenda 21 to seek a comprehensive programme to address core human resource needs in marine sciences at all levels, enabling the considerable data already available to indicate types of information required for solid bases in decision-making.

The last chapter of Agenda 21 outlines vital programme areas to inform decision-making, focusing on bridging the data gap and improving information availability[43]. The development and use of sound indicators of sustainable development, the improvement of methods of data assessment, analysis and utilization, and the consideration of local and traditional knowledge are highlighted as mechanisms to be strengthened or established to transform scientific and socio-economic assessments into information suitable for both planning and public use. This responsibility is not attributed exclusively to the academic sector, but science plays a significant role in making a sustainable development agenda effective and represents an important component of reinforcing international cooperation.

The outcomes of the 1992 United Nations Conference on Environment and Development were extensively referenced in the subsequent years, inspiring the establishment of numerous frameworks and processes that prioritized ocean and coastal affairs, and recognizing the importance of science-based information in supporting cooperation in this domain. In 1994, the General Assembly welcomed the adoption of Part XI of the UNCLOS[44], and the Convention entered into force. Later that same year, the UN convened the inaugural meeting of Member State Parties to the Convention and established the International Tribunal for the Law of the Sea.

[42] Agenda 21, Chapter 17.
[43] Agenda 21, Chapter 40.
[44] A/RES/48/263.

In alignment with these developments, the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks was adopted. The Agreement outlines principles for the conservation and management of these fish stocks, emphasizing that such management must be founded on the precautionary approach and the best available scientific information.

These events marked historical moments in international relations and the development of international law, as they elaborate on the fundamental principle of designing frameworks for cooperation in the conservation and management of marine resources[45]. These milestones also played a crucial role in demystifying intangible subjects, transforming them into concepts relevant to the public. Intending to increase public awareness of actions at global, regional, and national levels to better utilize and manage ocean resources, the General Assembly declared 1998 as the International Year of the Ocean[46]. This proposal, made in 1993[47] and adopted in 1994[48], draws on the Rio Declaration on Environment and Development and relevant Chapters of Agenda 21, adopted by the UNCED. It recognizes that the integral management of the coastal and ocean space depends on access to information and specific efforts to increase public and scientific awareness. Under the leadership of IOC-(,)5(draw)4(s)4(o)5(n)5( )]TJETQq0.00000912 0 612 792 reW*n Q 3i7 3i7 3inBT

regional initiatives to further support ocean science[50]. The success of this year-long event marked the first time the marine environment became a priority in the global agenda of environmental protection. IOC-UNESCO and the Lisbon Declaration on Ocean Governance[51], released in the same year of 1998, expressed a desire to sustain attention on the importance of the ocean to the ecological balance of the earth and its potential for social and economic development. Both pointed out opportunities to garner government support and commitments for the ocean research and protection agenda in the following years[52], using “unity, urgency, potential, opportunity and trusteeship” as elements for an awakening to ocean issues.

The narrative of understanding the ocean as an integrated whole, coupled with the gravity of challenges arising from aggressive usage patterns, and the threats to marine resources and biodiversity, underscored the need for governance procedures and institutions. This late twentieth century movement positioned ocean governance as an instrument for constructing a global democratic society, influencing forms of political action that could engage citizens and communities in collaborative efforts for the benefit of the ocean, and in consequence, the planet. The Lisbon Declaration on Ocean Governance proposed principles thatel2 r3ing oc[comol)3(rnme6[ )]TJETQq0

importance of facilitating access to and transfer of environmentally sound technologies and the corresponding know-how, particularly for developing countries[54].

ECOSOC also observed that ocean and seas represent a unique case for international coordination and cooperation, requiring a more integrated approach to build upon existing legal, economic, social, and environmental arrangements at intergovernmental and inter-agency levels. Means for more effective coordination were requested to be present by the reports of the Secretary-General to the General Assembly, considering the opportunity to enhance the existing ocean governance framework.

The global repercussions of El Niño/La Niña phenomena at the end of the twentieth century further heightened the significance of ocean issues within the climate agenda. The improvement of monitoring and prediction of climate variability depended on building capacity in oceanographic observation. States noted that cooperation in ocean science was increasingly important for assessing climate change and other developments in the global environment.

As a direct outcome of this movement and the ECOSOC recommendations, the open-ended Informal Consultative Process (ICP) was established in 2000[55]. This initiative aimed to facilitate an effective and constructive annual review by the General Assembly. The ICP became a yearly relevant event, suggesting specific issues for consideration by the General Assembly and its Member States. Since then, it consistently emphasized areas in ocean affairs and law of the sea where coordination and cooperation for ocean science at the intergovernmental and inter-agency levels should be enhanced.

Subsection A.2: Marine Scientific Research and Transfer of Marine Technology

The contribution of marine science to eradicating poverty, ensuring food security, and conserving the marine environment and resources worldwide has been widely acknowledged in recent decades[56]. Through sustained research efforts and the evaluation of monitoring results, this field of knowledge is crucial for understanding, predicting, and responding to current natural

[54] *Official Records of the Economic and Social Council*, 1999, Supplement No. 9 (E/1999/29).
[55] A/RES/54/33.
[56] A/RES/75/239.

events. It also plays an important role in promoting the sustainable development of the ocean and seas, applying such knowledge to effective management and decision-making[57].

The concept of marine science as a crucial element in building the international framework for ocean governance gained prominence in 1970, wF3 bxc47o1gBT(g)5(ovnralment)-447o1Assembl77(y)-

Assembly, and they served as means to drive action in sustaining the integrity of marine ecosystems[63].

According to UNCLOS, Coastal States exercise sovereignty over their territorial sea[64], holding the exclusive right to regulate, authorize, and conduct marine scientific research within this area[65]. Research and survey activities are not considered innocent passage if conducted by another State in the territorial sea of a Coastal State[66]. During transit passage in straits or archipelagos, research or survey activities should only occur with prior authorization of the States bordering the region[67,68]. In their exclusive economic zones, Coastal States have jurisdiction over marine scientific research[69], and consultation with them is mandatory if another State intends to undertake specified research programmes[70], including the sampling of fishing data[71]. States bordering an enclosed or semi-enclosed sea should cooperate in the exercise of scientific research, developing policies and appropriate joint programmes for the area[72].

On the high seas, all States enjoy the freedom of scientific research, subject to provisions outlined by Parts VI and XIII of UNCLOS, and other applicable rules of international law[73]. Scientific research happening in the Area must be exclusively for peaceful purposes and the benefit of humankind, in accordance with Part XIII[74]. The International Seabed Authority is empowered to carry out, promote and/or make contracts for marine scientific research concerning the Area and its resources[75]. International cooperation in marine scientific research is encouraged within the Area[76]

In the section that addresses the Protection and Preservation of the Marine Environment, UNCLOS supports global and regional cooperation arrangements, enabling States to conduct studies, undertake programmes of scientific research, and exchange information and data, particularly concerning pollution of the marine environment[77]. The Convention recommends the establishment of appropriate scientific criteria for formulating rules, standards, and recommended practices and procedures for the prevention, reduction, and control of pollution of the marine environment[78]. Competent international organizations are also entitled to provide scientific and technical assistance to developing States, improving their capacities, participation in research programmes, and access to marine research infrastructure[79].

