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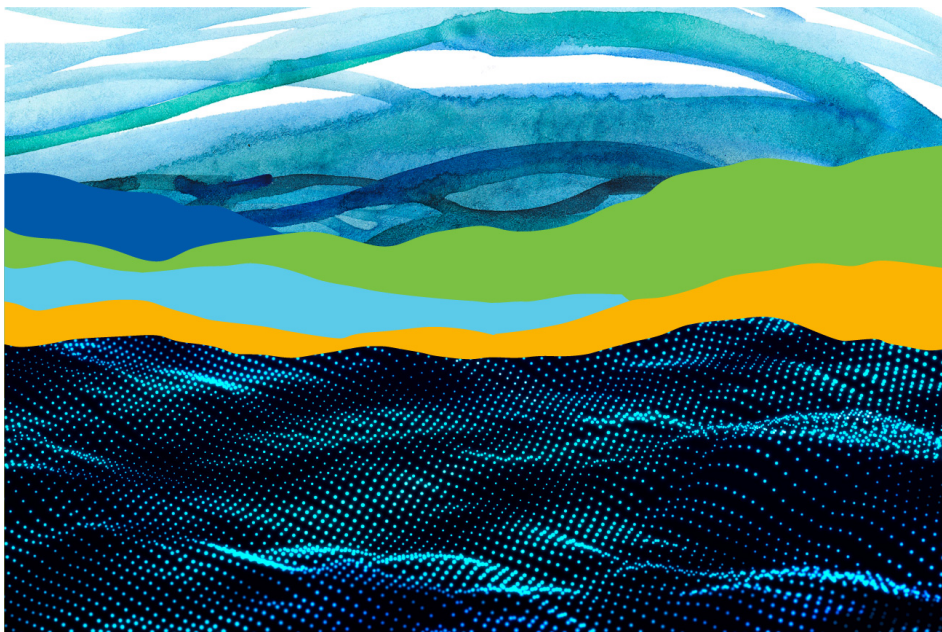
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OCEAN SCIENCE DIPLOMACY
The All-Atlantic Ocean Research Alliance case

by

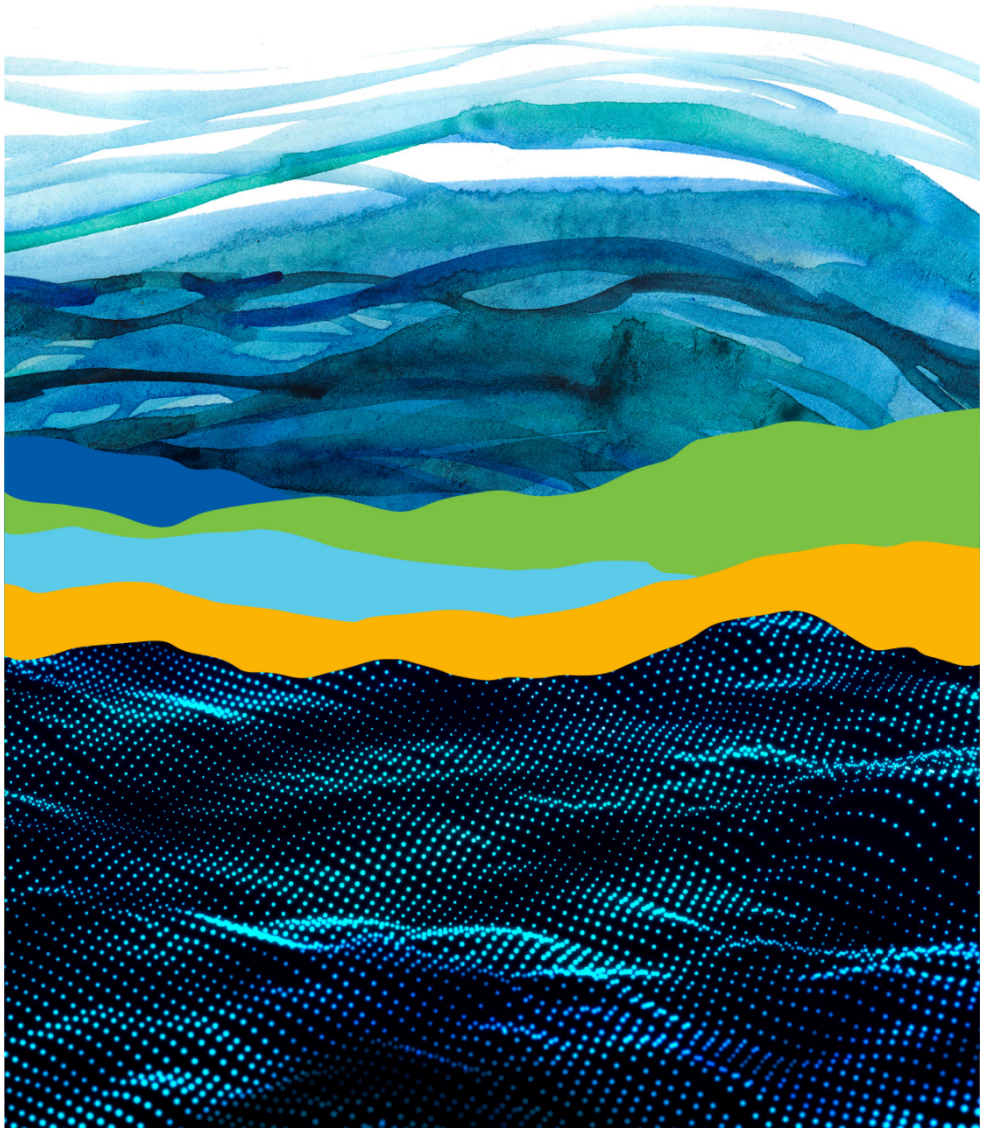
ANDREI POLEJACK



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No. 20, August 2022

OCEAN SCIENCE DIPLOMACY

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Ocean science diplomacy

The All-Atlantic Ocean Research Alliance case

Andrei Polejack
Brazil

A dissertation submitted to the World Maritime University in partial
fulfilment of the requirements for the award of the degree of
Doctor of Philosophy in Maritime Affairs

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No. 20, August 2022

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We are the children of a passionate truth and a truthful passion. We passionately know that reality is not reduced to what exists and that most of what does not exist could and deserves to exist.

– Boaventura de Sousa Santos, p.8 (2016)

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Abstract

Science diplomacy, the interlinkage between research and foreign affairs, is a recent field of research, albeit being claimed to be an ancient practice in international relations. Science diplomacy practices generally include the influence of scientific advice during international negotiations, the bridging of communities (or even conflicting nations) through joint research projects and the promotion of science by diplomatic channels, just to name a few. Largely identified today by mainstream intergovernmental policy-makers as a beneficial practice, science diplomacy is promoted as being rooted in the universality and cooperative nature of science and as a means for peaceful and uncontested international interactions. However, research on the processes underlying the adoption of science diplomacy practices is evaluating how the different imperatives of science and of diplomacy clash in values and expected outcomes. Thus, this study is aimed at exploring and understanding the importance of science diplomacy to ocean affairs, specifically looking at the power play between science and diplomacy in the Atlantic Ocean, utilizing the All-Atlantic Ocean Research Alliance as a case.