Part XIII of the Convention provides specific provisions to guide States in conducting marine scientific research, and all of them, irrespective of their geographical location, have the right to do so[80]. Marine scientific research should be guided by peaceful reasons; executed using appropriate scientific methods; avoiding interference with other legitimate uses of the sea compatible with this Convention; and acting in compliance with the protection and preservation of the marine environment[81].

Encouraging the creation of favorable conditions for cooperative efforts in the conduct of marine scientific research is understood as a mechanism to promote integrated science endeavors[82]. the conduct of

The establishment of general criteria and guidelines to assist States in conducting marine scientific research is also important[86]. If the defined criteria are not met, or if any other UNCLOS provision is not respected, a Coastal State has the right to require the suspension of the ongoing scientific activities within its exclusive economic zone or on its continental shelf[87]. The Convention outlines specific procedures for deploying, using, and ceasing any type of research activity or installation. States and competent international organizations are responsible and liable for undertaking and overseeing marine scientific research within in their maritime zones, including compensating for any damage resulting from such activities[88].

The Convention also provides that States and international organizations shall cooperate to transfer marine science and technology on fair and reasonable terms and conditions[89]. Part XIV of UNCLOS is dedicated to this topic, setting a solid basis to encourage States to provide equitable access to information for the benefit of all parties, particularly developing, land-locked, and geographically disadvantaged States.

The transfer of marine technology, as outlined by the Convention, aligns with the goal of supporting sustainable development, although this specific concept is not mentioned. Technology can fill in some existing gaps in ocean governance by contributing to the enhancement of observing systems, however, several States face challenges in enforcing monitoring and assessment efforts[90]. UNCLOS promotes measures that facilitate joint cooperation arrangements; the organization of conferences, seminars, and symposia on scientific and technological subjects; and the exchange of scientists and technological experts[91].

Long-term data collection, storage, and processing are usually expensive and time-consuming, often conflicting with States' short-term interests and lack of willingness to enforce marine laws[92]. The Convention recognizes the role of science in supporting peace, economic benefits, and the protection of marine environment and resources. It suggests that the State's policy

[86] UNCLOS, Article 251.

[87] UNCLOS, Article 252.

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As defined by the Guideline, marine technology includes information and data; manuals, standards, references; sampling, methodology, observation facilities and equipments; softwares; and expertise, knowledge, skills, and analytical methods, related to marine scientific research and observation[100]. The transfer of marine technology, facilitated by legal, institutional, financial, and scientific schemes, allows parties to the Convention to benefit on an equitable basis for the development of ocean activities and policy design at all levels.

IOC-UNESCO is further empowered to undertake numerous activities to enforce strategic planning and implementation of the Guideline, considering cooperation frameworks, existing bodies and fora, and relevant timelines. The assessment of projects, donors, grants, sources of information, cruises, experts, and other elements became an important task defined by this Guideline to orient the development of ocean science dedicated to policy in the subsequent years.

From this point, States and all kinds of stakeholders recognized information on the status of the marine environment and its resources as the basis to safeguard them for present and future

General Assembly during this period. These reports were selected for encompassing the priorities in the discussion of ocean-related topics relevant to all parties to the Convention and member States of the United Nations (UN). Contributions from UN agencies, programs, and bodies, as well as other intergovernmental organizations to the report of the Secretary-General on oceans and the law of the sea to the sessions of the General Assembly released during the same timeline, were not analyzed for this thesis.

Twenty-three reports (i.e. an average of 2.3 per year) were identified, and mentions of specific keywords related to ocean science (i.e. 'science,' 'scientific,' and/or 'knowledge') were surveyed in their texts. These keywords served as indicators of direct and indirect references to potential contributions of ocean science to the reported content. Occurrences of the keywords were documented, and the paragraphs containing one or more mentions of these terms were submitted to a content analysis for the identification and codification of their main narratives. Titles and footnotes were excluded from this analysis. To provide an overarching view of each year's findings, the frequency of mentions for each term was aggregated.

The period analyzed was selected to comprise a timeline of a decade of discussions and also to comprehend the launching of important milestones to the ocean agenda, such as the SDGs in 2015, the UN Ocean Conferences of 2017 and 2022, and the beginning of the UN Decade of ocean science for Sustainable Development in 2021.

Not all reports included references to every selected keywords, but discussions regarding ocean science consistently took place every year (Figure 2) during the General Assembly Sessions. The themes chosen for deliberation within the United Nations Open-ended Informal Consultative Process (ICP) on Oceans and the Law of the Sea[103] (Table 1) of each year directed influenced the subjects addressed by the Reports of the Secretary-General. This was expected as the establishment

2019	Ocean Science and the United Nations Decade of Ocean Science for Sustainable Development
2018	Anthropogenic underwater noise
2017	The effects of climate change on oceans
2016	Marine debris, plastics and micro-plastics
2015	Oceans and sustainable development: integration of the three dimensions of sustainable development, namely, environmental, social and economic
2014	The role of seafood in global food security
2013	The impacts of ocean acidification on the marine environment

	all levels.	sectors and disciplines across the ocean.	Conventions and their related processes.

Figure 3. Frequency (in %) of narratives of ocean science mentions in the context of the identified codes ('Resource management'; 'Environmental protection'; 'Sustainable development'; 'International cooperation'; 'Stakeholder engagement'; 'Legal frameworks'; 'Other'), from 2013 to 2023.

Subsection B.2: Ocean Science for International Cooperation

In 2012, Heads of State, Government and high-level representatives, and members of the civil society convened in Rio de Janeiro, Brazil, for the United Nations Conference on Sustainable Development (Rio+20). This Conference marked an important moment, reaffirming a collective commitment to a just, equitable, and inclusive sustainable development, as expressed in "The Future We Want" Declaration[105].

In this declaration, participating States shared a common vision, emphasizing the recognition of economic, social, and environmental interlinkages. The goal was to address emerging challenges, promote sustained economic growth, and foster equitable social development for present and future generations while managing natural resources and ecosystems that support them[106]. Rio+20 gave rise to a compelling narrative for an institutional framework for sustainable development. Building upon prior political commitments (e.g. the 1972 United Nations Conference on the Human Environment; the 1992 United Nations Conference on Environment

decade (2013-2023). In the “The Future We Want” Declaration, States emphasized the need for cooperation in marine scientific research and transfer of marine technology to implement UNCLOS provisions and support capacity development to improve conservation and sustainable use of the ocean, seas, and their resources.

The impact of these statements resonates in the Reports of the Secretary-General for Sessions of Oceans and the Law of the Sea in the General Assembly of the United Nations in the subsequent years. By recognizing the role of science in fostering international cooperation and stakeholder engagement for ocean governance and sustainable development, collaborative approaches in the science-policy interface have been encouraged to bridge technology and capacity gaps.

Investments in ocean science, once primarily a domain of study and discovery, shifted to resource management and environmental protection solutions. It is possible to identify in the Secretary-General Reports that ocean science has always played an articulating role in the context of multilateral agreements. The post-Rio+20 reports highlighted interdisciplinary research issues (e.g. fisheries, climate change, ocean acidification) that imply the need for a comprehensive approach to observation and research, standardize methodologies, spatially distributed and temporally intensive studies, and systems to maintain and share relevant data. By recommending that research and technical programs have a stronger impact in terms of societal benefits, safety, protection of the marine environment, and technological innovations, States called for a facilitated flow of information between governments and data-producing stakeholders, enabling the exercise of precaution and mitigation strategies.

In 2013, there was a recognized need for comprehensive information on the negative impacts on ocean health at the ecosystem level, including the interaction of multiple local and global stressors. With numerous unknown variables, modeling limitations, and scarce assessments undertaken regarding climate change impacts on the ocean, for example, a call was made for system-wide coherence and synergy in ocean matters. The aim was to collectively work towards the common goal of ensuring healthy oceans for prosperity. By strengthening ocean-related knowledge, ocean science was also expected to facilitate informed policy decision-making on sustainable development issues and, in this regard, to foster the science-policy interface.

In the Secretary General Reports from 2014, States recalled the Rio+20 Declaration and reiterated that while some progress was made towards greater social, and environmental

sustainability and responsibility in certain sectors, information regarding the cumulative pressures on the marine environment was still limited and not always accessible to decision-makers. In this year's reports, it is possible to identify several references to ocean science's potential to contribute to the implementation of existing legal frameworks and regimes, particularly the Convention, including the bodies established by it. By understanding and better managing human interactions with marine ecosystems, it is expected that predictions and responses to natural events are more effective, appropriate, and easy to internalize in different policies and arrangements, in accordance with international law.

The implementation of global and regional instruments and management tools designed to give effect to the provisions of the Convention has been accompanied by the development of science and technical guidelines in several areas. The production of policy-relevant science to contribute to eliminating poverty, ensuring food security, protecting the marine environment and predicting, mitigating and responding to the impacts of natural events and disasters, requires attention to the connection between land and ocean and activities that happen in this interface. An effective application of marine scientific knowledge and technology in an integrated manner poses a challenge to the development of appropriate national and regional approaches to ensure that decisions are based on ocean science.

In light of the critical role of technological capacity in achieving development and benefiting from the ocean and its resources, the Secretary General Reports from 2015 underscore the need for the transfer of technology, as outlined in the Convention. Initiatives such as the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects (so-called Regular Process) reflect the growing awareness of the need for a robust science and policy interface and global marine assessments to facilitate informed decisions and the monitoring of the resultant actions. The Regular Process, which is underpinned by ocean science, completed its first cycle in 2014 and released the World Ocean Assessment I in 2015[108]. This first global integrated marine assessment was an effort to harmonize the dimensions of sustainable development, involved a diverse set of stakeholders, and intended to support the General Assembly's review of ocean-related issues.

[108] A/70/112.

In the context of the SDGs, ocean science is recognized as an essential means of implementation for achieving integration, sustained and inclusive economic growth, social

for Sustainable Development (i.e. Ocean Decade) for the 10-year period between 2021 and 2030[117]. This marked the first time the United Nations dedicated a thematic decade to the realm of science. As a global campaign coordinated by the Intergovernmental Oceanographic Commission (IOC-UNESCO) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Ocean Decade also demanded stakeholder engagement to connect the efforts proposed by SDG 14 and other ocean governance instruments, while also advancing the necessary capacity-building to democratize and keep pace with the state of science, and technological innovations.

With the Ocean Decade proclamation, the General Assembly played a crucial role in supporting a comprehensive, cross-sectoral overview of the ocean and the law of the sea, fostering the momentum and action necessary to significantly advance ocean science for the benefit of the ocean and society within the framework provided by the Convention[118]. In 2019, the United Nations Open-ended Informal Consultative Process (ICP) focused on ocean science[119], highlighting the concern of ensuring that science is responsive to the needs of policymakers and other stakeholders. In this period, the scaling up of interdisciplinary efforts and the identification of synergies among existing initiatives and different types of knowledge were recognized as significant steps to advancing ocean science.

After 2019, international cooperation, in its many different forms, became the major topic related to ocean science, as addressed by the Reports of the Secretary General. Cooperation in this context was frequently present during the past decade, but the integrative nature of the 2030 Agenda and the Ocean Decade provided opportunities to identify critical research priorities through a more coordinated international research agenda[120].

International partnerships in Ocean Science are an important strategy for more effective resource use and inclusive participation, reinforcing scientific findings in policy formulation[121]. The stroke of the COVID-19 pandemic in 2020 significantly disrupted international cooperation, leading to the cancellation or postponement of research activities and key events, such as the

[117] https://www.un.org/sustainabledevelopment/blog/2017/12/un

Agreement is a commitment to the effective implementation of the relevant provisions of the Convention, and it stands out as a case of science diplomacy, underlining the need for internationalized sciences to enforce management proposals grounded in the best available science, traditional knowledge of Indigenous Peoples and local communities, while incorporating the precautionary and ecosystem approaches[125].

The Secretary General Reports from 2013-2023 highlighted the exponential attention dedicated to ocean science over the past decade, punctuated by several relevant events, documents, commitments, and agreements aimed at enhancing the quality and consistency of decision-making based on science. By leveraging ocean science as a catalyst for international cooperation and stakeholder engagement, the inherent challenges of multilateralism and the human aspects of ocean governance assume a growing role in sustainable development, on both regional and global scales.

Chapter 2: Science-policy interface

Section A: Science Diplomacy as a tool for ocean governance

Subsection A.1: Ocean Science Diplomacy

Science, with its diverse approaches, has played multiple roles in society, shaping perspectives on natural resources exploration, and reinforcing a colonial and imperialist knowledge paradigm[126]. Associated with the idea of progress, control of nature, predictability, and efficiency, science has often functioned as a tool of power, claimed to be apolitical[127]. The authority of science, advising while decisions are made by state representatives[128], created an idea

[125] A/CONF.232/2023/4.

[126] Alexandre Wadih Raffoul, "Listen to the science! Which science? Regenerative research for times of planetary crises", *Frontiers in Sustainability*, vol. 4 (2023). Available at: htt(henceETQ/nce/doQie)4.orgtt(/e)42178a

of scientific neutrality and detachment from subjects, reinforcing the interests of major players, and the invisibility of some regions and groups, typically vulnerable to environmental changes[129].

Nevertheless, as scientists increasingly receive incentives to influence policymaking and are urged to create impactful contributions from their research[130], the boundaries between knowledge production and decision-making are becoming more porous. Concepts like transdisciplinary science, regenerative research[131], science activism[132], and Science Diplomacy[133] reflect this growing demand to make knowledge and information more prominent in the public debate, acknowledging the political implications of the global environmental emergency.

Several strategies exist for positioning science as a responsible agent in addressing public and environmental challenges while maintaining its principles of credibility, ethics, and relevance[134]. The scientific community often collaborates across national borders to address issues of common interest and has actively participated in policy-relevant spaces, supporting innovative diplomatic alliances among nations, sectors and non-governmental organizations n4(innov2ct)-83(this)-79(growing)-86(de)4(r

policy objectives; *diplomacy for science*, facilitating international science cooperation in foreign affairs; and *science for diplomacy*, utilizing science cooperation to enhance international relations between countries[138].

epistemic communities, disciplines, and types of knowledge at the science-policy intersection can build responsible and democratic dialogues with policy-making[146].