This study reflects a stepwise process in unveiling the importance of science diplomacy in ocean governance. The first step was to review the current state-of-the-art on science diplomacy, its practices and scholarship. Second, analyze how science diplomacy is active in ocean affairs, departing from the United Nations Convention on the Law of the Sea and related instruments. Finally, use the All-Atlantic Ocean Research Alliance as a case in time to search for science diplomacy practices. In this journey, the collection of perceptions from researchers and government officials about science diplomacy informed me on the need to address issues of power, capabilities and South-North relationships in the Atlantic.

My ultimate goal was to identify how and why the Atlantic community of practice gives meaning to the use and practices of ocean science diplomacy. To this end, I interviewed both researchers and government officials from the South and North Atlantic involved in the negotiation and implementation of the Alliance. Through a thematic analysis I identified the values perceived by scientists and government officials with regard to ocean science diplomacy, in particular in the context of the UN Decade of Ocean Science for Sustainable Development.

My results indicate that most practitioners were and remain unfamiliar with the available concepts of science diplomacy. There is, however, a common perception of it being positive, relevant and influential to international ocean negotiations. This benevolent perception of ocean science diplomacy in the Atlantic Ocean is further contrasted with different expectations coming from the South and North Atlantic, as well as different perspectives revealed by researchers and government officials.

By applying the theoretical framework of postcolonialism and decolonial thought, I discuss how different meanings of ocean science diplomacy between functional roles (scientists and officials) and regions (South and North Atlantic) cause distinct motivations in engagement. As a result, I advocate that ocean science diplomacy in the Atlantic will only be a driver to unite communities around shared goals and values if common interests are negotiated and achieved, recognizing the colonial past that shapes our understanding of ocean science diplomacy.

Abbreviations

| | |
|--------|--|
| AAAS | American Association for the Advancement of Science |
| BBNJ | Biodiversity Beyond National Jurisdictions |
| COP | Conference of the Parties |
| EU | European Union |
| IEA | Integrated Ecosystem Assessment |
| IPCC | Intergovernmental Panel on Climate Change |
| IOC | Intergovernmental Oceanographic Commission |
| IR | International Relations |
| SROCC | Special Report on the Ocean and Cryosphere in a Changing Climate (from IPCC) |
| UN | United Nations |
| UNCLOS | United Nations Convention on the Law of the Sea |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |

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List of Internationally Peer Reviewed Publications that Form the Core of this Dissertation

- I. Polejack, A. (2021). The Importance of Ocean Science Diplomacy for Ocean Affairs, Global Sustainability, and the UN Decade of Ocean Science. *Frontiers in Marine Science*, 8(March). <https://doi.org/10.3389/fmars.2021.664066>
- II. Polejack, A., Gruber, S., & Wisz, M. S. (2021). Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance. *Humanities and Social Sciences Communications*, 8(1), 52. <https://doi.org/10.1057/s41599-021-00729-6>
- III. Polejack, A., & Coelho, L. F. (2021). Ocean Science Diplomacy can be a Game Changer to Promote the Access to Marine Technology in Latin America and the Caribbean. *Frontiers in Research Metrics and Analytics*, 6(April), 34–36. <https://doi.org/10.3389/frma.2021.637127>
- IV. Muelbert, M. M. C., Copertino, M., Cotrim da Cunha, L., Lewis, M. N., Polejack, A., Peña-Puch, A. del C., & Rivera-Arriaga, E. (2021). The Ocean and Cryosphere in a Changing Climate in Latin America: Knowledge Gaps and the Urgency to Translate Science into Action. *Frontiers in Climate*, 3(November). <https://doi.org/10.3389/fclim.2021.748344>
- V. Polejack, A., Ramírez-Monsalve, P., & Wisz, M. S. (submitted). What does Integrated Ecosystem Assessment mean to research and policy stakeholders working in the Atlantic ocean science diplomacy? Invited contribution to a special issue of *Frontiers in Marine Science*.
- VI. Polejack, A. (submitted). Coloniality in Science Diplomacy – evidence from the Atlantic Ocean. Invited contribution to a special issue of *Science and Public Policy*.

1 Introduction

This work reports on a journey to understand the adherence of science diplomacy to ocean affairs. It was motivated by my own experience in witnessing the progressive use of the term “science diplomacy” in different negotiations among States and communities of practice during my career as a government official at the Ministry of Science, Technology and Innovation of Brazil. The meaning given to science diplomacy in such contexts is usually positive, as a way to achieve greater coordination and cooperation among countries (Skolnikoff, 1993). However, the interaction between science and diplomacy can also be pernicious in the sense of scientific evidence being bent to serve national interests (Flink & Schreiterer, 2010).

Science diplomacy departs from the assumption that science is solely a technical procedure with no inherent political values when, in reality, science can be prestigious and biased (Latour, 1993; Thorp, 2020a). Moreover, diplomacy can promote scientific capabilities as a country’s soft form of power, attracting other countries to attain their foreign policy goals (e.g., House of Lords, 2014). In order to understand the driving forces behind this formulation of science diplomacy, this transdisciplinary research navigates through theories and practices from a diversity of areas, including science and technology studies, sociology, philosophy of science, science-policy interface, and international relations, among others. The work was conducted over the past three years and provides an overview of what I chose to term “ocean science diplomacy”, both a social phenomenon as well as a common practice in global ocean affairs. The following sections take the reader through the line of reasoning behind this research. In doing so, we will explore the two terms that compose the concept of science diplomacy: science and diplomacy. More detail about the current academic debate around science diplomacy will be presented and then related to some contemporary developments and pressing issues in ocean affairs. Finally, the basic features and standard architecture of this study are presented, including the choice of my case study, and the methodological and theoretical approaches followed therein.

1.1 Line of Reasoning

Our journey into science diplomacy needs to depart from its conceptualization, which is done through the use of language. Language drives our comprehension of reality. It is through the exercise of conceptualization that humanity is able to classify reality and adopt a system by which reality makes sense (Calhoun, 2001, p. 92). Conceptualization goes beyond the categorization of concrete and visible objects; it classifies abstractions, subjectivities, and hence values and beliefs. Thus, through concepts, language builds meaning, constituting social identities, relationships, and subjectives (Angermuller, 2014).

Language and concepts change over time and represent specific historical, cultural and social contexts. For example, the conceptualization of science diplomacy within academia has been debated over the past two decades. In this line of thought, which is notably characterized by a predominance of European and American views, science diplomacy is grounded in specific assumptions and values of both science and diplomacy (Fedoroff, 2009; Gluckman *et al.*, 2018; The Royal Society & AAAS, 2010). These specific views tend to promote science as a universal language through which international players are brought together around shared goals (Skolnikoff, 1993). Similarly, diplomacy is promoted as a State-centered peaceful exercise of negotiating compromised terms of action, to a certain extent influenced by the universality of science (Berkman, 2019; Gluckman *et al.*, 2018). This perception of science diplomacy can be understood as a discourse that promotes science as being universal and diplomacy as an active engagement in inter-State and other relations for peace building.