At the same time, the tools, techniques, and tactics of international relations are under pressure to adapt to a world characterized by increasing scientific and technical complexity and global environmental challenges[147]. In-depth information forms the basis for the use, management, and governance of the ocean[148]. Effective ocean policies need to consider multisectoral perspectives and disciplines to be able to integrate global change dynamics and interactions[149]. Science diplomacy facilitates the coordination of efforts and the co-investment in the assessment of information at the oceanic scale[150].

Proactive efforts in quality knowledge production and science diplomacy for governance are indispensable for fostering innovation and driving transformative change, ensuring the sustainable development of the ocean[151]. Challenges and commitments identified at major conferences, summits, and global sustainability initiatives in recent years are interrelated and demand integrated solutions grounded in the best available knowledge[152].

Although ocean science diplomacy has largely been overlooked in marine science and ocean policy academic literature[153], forms of diplomacy and science that operated beyond national borders were necessary for expansive fisheries activities, coastal development, and political

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[146] Alexandre Wadih Raffoul, "Listen to the science! Which science? Regenerative research for times of planetary crises", *Frontiers in Sustainability*, vol. 4 (2023). Available at: https://doi.org/10.3389/frsus.2023.1115238.

[147] *New frontiers in science diplomacy: Navigating the changing balance of power*, American Association for the Advancement of Science (AAAS) and the Royal Society of London Policy document 01/10 (2010).

[148] Anna-Katharina Hornidge, Stefan Partelow and Kerstin Knopf, "Knowing the Ocean: Epistemic Inequalities in Patterns of Science Collaboration" in *Ocean Governance, Knowledge Systems, Policy Foundations and Thematic Analyses*, Stefan Partelow, Maria Hadjimichael, and Anna-Katharina Hornidge eds (MARE Publication Series, volume 25; Cham, Switzerland, Springer Nature, 2023). Available at: https://link.springer.com/chapter/10.1007/978-3-031-20740-2_2

[149] Joachim Claudet and others, "A Roadmap for Using the UN Decade of Ocean Science for Sustainable Development in Support of Science, Policy, and Action", *One Earth*, vol. 2, No. 1, p. 34-42 (2020). Available at: https://doi.org/10.1016/j.oneear.2019.10.012

[150] Andrei Polejack and others, "Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance", *Humanities and Social Sciences Communications*, vol. 8, No. 52 (2021). Available at: https://doi.org/10.1057/s41599-021-00729-6

[151] A/78/339.

[152] A/RES/70/1.

[153] Andrei Polejack and others, "Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance", *Humanities and Social Sciences Communications*, vol. 8, No. 52 (2021). Available at: https://doi.org/10.1057/s41599-021-00729-6.

contexts throughout the twentieth century[154]. The negotiation process of UNCLOS itself relied on the available information about the marine environment and the power exercised by States that had more access to scientific knowledge to guide the discussions[155]. Numerous examples illustrate how ocean science is essential to implement the Convention, from explicit provisions of Parts XIII and XIV, to dispute settlements and maritime delimitation[156].

More recently, the inclusion of the ocean in the climate and biodiversity agenda can reinforce ocean affairs' vocation to international cooperation and diplomacy. Discussions in

exemplify the broad recognition of ocean science in international cooperation, negotiation, and

of environmental governance[169]. These efforts evolved into solution-ori
frameworks[170], establishing a shared knowledge basis of high legitimacy amo
outcomes of assessment processes not only offer perspectives on issue prio
resource allocations, garner social adherence, influence policy-makin
the capacity of institutions and stakeholders at the science-policy in

approach, addressing the complexity of informing the decision-makers and citizens in general about ocean-related subjects[184].

Given the increasing risks associated with climate change, loss of biodiversity, marine pollution and social injustices, regular scientific assessments of the state of the marine environment are essential for enhancing the scientific basis for ocean governance[185]. Aligned with a growing international scientific research agenda, assessment efforts now aim to embrace transdisciplinary research with co-design and co-production of multidisciplinary science[186]. This is coherent with the demand for a plural, equitable, and inclusive dialogue in ocean science activities, seeking broader and more representative scientific experiences and interpretations for transformative ocean governance [187].

Getting to know the ocean means acquiring valuable knowledge about the functioning of the planet, and necessary information for addressing global challenges[188]. Open access to ocean

applicability and legitimacy[191]. Considering the ocean's inherent complexity, policymakers should regularly revisit policies and adapt management practices[192]. Synchronizing assessments to support this flexibility poses a significant challenge.

In this context, the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects (Regular Process) aims to establish a new form of integrated assessment that is global in scope and comprehensive in its coverage of issues. Focusing on the socioeconomic causes and consequences of marine environment degradation, the Regular Process produces the World Ocean Assessments (WOA), providing a scientific basis and rationale for policy development, integrated management planning, and the sustainable development of coastal and marine areas[193].

Established in 2002[194], following the recommendations of the United Nations World Summit on Sustainable Development held in Johannesburg, South Africa[195], the Regular Process is mandated to strengthen the science-policy interface, in close collaboration with Member States, relevant organizations and agencies and programmes of the United Nations system, other competent intergovernmental organizations and relevant non-governmental organizations[196].

Since 2004, the Regular Process executed two full cycles (2010-2014; 2016-2020) that involved several activities and experts in outlining, producing, and reviewing WOA I and WOA II[197]. Both processes included capacity building steps, regional workshops, mobilization of funding mechanisms and meetings in conjunction with the United Nations Open-ended Informal Consultative Process. Under the recommendations of the General Assembly, the Regular Process had grown in complexit8 32.mto cal o

the first IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, launched in 2019[198].

In its current third cycle (2021-2025), the Regular Process includes a coherent capacity-building programme aimed at strengthening the ocean science-policy interface at multiple levels. Building on existing mechanisms and lessons learned from WOA II[199], the ongoing assessment is aligned with the contemporary demands for ocean governance, such as climate change, marine biodiversity, the Sustainable Development Goal 14, the UN Ocean Science for Sustainable Development, and the UN Decade on Ecosystem Restoration[200].

The General Assembly encourages that the Regular Process, the Global Sustainable Development Report, and those prepared under the IPCC, and the IPBES, support one another and avoid unnecessary duplication[201]. Key systems such as the Global Ocean Observing System; the Census of Marine Life and its Ocean Biogeographic Information System (OBIS); the Global Coral Reef Monitoring Network; the UN Atlas of the Oceans; and the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), have been helping to narrow the collaboration between the scientific and the policy-making community[202].

Amidst various global efforts to assess and monitor ocean parameters over the past decades (e.g. Global Environmental Outlook; Global International Waters Assessment; Millennium Ecosystem Assessment; reports of the High Level Panel for a Sustainable Ocean Economy), science is utilized within a context of collective mobilization and policy action to address a universal challenges[203]. Performing the assessments at the same time as ideas, behaviors, policies,

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198 *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC, 2019). H.-O. Portner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer, eds. (Cambridge University Press, Cambridge, UK and New York, USA, 755 pp. 2020). Available at: https://doi.org/10.1017/9781009157964.

199 *Lessons learned from the second cycle of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects* (United Nations publication, 2020).

200 A/78/339.

201 A/RES/75/239.

202 Kyle Fawkes and others, "Learning from experience: what the emerging global marine assessment community can learn from the social processes of other global environmental assessments", *Anthropocene Coasts*, vol. 4, No. 1 (2021). Available at: https://doi.org/10.1139/anc-2020-0018.