Discourse, as a socially constructed phenomenon, is a debated concept amongst scholars (e.g., Hesselmann, 2019; Laclau & Mouffe, 2001; Stoddart, 2007). In this work, we assume discourse to be a system of signs that use language to express not solely ideas, but also the cultural, historical and social determinants that form those ideas (Paltridge, 2014). Poststructuralists claim that there are multiple simultaneous discourses being disseminated in society, whereas individuals abide by those with better adherence to their own values and beliefs (Braun & Clarke, 2013; Çalkıvık, 2017). Assuming that multiple discourses co-exist in similar social contexts leads to a power relation between them (Foucault, 1972). In this sense, hegemonic discourses are those that seek to exclude other discourses by finding ways to demonstrate moral and intellectual leadership, but also are reinforced by domination and coercion (Gramsci, 1971). As an example, current discourses around science tend to highlight the issue of trust. While some accept science as a reliable source of truth, others challenge modern science, including those with a more extreme resolution to deny certain scientific knowledge, in particular knowledge that does not support their personal beliefs (Cook, Lewandowsky, & Ecker, 2017; Oreskes, 2019; Thorp, 2020b).

Marxists argue that a dominant class, an elite rooted in economic power, is responsible for upstanding hegemonic discourses that are absorbed by lower classes as their own (Stoddart, 2007). In this sense, hegemonic discourses tend to become our common sense, guiding our understanding of the world (Laclau & Mouffe, 2001; Stoddart, 2007). Thus, elites hold the power to dominate the discourse, determining what is true and normative, generally seeking ways to profit from such beliefs (Freire, 2005; Hopf, 1998; Spence, 2007). In this line of reasoning, for instance, we associate certain roles to genders as they were naturally born and not socially constructed. Discourses also frame what a scientist is, what a diplomat should do, what is expected from each of us in terms of productivity, our role in the market, and so on. These hegemonic discourses, according to Marxists, act as tools for oppression by which we relate our individual worth to our role in the market, somehow limiting our individual freedom (Gramsci, 1971). In this sense, science diplomacy is impacted by the modern hegemonic discourses that signify the roles of scientists and diplomats and that drive the way in which they engage and for what purpose. These assumptions on the social roles of scientists and diplomats and the ways through which they interrelate can be seen in current literature that often defines what science diplomats, or the agents of science diplomacy, are in practice (e.g., Melchor, 2020). In accordance with the poststructuralist approach, positioning these two actors in distinct boxes creates a power struggle between them, which can also be extended to the geographical sphere of science diplomacy.

As discussed below, this line of reasoning navigates through language, concepts, discourse and hegemony. This perception has been critical to understanding the theoretical framework underpinning my work. For now, I will explore further the social specificities of both science and diplomacy, referring back to this line of reasoning when presenting my arguments.

1.2 Science

Science is claimed to be a universal language that, through empirical observation and evidence-based testing, is based on replicability, transparency, and merit in search of the truth (Oreskes, 2019; Popper, 1963). Science adopts certain epistemologies. Epistemology is how we come to know what we know, how we assemble information and signify it as knowledge, and to which purposes (Moon *et al.*, 2021). Through the scientific method, scientists evaluate if a given information, one of many possible perceptions of reality, fits the necessary and mutually agreed criteria of what can be called scientific knowledge (Khun, 1962; Popper, 2002). For example, science will accept forms of life to be clustered as a biological species only if an agreed set of criteria are met, that is, as an aggregate of interbreeding populations that are reproductively isolated from other groups, creating viable,

fertile new beings (Mayr, 1982). Despite the general public assuming that science largely has been able to classify biological species as basic units of ecosystems, this classification has faced several challenges that are not disclosed, in particular regarding microorganisms. Not all living beings meet all the necessary criteria to be classified as a biological species. Yet, our general sense is essentially positivist, meaning that those not trained in science share a perception that scientists seek to reveal the truths that are out there waiting to be discovered (Merton, 1973; Smith, 2012). Consequently, other forms of knowledge, other epistemes, are largely unaccepted by science because they do not fit the requirements of the scientific method. If these forms of knowledge are not scientific, then the common sense approach is to challenge that source of truth, or even disregard it, until it passes through the scrutiny of the scientific method (Harden-Davies *et al.*, 2020; Sharma, 2021).

Science has been responsible for producing a robust body of knowledge about the natural world that has improved humanity's well-being and survival (a good example is the rapid pace by which science responded and produced vaccines for the COVID-19 pandemic). There is no question about the value that science and technology have made to the progress of humanity over the past centuries. However, science has many limitations, one being the elitism that it has reproduced through the imposition of what a correct episteme is, a feature that can be similar to a hegemonic discourse (Kopke, Black, & Dozier, 2019; Saltelli & Funtowicz, 2014).

Science has produced a method of work, a sort of code of conduct, that is restricted to the literate, to the enlightened (Goeminne, 2011; Merton, 1973). Since the Enlightenment, Western science is responsible for promoting an elite of truth-bearers, segregating itself from society, undermining other forms of knowledge, and suppressing minorities, in particular women, queer communities and people of colour (Harding, 2008; Hayes, 1992; Smith, 2012). Such an assumption about science can produce profound consequences to environmental governance, where scientific evidence is taken for granted, evidence which is grounded in the specific Western perspective of science (Turnhout & Lahsen, 2022). Understanding science to be a code, a language, results in it being subject to social constructs, leading to elitism and, ultimately, power. In line with this argument, science is then polyphonic, embedded in social and political values that are generally kept disguised in order to promote it as value-neutral and, in consequence, above the common human (Latour, 1993; Merton, 1973). Therefore, science is also a political act (Latour, 1993; Saltelli & Funtowicz, 2017; Thorp, 2020a).

In this sense, one can assume the discourse around what science is supposed to be as hegemonic. For example, the hegemonic discourse of science holds any person accountable for being called a scientist if, and only if, he/she is subject and adherent to that value system, to that code of conduct (Stoddart, 2007). Another hegemony

in the discourse around science pertains to the value that Western science has over other sciences. For instance, terms such as “science excellency” represent a Western perspective grounded in privileged scientific capabilities, which places a burden on scientists elsewhere to live by those standards (Koskinen & Rolin, 2021).

In the context of science diplomacy, the science which is commonly referred to in the literature is the one embedded in Western values of science. Thus, disclaiming that science is polyphonic and diverse will impact our understanding of what science diplomacy is in different social contexts.

Science progressively became instrumental to international decision-making, based on Western values of science as this apolitical and neutral entity that informs diplomacy as the best (and often the only) way forward. Repeatedly, scientific reports have been called upon to inform humanitarian crises, such as climate change, the depletion of the ozone layer, and, most recently, the COVID-19 pandemic (Spence, 2007). During the International Geophysical Year of 1957, an entire continent was devoted to scientific research. As a result, in the 1960s, diplomacy found in science a way of pacifying territorial claims in Antarctica and led to the adoption and implementation of a treaty that is, for many, one of the most important international legally binding instruments ever negotiated (Berkman *et al.*, 2011). As a consequence, the current discourse about the role of science in international diplomatic negotiations promotes science as a powerful means of producing better engaged and peaceful diplomacy (e.g., Fedoroff, 2009).

1.3 Diplomacy

Diplomacy, similar to science, is grounded in language. Traditional diplomacy is statecraft with the goal of promoting non-violent international relations, advising, shaping, and implementing foreign policies (Barston, 2019). Anyone with experience in diplomatic negotiations knows the amount of time diplomats devote to finding suitable language. They can spend hours in a room, discussing whether a chapeaux paragraph to be adopted by the United Nations General Assembly or indeed the United Nations Security Council should start with the verb “welcome” instead of the verb “note”, including innumerable possibilities in between, such as “note with appreciation”.

The choice of language selected will rank the level of importance of a certain subject. Recently, at the 26th UN Climate Change Conference of the Parties (COP26), India was blamed for watering down the outcomes of the entire meeting for requesting, at a late stage, the substitution of the verb “phase out” for “phase

down” in a paragraph regarding coal sourced energy¹. States use diplomacy to fuel a hegemony struggle between interests and domination (Stoddart, 2007). These power disputes rely intensively on language and its use to dominate a discourse (Spence, 2007), in particular for promoting a country’s brand, where science acts as a soft, seductive form of power (Nye, 1990; Raev & Minkman, 2020). Language is, therefore, critical to both science and diplomacy, as well as to the power relations inherent to each (Rungius & Flink, 2020).

Since after the Cold War, traditional diplomacy has seen science as a useful tool for bridging countries and agreeing on less sensitive matters, such as scientific cooperation and the deployment of large research facilities (Flink & Kaldewey, 2018). Documents from the United States government regarding the role of science during the Cold War tended to place scientific cooperation within the scope of cultural diplomacy, making scientists and art performers equally important in passing on national values (Adamson & Lalli, 2021). The promotion of cultural and scientific aspects through diplomacy was a way of allowing a dialogue to be started, sometimes away from the traditional—and formal—diplomatic setting (Flink & Schreiterer, 2010). The freedom that scientists had to cooperate with their foreign peers would be encouraged by the State, without much engagement of policy officers in the initial stages of collaboration. This type of diplomacy, not State-centered, is termed public diplomacy or Track 2 diplomacy in international relations scholarship. It refers to the parastatal informal diplomacy in which stakeholders are not necessarily bound to a government (Jones, 2015). Public diplomacy is said to be more flexible and to address community and common interests (Gregory, 2008). Today, it is increasingly becoming an all pervasive feature of ocean affairs, including the intersessional work of the post-2020 biodiversity framework (including the BBNJ), as well as the climate change Track 2 negotiations associated with the implementation of the Paris Agreement (Long & Brincat, 2020).

The literature around science diplomacy generally makes reference to traditional diplomacy and the role of States (Berkman, 2020). However, there are also those claiming a powerful role for public diplomacy as the driving force behind science diplomacy (Nye, 2008). In this view, public diplomacy and soft power are interrelated and States benefit from such engagement as a means to attract investment and promote national interests and values abroad (Kim, 2017). In either view, that of traditional diplomacy or that of public diplomacy, science has increasingly influenced the international arena, leading scholars to research science diplomacy.

¹ <https://www.theguardian.com/environment/2021/nov/13/cop26-countries-agree-to-accept-imperfect-climate-agreement>, accessed 15 February 2022.

1.4 Science Diplomacy

Naturally, with the increasing influence of scientific knowledge in international decision-making, debate arises on the process by which the power play between science and diplomacy occurs. This has culminated in the need to coin a new research field, namely, science diplomacy. Science diplomacy has been described as an ancient practice, but also a recent field of research (e.g., Turekian, 2018). With a view that after the World War II large-scale and onerous research projects would require collaboration in a world seeking a new order, science diplomacy started to gain political attention (Flink & Schreiterer, 2010; Vadrot *et al.*, 2021). As is evident from the scholarly literature, science diplomacy is attributed to the enhancement of the dialogue between nations in spite of geopolitical conflicts (Berkman, 2019; Fedoroff, 2009; Skolnikoff, 1993; Wagner, 2002). Departing from the perception that science is apolitical, based in a universal language concerned about finding the truth and the truth alone, science diplomacy assumes science will inspire communities to act together and find common grounds for action. Science is said to be a force that diplomacy can no longer ignore (Berkman, 2018). However, traditional international relations scholarship historically has devoted less attention to the role of science in influencing diplomacy and vice versa (Domingues & Ribeiro Neto, 2018; Mayer, Carpes, & Knoblich, 2014), as science and technology studies do not fit well into international relations theoretical frameworks (Flink & Schreiterer, 2010). Consequently, science diplomacy as an interdisciplinary field of research aims to observe, analyse, conceptualize, and explain the multiple ways by which research and international affairs interrelate. Although it is a prominent field of knowledge, it is highly contentious, with a few but nonetheless growing attempts to define it and to frame the narrative in epistemic terms.

Indeed, there are currently at least two accepted taxonomies of science diplomacy in academia (Table 1). The first attempt to categorize science diplomacy came after a meeting held by the Royal Society and the American Association for the Advancement of Science (AAAS) (2010). In their report, science is related to diplomacy in three ways. Science in diplomacy deals with the role of scientific advice in international decision-making, as with the Intergovernmental Panel on Climate Change (IPCC) informing the United Nations Framework Convention on Climate Change (UNFCCC), which is a cogent and compelling example. In the alternative, science for diplomacy stands for the bridging of communities from different countries around joint and collaborative research endeavours, such as the Conseil Européen pour la Recherche Nucléaire (CERN) in Switzerland. Finally, it is argued that by building international relations around scientific research practices, scientific communities would benefit from enhanced visibility, funding, and capacity development schemes. The latter is coined as diplomacy for science. These

three very different taxonomies are shown in Table 1. However they do not tell the full story or capture the malleable nature of the concept.

Table 1: Science diplomacy taxonomies as per presented in current academic literature

| science diplomacy taxonomies | | |
|--|---|-----------------------------------|
| Royal Society & AAAS (2010) | 01 science in diplomacy Science can provide advice to inform and support foreign policy objectives | |
| | 02 diplomacy for science Diplomacy can facilitate international scientific cooperation | |
| | 03 science for diplomacy Scientific cooperation can improve international relations | |
| 01 | actions designed to directly advance a country's national needs | Gluckman et al. (2018) |
| 02 | actions designed to address cross-border interests | |
| 03 | actions primarily designed to meet global needs and challenges | |

For instance, Gluckman, Turekian, Grimes, & Kishi (2018) proposed three new categories based on the interests of countries of being involved in science diplomacy practices. To these authors, the classification suggested by the Royal Society and AAAS ignored the forces that these interests would play in driving science diplomacy. Thus, they propose that science diplomacy could be framed in actions designed to (i) directly advance a country's national needs, (ii) address cross-border interests, and (iii) meet global needs and challenges. According to their proposition, this scale of interests would determine how science diplomacy operates and which drivers will propel the relationship between research and international relations.