203 Joachim Claudet and others, "A Roadmap for Using the UN Decade of Ocean Science for Sustainable Development in Support of Science, Policy, and Action", *One Earth*, vol. 2, No. 1, p. 34-42 (2020). Available at: https://doi.org/10.1016/j.oneear.2019.10.012

research in the field of marine technology”[209]. To comprehensively assess the broader status and

To provide guidance during this period, in 2020, the General Assembly endorsed an Implementation Plan for the UN Ocean Decade[224]. This plan emerged from an extensive consultative process conducted by IOC-UNESCO between 2018 and 2020. The strategy co-designed by an Executive Planning Group of nineteen ocean science stakeholders, who organized a series of global, thematic and regional planning meetings involving approximately 2,000 participants from the scientific community, governments, UN entities, NGOs, private sectors and donors worldwide. From 2019 and 2020, the zero draft of the Implementation Plan was submitted and analyzed by numerous institutions, and its final version was reviewed by Member States of the IOC-UNESCO and UN-Oceans[225]. In an explicit display of international cooperation, the scoping phase of the UN Ocean Decade assessed disciplinary understandings of ocean processes and proxies that should be considered in a solution-oriented research agenda for ocean governance and sustainable development.

The UN Ocean Decade is also entitled to support numerous UN entities in fulfilling their ocean-related responsibilities. Furthermore, it anticipates the active engagement and collaboration of multiple stakeholders beyond their traditional communities of practice. Within the UN Ocean Decade framework, partnerships, voluntary commitments, treaties, conferences, and intergovernmental initiatives focused on ocean health are recalled to reiterate the essential need for cooperation[226].

The Implementation Plan recognizes the UN Ocean Decade as a campaign promoting multilateralism and interdisciplinary in ocean sciences. This audacious movement, focusing on a highly visible, shared, global effort built upon scientific achievements, might appear straightforward due to its captivating approach and its non-prescriptive nature in setting ocean policy. However, the Decade operates within a complex framework that invites the international community to experiment and learn how to prioritize the ocean in the global environmental agenda. The concept of "the ocean we want" is articulated through seven expected outcomes, illustrating both the desired state of the ocean (Outcomes 1 and 2) and the desired state of society's use of and

[224] A/RES/75/239.

[225] Song Guan, Fangyuan Qu, and Fangli Qiao, "United Nations Decade of Ocean Science for Sustainable Development (2021

interaction with the ocean (Outcomes 3 to 7). In all these outcomes, science is called upon to contribute to mitigating environmental challenges.

Outcome 1 envisions a *clean ocean* where sources of pollution are identified, reduced, or removed. Science-driven solutions, co-designed by multiple stakeholders, are expected to address

From the narrative created by the expected outcomes, the UN Ocean Decade Framework established major challenges to be tackled during this period. These challenges are designed to guide stakeholders in partnership efforts, ensuring that the proposal of the Decade is objectively met and science contributes to the 2030 Agenda and other policy structures. The ten challenges were distilled from discussions with stakeholders throughout the scoping phase of the UN Ocean Decade. They also represent scientific research priorities, encompassing social, economic and political science disciplines as well as indigenous and local knowledge.

Challenge 8: Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering and visualizing past, current and future ocean conditions in a manner relevant to diverse stakeholders.

Challenge 9: Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders.

Challenge 10: Ensure that the multiple values and services of the ocean for human well-being, culture and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step ith the ocean.

In order to fulfill the challenges, a multistep, iterative and cyclical process was designed based on three objectives: (i) the identification of knowledge that is required for sustainable development; (ii) the generation of the data, information and knowledge for the development of a comprehensive understanding of the ocean, its components and its interactions; and (iii) the use of the generated knowledge and understanding of the ocean to deploy solutions for sustainable development.

The responsibility for achieving these objectives and addressing the challenges outlined in the expected outcomes is shared among stakeholders. Over this hierarchical framework, the UN Ocean Decade urges for a substantial investment and expansion of ocean science activities. While the primary actors are the ocean science community, the UN Ocean Decade invites beneficiaries or audiences from all sectors to propose actions to be endorsed and to contribute to the Decade implementation. Thus, engagement with this process can occur at multiple levels and at an autonomous pace. However, there is a learning curve to understand which elements of the framework serve as the ideal entry point, depending on the sector or interest.

The governance system operating within this framework involves bilateral cooperation agreements among UN entities focusing on science-policy aspects, technical, scientific and capacity development collaboration. The Implementation Plan provides models for the establishment of Units, Coordination Offices, Decentralized Structures and Collaborative Centers

Part 2: Seascape of ocean governance in Brazil

Chapter 1: The Brazilian ocean governance context

Section A: *The ocean agenda in Brazil*

Subsection A.1: Guiding instruments for ocean governance and science in Brazil

Coastal and marine resources are of fundamental importance to Brazil, both to the economy of the country - enlisted as the ninth economy of the world[231], and to the relationship of Brazilians with the environment[232]. Maintaining and ideally improving conditions for ocean health and the protection of communities that use and depend on the ocean territory is a major challenge for the country[233]. Ocean governance in Brazil and the instruments and stakeholders that support it are sectorial, and although overlapping, they lack in integration and adequate planning, enforcement, and agency[234].

The Brazilian coastal zone encompasses about 8,000 km of extension, and it is home to diverse tropical ecosystems (e.g. mangroves, coral reefs, sandy beaches), 443 municipalities, and nearly 25% of the Brazilian population[235]. Since the late 1980s, the Brazilian Federal Constitution

execution of public environmental policies but also reinforced the imperative to incorporate the ocean and coastal zones into the new legal and institutional framework

Resources underwent an update in 2005[239]. Since then, it has served as the guiding force behind the development of several legal instruments for coastal and ocean governance in Brazil.

The overarching aim of the National Policy for Marine Resources is to provide direction for the responsible use, exploration, and exploitation of living and non-living resources within the Territorial Sea, the Exclusive Economic Zone, and the Continental S

It places significant emphasis on the development of systems for collecting and monitoring oceanographic, climatological, geophysical, geological, and biotechnological data. This data processing is especially pertinent to large ocean basins, the potential of marine organisms, climate variations, ocean circulation, the impact on marine living resources such as fish stocks, and the tracking of global environmental changes.

Moreover, this policy serves as a platform for establishing conditions for international collaboration in research, exploration, and the responsible use of marine resources within maritime zones under national jurisdiction. This coll

policies inspired by experiences in managing vulnerable ecosystems and valuable natural resources in coastal and ocean environments. These experiences have played an important role in consolidating the country's environmental laws and legal regulations[241]. With the establishment of the National Policy for Marine Resources and the National Environmental Policy, the creation of a National Plan for Coastal Management was mandated by law in 1988[242] to guide sustainable development in Brazil's coastal zone. Its first version was presented in November 1990[243] and was later succeeded by a second version approved in 1997[244], published as a Decree in 2004[245]. This second version remains in force in 2023 and considers insights from several significant discussions over the last two decades of the 20th century, including the United Nations Conference on Environment and Development (Rio-92), the 21 Agenda, and other experiences from UNCLOS by that period.

The coverage area of the National Plan for Coastal Management encompasses the territorial sea and the adjacent strip of the continent. This strip comprises municipalities that experience direct influence from phenomena occurring in the coastal zone, and include municipalities situated along the coast; those located within coastal metropolitan regions; municipalities adjacent to large cities and coastal state capitals; municipalities within 50 km of the coastline, where significant activities or infrastructure with substantial environmental impacts on the coastal zone or highly relevant coastal ecosystems are located; estuarine-lagoon municipalities, recognizing the

government and between government entities and society[246]. This decentralization is important for operationalizing the multitude of policy instruments set forth by the plan, which adds to the complexity of ocean governance in Brazil.

These instruments rely on systematic data collection and information systems to provide the foundation for the design of state and municipal policies, plans, and programs. The delineation of responsibilities, institutional procedures, and standards to govern these instruments is directly linked to the human resources and scientific endeavors indicated by the National Policy for Marine Resources. The generation of environmental quality reports, strategic zoning, and the evaluation of the efficiency and effectiveness of management measures and actions underscore the role of science in ocean governance in Brazil. This highlights the need for scientific contributions to be integrated into all mechanisms and forums, reinforcing the entities directly engaged in coastal and ocean management, as stipulated by the National Plan for Coastal Management.

Within the framework of the three major public policies mentioned (i.e. the National Environmental Policy, National Policy for Marine Resources, and the National Plan for Coastal Management), scientific and technological development agencies, as well as teaching and research institutions, are designated as essential contributors to the integration, advancement, and enhancement of ocean management and governance. The generationf(tr1a8)4(l 500000 Ge00912 0 612 792

The 2023 Decree specifies that the composition of CIRM includes representation from various authorities beyond the aforementioned ministries. These authorities include the Civilian House of the Presidency of the Republic; Ministry of Agriculture and Livestock; Ministry of Education; Ministry of Sports; Ministry of Integration and Regional Development; Ministry of Justice and Public Security; Ministry of Planning and Budget; Ministry of Ports and Airports;

The Brazilian Continental Shelf Survey Plan serves as a strategic instrument designed to outline critical measures to integrate the Territorial Sea and Continental Shelf into the Brazilian domain. It prioritizes the rational exploitation of ocean resources and energy sources, vital for the country's economic and social development, as well as national security interests. In light of Brazil's intentions to determine the outer limit of the continental shelf extending beyond 200 nautical miles, this policy envisions the active involvement of scientists and specialists from universities and the private sector to undertake the necessary tasks to achieve this goal.

CIRM assumes a central role in coordinating and overseeing initiatives associated with the Brazilian Continental Shelf Survey Plan. The policy outlines that every Ministry represented at CIRM holds the potential for involvement, with a particular focus on the Ministries of Defense (via the Brazilian Navy), Foreign Affairs, Education, Mines and Energy, and Science, Technology, and Innovation[254]. These ministries house specialized bodies and scientific secretariats tasked with guiding CIRM in matters pertaining to the planning and supervision of activities related to the continental shelf.

The Sectoral Plan for Marine Resources (PSRM, acronym in Portuguese), a direct outcome of the National Policy for Marine Resources, undergoes periodic updates every four years. In its tenth edition (2020-2023), the PSRM is designed to manage research activities to meet the demand for information in Brazil's jurisdictional waters, islands, oceanic regions, and international maritime areas of interest. Its primary objective is to provide the necessary information and conditions for the sustainable development and effective monitoring of the nation's maritime space[255].

The tenth PSRM explicitly commits to promoting the advancement of ocean science, technology, and innovation to comprehend the potential of marine resources, both living and non-living, as well as environmental monitoring of the ocean, marine biodiversity, the adjacent atmosphere, and climate. It emphasizes the importance of capacity building and indicates that ocean literacy and the blue economy play a role in enhancing the quality of life and the well-being of the Brazilian population. Investment in sci

This policy also highlights imperative efforts to reinforce the implementation of marine spatial planning in Brazil and underscores its commitment to achieving aspects of the 2030 Agenda related to the ocean and coastal areas. The PSRM positions itself as a communication tool to engage with society, aligning with national policy guidelines and economic and social development strategies. Its structure is designed to promote and integrate multidisciplinary activities, fostering collaboration among diverse stakeholders and harnessing the collective efforts of various entities represented at CIRM, along with its programs and national and international partnerships.

Within the PSRM, specific indicators and products are identified to advance research and facilitate the transfer of marine technology. It emphasizes the necessity for a contemporary and robust research infrastructure to propel the growth and consolidation of ocean knowledge. Additionally, the policy advocates for the establishment of National Institutes of Science and Technology in Ocean Sciences, the mobilization of funding bodies, and the deployment of oceanographic ships and vessels for data acquisition.

The policies and instruments mentioned above explicitly acknowledge the principle of inter- and intrainstitutional integration, reinforcing the importance of ocean science in supporting coastal and ocean management in Brazil. However, these principles, along with the existence of CIRM, do not, by themselves, guarantee effective interactions and connections among various governance components, such as policies, norms, responsibilities, and participation.

These significant tools are either comprehensive in their scope or currently undergoing updates to incorporate references to the 2030 Agenda, blue economy, the impacts of climate

on ecosystems of the Tropical and South Atlantic, as well as guide the sustainable exploration of fishing, aquaculture and biotechnology resources. To make that happen, the plan indicates the need to support institutional partnerships and multidisciplinarity among existing projects, research groups, and networks, both nationally and internationally, to bridge their gap with public policy design and innovative solutions to sustainable development.

For the development of science related to coastal areas and the continental shelf, the Plan proposes a focus on understanding and quantifying the current health of the coastal zone, its ecosystems, and processes. It suggests establishing an integrated observation system to provide the academic community, industry, public sector, and society with essential information for the advancement of knowledge and effective management. The plan underscores the importance of supporting data collection by various projects, networks, and research groups already in operation, highlighting the necessity for continuous partnerships in information acquisition to encourage the integration of actions across different national programs.

Ocean circulation, ocean-atmosphere interaction, climate variability, and change, are united in a main thematic area that aims to diagnose the causes and formulate future projections on climate processes. Brazil is vulnerable and still underprepared to cope with the consequences of environmental change, and the plan recognizes the significance of reliably anticipating meteorological and oceanographic conditions. This anticipation can contribute significantly to reducing the impacts of extreme events and global changes in the country. Maintaining

The final major thematic area addressed by the Action Plan is dedicated to technology and infrastructure for oceanographic research. The Plan recommends *in situ* and satellite data collection to stimulate the development of new technologies and research platforms that align with Brazil's interests. Recognizing the importance of technical expertise, the plan emphasizes the need to leverage the current available structure and build strategic national and international partnerships with stakeholders supporting the expansion, development, industrialization, and maintenance of instruments required for oceanographic research. In this context, the Plan indicates the establishment of the National Institute for Oceanographic and Waterway Research (INPOH, acronym in Portuguese), an organization to lead the implementation of ocean thematic programs in cooperation with institutions, universities, and innovative technology-based companies across Brazil.