The debate around the usefulness of such taxonomies points to the fact that the most important features of science diplomacy are not being discussed and that there is a general lack of empirical evidence to support such claims (Epping, 2020). Issues such as power disputes, industrial espionage, and the misuse of science and scientists are among such critical features underlying science diplomacy (Flink, 2020; Ruffini, 2020a). Not surprisingly, science diplomacy has been a term increasingly present in political statements (Legrand & Stone, 2018; Moedas, 2016; Pandor, 2017). In fact, Ruffini (2020b) advocates that most of the available

literature on the theme comes from political perspectives rather than scientific evidence. Therefore, despite the promotion of science diplomacy as a beneficial tool to foster better international engagement, evidence is lacking on the drivers and products of such interaction (Flink & Rüffin, 2019). Consequently, research is needed to unveil the social phenomena related to science diplomacy from multiple areas of expertise. An appropriate and illustrative case arises in this regard in relation to ocean affairs, which we turn to next.

1.5 Ocean Science Diplomacy

The ocean has been claimed to be a global commons (Vogler, 2012), a shared humanitarian common good (Wolfrum, 1983), and impacted by humans without much concern about its thresholds (Rockström *et al.*, 2009). The ocean has been neglected by world leaders both in terms of investment in research and management and in terms of public policies for enhanced sustainable exploitation of marine resources (Costanza, 1999; IOC-UNESCO, 2020a; Singh *et al.*, 2021). Threats such as pollution, climate change, and loss of biodiversity make the ocean an endangered life-supporting system. In addition to such environmental concerns, the ocean is also a stage for historical conflicts and disputes, which motivated the negotiation and adoption of the United Nations Convention on the Law of the Sea (Koh & Jayakumar, 1977; Ranganathan, 2020). Whether from the environmental perspective or the regulatory standpoint, science has always had a critical role in informing decisions with regard to the state of the ocean and in tendering possible innovative solutions (Robinson, 2020a). Therefore, diplomacy and science meet in almost all aspects of international ocean governance. Indeed, the latter is the principal reason why this body of work adopts the term “ocean science diplomacy” (Paper 1 - Polejack, 2021). Ocean science diplomacy stands for the interaction of ocean sciences with international affairs, be it between communities of practice, between countries, in multilateral arrangements, or through intergovernmental frameworks. As a core part of this work, ocean science diplomacy both as a concept and as a practice is explained in more detail in the first paper of this dissertation, which explores the importance of ocean science diplomacy for ocean affairs, global sustainability, and the UN Decade of Ocean Science (Polejack, 2021).

In general, science diplomacy is focused on anthropogenic impacts and environmental interaction within and on the terrestrial environment, in other words, on land. Ocean science diplomacy is relatively more complex due to the importance that scientific evidence has had in the drafting of the international regime regulating ocean activities (Brown & Fabian, 1974). Moreover, the overlap in mandates and jurisdictions in marine spaces adds another layer of complex international relationships in which science diplomacy seems to be a good fit (Boyes & Elliott,

2014; Robinson, 2020a). Finally, the lack of sufficient scientific information on marine environments, as well as the technological race to exploit the ocean, have been responsible for conflictual international negotiations on ocean governance frameworks (Robinson, 2020b). Thus, ocean science diplomacy should hold enough substantive elements to be a field of research *per se* and in its own right.

Ocean science diplomacy is embedded in social interactions, from transboundary community-based resource exploitation to global matters of concern. The ocean signifies different things to different people and is thus subject to many epistemologies, that is, different ways of validating ocean knowledge (Costanza, 1999; Moon *et al.*, 2021; Squarcina & Pecorelli, 2017). Science is very influential in international interactions about the ocean, but not always in a beneficial sense. The scrutiny of the scientific method, mostly carried out using the peer review system, has not been enough to prevent science from being applied rightly or wrongly in international ocean governance schemes to promote individual countries' interests (Goncalves & De Santo, 2021). For example, several regional fisheries management organizations use of science and scientific evidence has been characterized as subsidies due to relaxing of fishing quotas for some countries (Belhabib, 2021; Jouffray *et al.*, 2020; Österblom *et al.*, 2020). Therefore, understanding ocean science diplomacy is a timely issue that needs to be at the very core of our understanding and respective cognitive fields if we are to promote sustainability and improve international interactions. Indeed, the latter proposition often appears to be the desire of those advocating for the strength of science diplomacy. Furthermore, its importance and validity can be gauged from the United Nations General Assembly Resolution on the adoption and implementation of the Decade of Ocean Science (United Nations, 2017).

1.6 The Decade of Ocean Science

Our scientific ignorance about the ocean, with extensive areas still under-sampled and often unknown to humanity, provided the backdrop for the UN General Assembly to adopt 2021–2030 as the Decade of Ocean Science for Sustainable Development (Ryabinin *et al.*, 2019). The Decade aims to leverage research efforts around the globe to produce relevant information for improved decision-making while bringing societal benefit at the core of its actions (Claudet *et al.*, 2019). The Decade is led by one of the most relevant and historical institutions to develop ocean science diplomacy, the Intergovernmental Oceanographic Commission of UNESCO (IOC). The Decade is a compelling case and context for the research discussed here. The discourse around the Decade reflects to a great extent the language used by multilateral arrangements when combining ocean science with diplomacy. Therefore, investigating the Decade has the potential to expose the

current discourse around ocean science diplomacy, despite the lack of such a concept in official documents establishing the Decade (Polejack, 2021). Thus, the Decade is present in almost all the results of this research (e.g., Papers 1–6), reflecting a mechanism by which ocean science diplomacy is put into practice, but also from which it evolves. In this sense, the papers integral to this dissertation present a few recommendations of how the Decade should become central to and leverage favourable outcomes from the practice of ocean science diplomacy.

1.7 The All-Atlantic Ocean Research Alliance

The Decade is a global effort and very difficult to explore from an analytic perspective due to the multiplicity of endeavours and regimes adopted in different countries and regions. Accordingly, the focus here is on one specific international arrangement in the Atlantic Ocean; namely, the All-Atlantic Ocean Research Alliance. The Alliance aims to apply science diplomacy to foster engagement and ocean stewardship to promote an Atlantic ocean community around research outputs (as described in Paper 2 - Polejack *et al.*, 2021).

The Alliance will contribute to the implementation of the Decade objectives, at least with regard to actions in the Atlantic. The stepwise creation of the Alliance involved countries from the North and South Atlantic seeking agreements in research priorities and the alignment of resources, and thus became a petri dish case study for exploring the realpolitik of ocean science diplomacy in action. This research drew from this construct to engage with practitioners of science diplomacy in the Atlantic, as well as to study the issues of national interests in forming it. Paper 2 of this dissertation (Polejack *et al.*, 2021) explored the Alliance as a case study of ocean science diplomacy. In that article, the authors attempted to correlate the science diplomacy taxonomies (as presented in Table 1) as well as to analyse the political interests driving its establishment. In contrast with the Decade, which is mainly conducted in an intergovernmental setting, the Alliance relies on national foreign policies that are debated within restricted groups of decision-makers. Consequently, analysing the Alliance also provides insights on any existing differences between ocean science diplomacy in intergovernmental and in bi-multilateral frameworks, as discussed in Paper 2.