Officially created in 2023, INPOH joins other institutes of national scope tasked with consolidating science, technology, and innovation in strategic areas for Brazil's development. While its operation is still uncertain, it indicates the potential to gather all thematic areas outlined by the Action Plan on Science, Technology, and Innovation for Oceans. The institute is expected to be multisectoral, connecting with other national environmental mechanisms and stakeholders already entrenched in the Brazilian scientific landscape. INPOH's overlapping with CIRM and its potential to provide information for the implementation of the ocean governance policies and legal instruments in Brazil are also yet to be determined.

The activities and thematic priorities highlighted by the National Strategy and the Action Plan convey a message of a consolidated ocean science capacity in Brazil to guide economic and social endeavors and concerns, considering sustainable development and cooperation. The effectiveness of decision-making is attributed to the science's ability to provide easily and timely accessible information. However, there are fundamental needs pointed out by these documents, such as mapping current research projects and networks and understanding opportunities to build strategic partnerships nationally and internationally. And, it appears that it is up to science to accompany the national interests, rather than guide them at this stage. The role of science

National Strategy. The fragmented systems in which ocean governance and science operate are intertwined and complex. The goal of delivering science-based decisions is clear, but the mechanisms to effectively integrate science into policy processes and influence the national trajectory are intricate.

Subsection B.2: Atlantic cooperation

The Atlantic Ocean borders Africa, Europe, and America, extending from pole to pole and covering about one-fifth of the planet[262]. During the last decades, states of the Atlantic region recognized the potential of joint marine research and innovation as a way to unlock multilateral cooperation and co-produce useful information for the management and utilization of this area. Cooperation in the Atlantic region has also been acknowledged as a platform for the achievement of the Sustainable Development Goals[263] and the implementation of research programs and projects of local and regional scope that contribute to a gain of scale for the oceanic agenda.

Knowledge gaps in the Atlantic region were recognized by states as risks to properly understanding and managing ecosystem services in the region[264]. The challenge of setting priorities and investments for shared ocean resources highlighted the need for international alliances and diplomatic negotiations[265].

Materializing the European Union (EU) efforts and goals from its Integrated Maritime Policy[266], from 2007, and Atlantic Maritime Strategy[267], adopted in 2011, an ocean science coalition statement was signed between the EU, Canada, and the United States in 2013. Called The Galway Statement on Atlantic Ocean Cooperation[268], it is the result of a consultative process and

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[262] *All-Atlantic Ocean Research Alliance A success story of ocean science diplomacy* (European Commision, 2022).
[263] Ibid.
[264] Andrei Polejack and others, "Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance", *Humanities and Social Sciences Communications*, vol. 8, No. 52 (2021). Available at: https://doi.org/10.1057/s41599-021-00729-6
[265] Ibid.
[266] *Integrated Maritime Policy of the European Union* (European Union, 2007)

encourages the co-development of and investment in capacity development, knowledge transfer, data standards, ocean literacy, and sharing of research infrastructure between those states.

The Galway Statement realizes that the signatories face similar challenges in promoting a healthy and well-understood Atlantic Ocean. The three aforementioned instruments proposed by the EU represent an effort to gather fragmented marine policies, practices, and plans in the region[269]. Synergies identified in previous experiences in ocean sciences are valued in the Galway Statement, indicating a continuous and evolved investment in international partnership. Its alignment with EU policies indicates that supporting ocean sciences in the region relies on international cooperation[270].

The cooperation encouraged by the Galway Statement is focused on increasing knowledge of the Atlantic Ocean and its interlinks with the Arctic region, including support to the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects. By enforcing multilateral cooperation frameworks related especially to ocean observation and ocean literacy initiatives for the northern section of the Atlantic, the declaration indicates the potential of its outcomes in contributing to recommend priorities and planning efforts for future cooperation, involving multiple stakeholders in the region.

The implementation of the Galway Statement triggered bilateral arrangements between the European Commission, Brazil, and South Africa. These two states were already involved in the design of the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans[271], also a result of a consultative process of stakeholders in the region[272]. This Framework claims South Atlantic Ocean countries as leaders of joint and individual observational and research endeavors in the South Atlantic region[273].

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[269] Andrei Polejack and others, "Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance", *Humanities and Social Sciences Communications*, vol. 8, No. 52 (2021). Available at: https://doi.org/10.1057/s41599-021-00729-6

[270] Ibid.

[271] *South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans* (Brazil and South Africa, 2017).

[272] Andrei Polejack and others, "Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance", *Humanities and Social Sciences Communications*, vol. 8, No. 52 (2021). Available at: https://doi.org/10.1057/s41599-021-00729-6

[273] *South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans* (Brazil and South Africa, 2017).

Recognizing the importance of existing strategic partnerships on marine research in the context of the South and Tropical Atlantic, and Southern Ocean, the Belem Statement on Atlantic Research and Innovation Cooperation was signed in 2017 by Brazil, South Africa, and the European Union[274], and further joined by Cape Verde, Kingdom of Morocco, and Argentina through Innovation Cooperation Administrative arrangements. This Statement aimed at increasing scientific knowledge of marine ecosystems and their interrelations with climate processes and oceanographic systems from Antarctica to the Arctic. Along with other instruments (e.g. Benguela Current Commission), the Belem Statement outlines the importance of science diplomacy in collaborative scientific exploration to support policy design for the region based on sustained, long-term observations and research.

The Belem Statement is complementary to the South-South Framework and the Galway Statement and encourages new models for cooperation based on the principles of shared responsibility and mutual benefit. Through the investment in the acquisition of information regarding scientific and societal challenges in the region, the States rely on science to indicate and maintain a cooperation framework dedicated to tackling common issues. The participation in this multilateral process is acknowledged by Brazilian policies and plans for ocean governance in the same period.

The connection of major players in ocean science within the whole Atlantic Basin sets this ocean space as a stage for exercising international cooperation and partnerships materialized by both Galway and Belem Statements in a short period of time. Acknowledging the Atlantic role in contributing to regional, national, and global economies, including sustainable and inclusive ocean economies, and in supporting human and environmental health, the principles enhanced from the implementation of those commitments are rooted in the need for accurate, open science and knowledge to inform decisions regarding the considerable challenges faced in the Atlantic region.

Cooperation in ocean science across the Atlantic is the legacy of several ocean science diplomacy movements and processes that earned space at the science-policy interface globally. From the experiences of the cooperation Statements in the region, in 2020, the European Union reviewed its Atlantic action plan within the Atlantic Maritime Strategy, as a way of representing a common vision of priorities for the region. The new EU action plan includes four pillars (i.e. ports

[274] *The Belem Statement on Atlantic Research and Innovation Cooperation* (European Union, South Africa, and Brazil, 2017)

territory also as a forum for the development and strengthening of science and technology, education, capacity-building, consolidation of national institutions, among other topics[281].

In its Eighth Ministerial Meeting, held in Cape Verde, in 2023, members of the ZOPACAS approved a Plan of Action[282], centered on exchanging ocean knowledge and practices. The Plan encourages its Member States to promote capacity building and enhance ocean scientific research of the continental shelves, the high seas, and the Area. The plan highlights cooperation towards sustainable biodiversity-based activities, products, and services,

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All of these instruments for cooperative efforts in ocean science underlie the need for long-term observations and the ability to respond appropriately to the planetary crisis based on those observations[284], which is particularly important for Global South States. This kind of collaboration also intends to address national and global knowledge gaps towards meeting obligations under international agreements like UNCLOS, the Convention on Biological Diversity, the Paris Agreement, and other important instruments for the regional context, such as agreements made in the context of the Food and Agricultural Organization and the International Whaling Commission.