While focusing on the general aspects that motivated the science diplomacy behind the creation of such Alliance, one of the multinational research projects funded by the European Commission as a means of implementing the Alliance was highlighted. Thus, ocean science diplomacy in practice was analysed by looking at

the Mission Atlantic Project², which aims to conduct marine integrated ecosystem assessments (IEA) from North to South Atlantic. The draft of Paper 5 of this dissertation presents the work done with regard to the relationship between IEAs and science diplomacy, informing the implementation of the Alliance.

1.8 Theoretical Underpinnings

This research adopts inductive reasoning, whereby theories are not tested, but are an outcome of the analysis, that is, the empirical evidence drives reasoning and is discussed in line with available theories (Bryman, 2012, p. 26). This study rejects positivism by assuming there is not one single reality that is to be assessed through universally accepted and empirically tested truths. Instead, consistent with the social constructivism epistemology, this research departs from the understanding that reality is multifaceted and interpreted by self constructs, dependent on moral, cultural, and social imperatives that build the being (Braun & Clarke, 2013).

This work adopted a few assumptions. First, it assumes that science resembles other social phenomena, that is, guided by social norms and values, mostly shaped by an elite (in the case of science, the enlightened), as argued by the science and technology studies scholarship (Latour, 1993). In assuming science as a social phenomenon, it is also assumed that science is based on discourses that can be subject to power relations, including disputes over interests, as argued by poststructuralists (Foucault, 1972).

Second, it is assumed that traditional diplomacy aims at protecting and promoting national interests, with science being one such interest. In the field of international relations, this research adheres to critical constructivism (Hopf, 1998). Third, science diplomacy is understood to foster specific perceptions of science and of diplomacy, along with specific meanings of what constitutes a scientist and a diplomat, also along the lines of poststructuralism.

Fourth, it is assumed that the world is driven by power conflicts fuelled by interests and resulting in dominance over the other, in a quest to maintain an elite with power to determine the normative standard (Foucault, 1995; Gramsci, 1971; Losurdo, 2020). On the latter point, it is also assumed that the dominant view of science diplomacy departs from Western perceptions of science and diplomacy, combined now as a new term also centered on Western values. By assuming such claims, it is also acknowledged that this binary logic (here-there, I-the other) restricts the way in which we perceive these power relations, where conflict would emerge from

² <https://missionatlantic.eu/> accessed 24 February 2022.

attempts of one side to dominate the other side (Chimakonam, 2019). This binary logic becomes a limitation, a simplistic fashion to access this research's findings. Therefore, considerations of polymorphisms and multiple perceptions are discussed along the lines of this study.

As poststructuralists argue, social reality can be explained by analysing social structures, that is, "patterns and forms of social relations and combinations among a set of constituent social elements or component parts such as positions, units, levels, regions and locations, and social formations" (Heydebrand, 2001). The social structures adopted in this study relate to at least two of the functional social roles deemed critical to science diplomacy: government officials and researchers (diplomats and scientists). The goal was to gather insights from key individuals involved in the establishment of the All-Atlantic Ocean Research Alliance. This community involves countries bordered by the Atlantic which are diverse in terms of socio-economic development, language, culture, and ultimately, political and social frameworks. Moreover, these countries have distinct historical colonial ties with Europe, but with the common feature of having largely adopted European values of civilization to be the norm.

The theoretical framework that I found most suitable to analyse this research's findings was postcolonial theory (Césaire, 1955; Harding, 2021; Said, 1978) and decolonial studies (Mignolo, 2009; Anibal Quijano, 2000), in particular after being contrasted with other theories that could be applied alike to the results found in this research. Table 2 brings a non-exhaustive summary of theories influencing this study. Elements from these theories were used to discuss this research's results, with a main focus on postcolonialism and decolonial theories. This choice is supported by the premises of post- and decolonial thinking that current reality cannot be understood without acknowledging the impacts of the colonial past in the world politics and its current living consequences. As an inductive research, those theories came to be central to this work because of the collected perceptions of ocean science diplomacy from its agents in the Atlantic Ocean. In addition, the Atlantic is of major importance in understanding our colonial history and current coloniality of power exactly because of its role in the flow of people and resources from colonies to empires (Anibal Quijano, 2000). A more detailed justification on the adoption of postcolonial and decolonial reasoning in this body of work can be found both in the discussion section of this dissertation, as well as in the manuscript of Paper 6.

Table 2: Theories assessed during the course of this research.

| Theory | Main ideas | References |
|-----------------------------|---|--|
| Poststructuralism | <p>"Poststructuralism focuses on the question of representation and explores the ways in which dominant framings of world politics produce and reproduce relations of power: how they legitimate certain forms of action while marginalizing other ways of being." (Çalkıvık, 2017)</p> <p>"Poststructuralists argue that 'knowledge' comes to be accepted due to the power and prominence of certain actors in society known as 'elites', who then impose it upon others. Elites take on a range of forms and occupy many different roles in contemporary society." (Morrow, 2018)</p> <p>Recognizes that "political institutional arrangements greatly affect policy processes and outcomes, including dictating which issues are considered by decision makers, whose interests are represented or the steps and processes through which decisions can or cannot be made. Assumes institutions to be at the center of policy making, whereas considerations about their formal structures, culture and mode of operations would shape policy-making" (Parkhurst, 2017)</p> | <p>(Çalkıvık, 2017; Morrow, 2018)</p> |
| Institutionalism | <p>Departs from the assumptions developed by behavioralism (Sanders, 2018) and rational choice (Hindmoor & Taylor, 2018) that, in contrast to institutionalism, believe that individual agency and actions shaped policy more than institutional setups. "New institutionalism assumes that an institution transcends individuals to involve groups of individuals in some sort of patterned interactions that are predictable, based upon specified relationships among actors. It attempts to understand institutional change over time and the role that individual behavior (or social groups) have in shaping institutional frameworks." (Peters, 2019)</p> | <p>(Parkhurst, 2017)</p> <p>(Peters, 2019)</p> |
| Discursive Institutionalism | <p>This theory can be interpreted as an attempt to incorporate discursive power structures in the assumptions of the new institutionalist school. It assumes institutions to be "defined by their internal discourses, as well as by the discourses that they utilize to communicate with their environment" (Schmidt, 2008), being subject, <i>inter alia</i>, to the Foultcauldian rhetoric of power in shaping social dynamics between and within social institutions.</p> | <p>(Schmidt, 2008)</p> |
| Reflexivity | <p>Reflexivity stands for the positionality of the researcher as determinant to the result generated by the scientific enquire. "Reflexivists emphasize the importance of human self-reflection for the nature of institutions and ultimately for the character of world politics".</p> <p>"Scientific knowledge is not simply an expression of one's class or race or gender or any other categorical or positional attribute, but instead either reinforces or challenges such social distinctions. This function is not an accidental impact of knowledge, but is intimately wrapped up with the very production of knowledge in the first place. For a reflexivist, knowing the world and changing the world are inseparable." (Jackson, 2016)</p> | <p>(Alejandro, 2021; Jackson, 2016)</p> |
| Postcolonialism | <p>Postcolonial theory challenges the Western dominant worldview by stating how colonial history has shaped reality and the value system by which one makes sense of it. "The postcolonial does not privilege the colonial. It is concerned with colonial history only to the extent that history has determined the configurations and power structures of the present, to the extent that much of the world still lives in the violent disruptions of its wake, and to the extent that the anti-colonial liberation movements remain the source and inspiration of its politics." (Cooper, 2005)</p> | <p>(Cooper, 2005; Losurdo, 2020; Said, 1978; Santos, 2016)</p> |
| Decolonialism | <p>Decolonialists argue that modernity as a concept is a result of a coloniality of power, that is, a political project to maintain and benefit from colonial domination. "Coloniality of power is based upon 'racial' social classification of world population under Eurocentered world power. But coloniality of power is not exhausted in the problem of 'racist' social relations. It pervaded and modulated the basic instances of the Eurocentered capitalist colonial/modern world power to become the cornerstone of this coloniality of power." (Quijano, 2000)</p> | <p>(Mignolo, 2007; Quijano, 2000)</p> |