The most recent phase of this process was the signing of the All-Atlantic Ocean Research and Innovation Alliance Declaration in 2022[285], an initiative built upon the existing international efforts of the Galway and Belem Statements in the last decade. Signed by European Union, Argentina, Brazil, Canada, Cape Verde, Morocco, and South Africa, the declaration establishes and unifies a long-lasting All-Atlantic Ocean Research and Innovation Alliance intended to support the sustainable development of the Atlantic Ocean. Innovative and transformative outcomes-81(3(a)e)3( )4(st)-14717(o)5(f 7(b Tm(most)-147)5(roc)7)-14(most)-147seardBT/F3 12 Tf1 0 0 1 4

therefore, understood as an instrument to address imbalances and injustices within the cooperation strategy, an innovative proposal of this new agreement.

Chapter 2: Science to build political robustness for ocean governance in Brazil

Section A: The blue momentum being built in Brazil

Since the United Nations Conference on Sustainable Development in 2012, the Brazilian organized civil society began deliberating a regulatory framework to consolidate existing management instruments for coastal and marine ecosystems in Brazil. In an effort to assess the legislation and policy implementation for the marine environment in Brazil and other countries, the non-

policies aimed at protecting marine resources and biodiversity in Brazil since the 1960s, the legal framework remains legally weak and biologically limited[289]. PNCMar, in this context, mirrors UNCLOS universal, comprehensive, and integrated framework, proposing standards for the management, conservation, and sustainable use of natural resources in the marine environment. This law is intended to be interpreted and applied in accordance with existing national legislation, not as a substitute, but as a proposal for a less fragmented legal regime under the competence of different public entities.

PNCMar aims to promote the shared and sustainable use of associated marine and coastal ecosystems and resources, contributing to the conservation of marine biodiversity. It considers area-based conservation measures to facilitate sustainable, scientific, and technological development, while maintaining and improving the quality and integrity of the marine environment. The bill encourages the consolidation of ocean literacy approaches to enhance public understanding of the ocean ecosystem services and opportunities for blue economy. Grounded in scientific recommendations, PNCMar suggests monitoring, prevention, mitigation, and restoration practices to address negative socio-environmental impacts caused by anthropic activities and stressors.

The PNCMar acknowledges UNCLOS as the foundation framework for other ocean-related treaties ratified by Brazil. These include the United Nations Convention on Biological Diversity; the United Nations Framework Convention on Climate Change; the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat; the International

These international agreements align with Brazil's status as a megadiverse country with significant potential for both ocean economy at industrial and artisanal scales, based on sustainable practices. Brazil is expected to secure environmental legislation that ensures long-term sustainable development, since industrial fisheries, climate change, and land-based activities are the most severe threats to the Brazilian marine environment[290]. Additionally, non-regulated tourism, pollution, and oil and gas exploitation have been associated with adverse impacts on Brazilian

One significant aspect of PNCMar is its proposal for marine spatial planning, advocating for a participatory, integrated, and ecosystem-based approach. This proposal introduces a complex point of discussion within the Brazilian community involved in ocean

activities on resources and the marine environment. PNCMar lists numerous instruments that will

implementing of effective solutions[293]. In a time of unprecedented social,e otieeee

to guide developing nations through the challenges they are bound to encounter in the coming decades as impacts of environmental change intensify[320].

Brazil is committed to a multilateralist approach within the Global South, aspiring to assume a leadership role in South America. Over the past few decades, this strategic stance has positioned Brazil as a key participant in numerous multilateral associations, demonstrating its dedication to fostering connections and collaboration. These include prominent bodies such as the African Union, MERCOSUR, BRICS, IBSA, UNASUR, the South American Defence Council, and the ZOPACAS[321].

Brazil's active involvement in regional technical and scientific collaboration not only enhances its capabilities but also contributes to the collective influence of the region in shaping relevant policy development on both regional and global scales[322]. Particularly within the context of the Global South, the concerted efforts in developing coordinated and joint initiatives play a crucial role in supporting science, and peaceful and equitable regional economies. These initiatives aim to reduce dependencies on both living and non-living resource extraction, aligning with a sustainable and diversified approach to economic development.

[320] Saroj K. Mishra and others, "A need for actionable climate projections across the Global South", *Nature Climate Change*, vol. 13, p. 883–886 (2023). Available at: https://doi.org/10.1038/s41558-023-01778-2.

[321] Maísa Edwards, "When defence drives foreign policy: Brazilian military agency in the revitalisation of the ZOPACAS", *Conflict, Security & Development*, vol. 23, No. 2, p. 179-197 (2023). Available at: https://doi.org/10.1080/14678802.2023.2211536.

[322] *South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans* (Brazil and South Africa, 2017).

CONCLUSION

While this thesis can not cover the full spectrum of how science can be tracked and integrated into ocean governance, it provides analyses that support the potential of the science-policy interface to foster pluralistic understanding, cooperation arrangements, and the enhancement of capacity to manage the ocean at all levels. As science continues to be engaged in ocean governance approaches, States such as Brazil can enable critical-systemic-thinking to support sustainability practices for the future of ocean health.

Over the last decade, there has been an unprecedented surge in ocean discoveries, expanding science frontiers from coasts to the deep sea and governance systems[323]. Nevertheless, the ocean is still underrepresented in sustainable development concepts, which undervalue opportunities for narratives and models based on ocean science[324]. Exercises of knowledge integration to assess unique characteristics, functioning, and power relationships in ocean domains are scarce, and a lot of decisions are made by transposing land-based experiences not tailored for the ocean

systematic data acquisition to support decision-making prevail and hamper any regional and global attempts to coordinate efforts for cooperation in ocean governance[327].

The interpretations of an environment such as the ocean are influenced by local cultures of use and regulatory institutions employed to manage interests and power[328]. These interpretations result from a configuration of society that naturally has different types of knowledge, based on experience or scientific endeavors, applied to support the development of ocean activities. However, there are hierarchies in knowledge production, sharing, and inclusion based on interests, regionalization, funding, power relationships, and the proximity of the science-policy interface.

Knowledge generation and value is unequal across space, time, thematic areas, or disciplines. Social inequalities and power disparities influence how and if knowledge systems are converted into science and how science is utilized in decision-making, politics, and governance. The prospects for effective governance of the ocean will depend on putting into practice improved ideas, methods of cooperation, institutions, and measures of implementation. This is the overriding challenge, concerning the ocean, that confronts humanity with such urgency at the present time. This is the challenge, also, that will be met only by the successful mobilization of grassroots support based on a far greater understanding of the ocean in all parts of the world. It is vital to make the fullest use of human wisdom and creativity, as well as make available the knowledge of scientific communities. Society also requires more responsible governmental action to devise and enact policies that will prudently protect and even enhance ocean quality for present and future generations.

International asymmetries, restricted access to databases,

to join a global movement and infiltrate proposals and incentives for ocean science and governance in domestic processes, it might become easier to pursue ocean-oriented collective goals. A UN-driven action gives remarkable legitimacy and visibility to ocean affairs that could not happen by any single nation or international advocacy group.