Apart from postcolonialism and decolonialism, the other theories presented in Table 2 share a common feature that they depart from a Western centered perspective when addressing their line of reason. This is because most of its scholars are limited in discussing reality which they are familiar with and, at the same time, reproducing colonial values of Eurocentrism. Thus, institutions and other social structures are debated from the standpoint of ignoring Southern realities and how they differ from Northern constitutions. Opposite to that, postcolonialists argue that the spread of Western-centered views and values as the norm and standard to live by is a direct consequence of historical imperial and colonial rule (Santos, 2016). The historical ties developed through colonization has at least two consequences or outcomes. First, the colonizer gives meaning to the colonized, signifying he/she as the other, as the different and, to a certain extent, less humanized than the colonizer (Fanon, 1965). In establishing this rank of humanity, colonies became extraction sites and their people were perceived as the servers, as those in need of assistance and enlightenment (Césaire, 1955). Second, the colonizer imposes a foreign value system on the colonized, resulting in them being guided by the colonizer's rule of right and wrong. In this sense, the colonized uses this foreign value system to signify him/herself and seek ways to become him/herself the colonizer, the optimal, the norm (Losurdo, 2020; Quijano, 2000; Said, 1978). As a consequence of the political European project of colonization, the physical traits of bodies in colonies became a social construct that built a racial differentiation which guides world politics, according to decolonial thinking (Quijano, 2000). Decolonialists defend that modernity, in a sense of progress and development, is a concept based on the dominance and submission of what were once called colonies, particularly in what today is termed as Latin America, in a new project of a "coloniality of power" (Quijano, 2007). I invite the reader to visit Paper 6 of this dissertation where this argument is discussed in more detail, for the aim of synthesis in this dissertation. Therefore, due to the impressions shown by interviewees from this research, as well as the central role of the Atlantic Ocean in the colonial project, both postcolonialism and decolonialism became central to this work, particularly when addressing what meaning agents make of ocean science diplomacy in the context of the All-Atlantic Alliance.

At this stage, it is important to state that positionality matters to this research in multiple ways. Positionality stands for "how an individual's perspective is shaped by their social position, including class, gender and sexuality, racial identity, and other determinants of social privilege" (Polk & Diver, 2020). In general, our positionality reflects the sense that we make of the world and the lenses through which we analyse it, including the hegemonic discourses embedded in this sense-making (Gramsci, 1971; Waisbich, Roychoudhury & Haug, 2021). My own positionality embraces the perspective of a Latino white male, trained in the natural sciences as a biologist, with decades working as a government official in ocean

science and technology in Brazil. My positionality becomes the standpoint from which my analysis departs and results are discussed. Moreover, my former personal engagement in the negotiations of both the Alliance and the Decade situates me as an insider researcher, where positionality also matters (Merriam *et al.*, 2001). Therefore, reflexivity becomes critical to this work. By analysing my own discourse in a sense of revisiting my own writings in search for Eurocentric values and colonial thinking, reflexivity was applied throughout this research (Alejandro, 2021). In this sense, I explored in a series of publications how ocean science diplomacy practices impact those in the South Atlantic differently than those in the North. I also used positionality to analyse the perspectives stated by the interviewees in this research. Consequently, one can assume this research to comprise a thematic analysis done through the lenses of ocean science diplomacy from a Global South standpoint (Waisbich *et al.*, 2021).

As a consequence of these assumptions and my own positionality, three different approaches were designed to attain this research's goals. First, a general comprehension of science diplomacy was needed, and how it relates to international ocean affairs. This was done by conducting a literature review on the scholarship around science diplomacy, international relations, science-policy interface, and other related fields. Second, I also assessed in a forensic fashion the official documents that informed the establishment of the UN Decade of Ocean Science, as well as the All-Atlantic Ocean Research Alliance. Moreover, I reviewed the role of science in the implementation of the UN Convention on the Law of the Sea. Third, as language matters to both science and diplomacy, I investigated the perceptions of ocean science diplomacy from influential individuals in the Atlantic Ocean. My interviewees were key researchers and government officials in positions of power. This comprehensive approach allowed me to depart from literature and theories to assess practitioners' sense-making of ocean science diplomacy.

1.9 Problem Statement

Science diplomacy is being mainstreamed in the international policy world as a benign, if not critical, force to build a more sustainable world. However, we lack clarity on what are the drivers and interests currently shaping this discourse and for what purpose, especially in relation to ocean governance.

1.10 Research Questions

1. Why is science diplomacy important to global ocean affairs?
2. How has science diplomacy shaped the All-Atlantic Ocean Research Alliance?
3. Can ocean science diplomacy further benefit the Global South in achieving shared interests and realizing common values?
4. What are the meanings and values given to science diplomacy by science diplomats in the Atlantic?

1.11 Research Objective

This research's goal was to critically assess what ocean science diplomacy entails in theory and in practice. Drawing from these findings, recommendations are also proposed, in particular from a Global South perspective and in the broader context of the UN Decade of Ocean Science for Sustainable Development.

2 Methods

“Methodology can be read as rhetoric, encoding certain assumptions and values about the social world”

– Ben Agger (1991, p. 114).

This study was designed to accommodate and integrate three different methodological approaches: a literature review, a document analysis, and a thematic analysis. The literature review was aimed at understanding the state-of-the-art of the academic debate around science diplomacy. The document analysis had a goal of assessing the role of science in diplomatic instruments, such as the United Nations Convention on the Law of the Sea (UNCLOS), as well as official documents establishing and informing the All-Atlantic Ocean Research Alliance and the UN Decade of Ocean Science for Sustainable Development. The thematic analysis aimed at assessing individual perceptions about ocean science diplomacy of scientists and government officials, including diplomats, who were involved in the All-Atlantic Alliance.

2.1 Literature Review

First, a chain referral literature review on the issues of science diplomacy (e.g. Bainbridge, Potts, & O’Higgins, 2011) started with the 2010 report by the Royal Society and AAAS and searched for further references citing that report (The Royal Society & AAAS, 2010). Subsequently, academic literature was searched for terms such as “science”, “diplomacy”, “ocean”, “governance”, and “international” using search engines, including Google Scholar and Web of Science. As this research continued, a snowballing exercise was done by which the list of references of the relevant literature was assessed to broaden the scope of the review. Mendeley Desktop (version 1.19.8) was used as the reference manager software.

2.2 Document Analysis

Second, the provisions in UNCLOS directly dealing with science were analysed, in particular the preamble and Parts XIII and XIV (Marine Scientific Research and Development and Transfer of Marine Technology, respectively). UNCLOS provisions that indirectly involve science, such as protection and preservation of the marine environment and settlement of disputes, among others, were also analysed. Paper 1 (Polejack, 2021) also analysed the UN General Assembly annual omnibus resolution from 2009 to 2019 to identify modern themes of concern where State Parties require science to be instrumental. This was the first peer reviewed publication that undertook such an analysis and synthesis, to the best of my knowledge.

In addition, official documents supporting and guiding the establishment of the All-Atlantic Ocean Research Alliance and the UN Decade of Ocean Science for Sustainable Development were assessed. Documents regarding the Alliance included the Galway and Belém Statements, the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans, and other related reports and policy documents that are instrumental to the Alliance (e.g., Brazil & South Africa, 2017; European Commission, 2013; European Commission & Argentina, 2018; European Commission & Cabo Verde, 2018; European Union, 2018; European Union, Canada, & United States of America, 2013; European Union, South Africa, & Brazil, 2017). Concerning the UN Decade of Ocean Science, official documents from the UN General Assembly and from IOC-UNESCO that adopted this endeavour and inform its implementation were assessed (e.g., IOC-UNESCO, 2017, 2018, 2019, 2020b; United Nations, 2017).

2.3 Thematic Analysis

Third, and more elaborated, a qualitative method to assess individuals' sense-making and perceptions of ocean science diplomacy was applied. All these individuals had an active role in negotiating (and now implementing) the All-Atlantic Ocean Research Alliance. A thematic analysis (Braun & Clarke, 2006) of ocean science diplomacy in the Atlantic was conducted. This specific methodological choice is justifiable for at least two reasons. First, science diplomacy is an emerging field of research with few empirical data available to date. Second, there is a need to understand how this concept and social phenomenon is perceived from the individual perspective, that is, from the standpoint of the science

diplomat (as defined by Melchor, 2020), from whom the whole process emerges and is put into practice.

Thematic analysis was chosen (Braun & Clarke, 2006) because it allows the identification and organization of patterns of meaning, suitable to identify these individual's perceptions and values in engaging in ocean science diplomacy practices, irrespective of the sample size. Thematic analysis, however, is limited to collect *what* was said, rather than *how* interviewees say it, which also limits the scope of the discussed results. Moreover, positionality is very influential in thematic analysis for it is the researcher who assigns codes and organize themes, which naturally denote her/his standpoint, grounded on issues of gender, class, race, and social realities (Braun & Clarke, 2013, pp. 174–183). In spite of such limitations, this method was suited to collect the necessary understanding of what agents in the Atlantic context mean by engaging in science diplomacy practices.

Twenty semi-structured interviews were conducted with high-level decision-makers (13 interviewees) and key researchers (7 interviewees) involved in the setup and implementation of the All-Atlantic Ocean Research Alliance, coming from Argentina, Brazil, Canada, Germany, Portugal, Spain, South Africa, the United States of America, and the European Commission. Decision-makers were government officials who occupy high-level hierarchical positions in national ocean-related science systems, including science and technology State secretaries and ministers, directors, heads of departments, science managers, and diplomats. The general profile of the interviewed researcher is a person who has gained extensive experience in international scientific cooperation by coordinating transboundary research projects and scientific programs. Another feature is that the interviewed researchers are involved in the management of large international research projects.

Semi-structured interviews were done in person (12 interviews) during the All-Atlantic Forum³ (Brussels, February 2020), as well as online (8 interviews), due to the COVID-19 travel restrictions, from April to October 2020. Vitally, as the author was involved in drafting and negotiating the All-Atlantic Alliance, his professional network was accessed to identify and engage with interviewees. These previous contacts might have improved trust-building and consequently facilitated openness and sincerity when answering the questions since all interviews were done by the same researcher.

Interviews were composed of a set of nine questions, of which six were common to all interviewees, while three additional questions were specific to researchers or government officials (Table 3). General questions assessed interviewees' sense-making of science diplomacy, including its applicability, the relevance of the UN

³ <https://allatlanticocean.org/view/atlanticforums/2020-brussels>, accessed 18 November 2021.

Decade of Ocean Science for Sustainable Development, and the specificities of IEAs as concrete actions in the application of ocean science diplomacy. Questions were purposely designed to be broad enough so interviewees were free to explore answers at their discretion, supporting the aim of collecting their perceptions of truth.

Table 3: Interview questions applied in this research

| GENERAL SET OF QUESTIONS | |
|--|--|
| <ol style="list-style-type: none"> 1. Can you tell me a bit about yourself? Background, age, experience...? 2. Tell me about science diplomacy, what is it to you? 3. In this context, please let me know how useful science diplomacy could be? 4. Please share your views about the need for a UN Decade of Ocean Science for Sustainable Development. 5. In your opinion, what should a UN Decade achieve? How (or why)? 6. With regard to tools for collaboration, tell me what you know about integrated ecosystem assessment. Any ideas on how to measure its success? | |
| QUESTIONS FOR SCIENTISTS ONLY | QUESTIONS FOR GOVERNMENT OFFICIALS ONLY |
| <ol style="list-style-type: none"> 7. Let's say you hold an important result that could help authorities to deal with a problem, what would you do? 8. Tell me how you feel about your participation in negotiations (national or international). 9. Would you have any insights on how this picture could look better? | <ol style="list-style-type: none"> 7. Please share how you use scientific information in your work. How to access, apply? 8. Tell me your perception of how negotiations take scientific information (first nationally, then internationally). 9. Any final recommendations on how to improve this? |

Interviews were conducted both in English and Portuguese and were fully transcribed in their original language. Transcripts were analyzed with the software MAXQDA Plus 2020 (Release 20.4.1) and codes were assigned to text extracts. Codes were generated by the author in accordance with grounded theory (Bryman, 2012), meaning that no pre-established codes were used. Coding was revised multiple times. These revisions included reassessing transcripts and the audio of the interviews in full, assigning codes relevant to capture the main ideas expressed by interviewees. The same text (or parts of it) could have been assigned to multiple codes. Revisions were considered fulfilled when coded segments did not require further reassignments. The full list of code categories can be seen in Table 4. Codes were clustered in themes, as per a thematic analysis (Braun & Clarke, 2006). Themes were also revised multiple times. Revision of themes was carried out by clustering all the coded segments under each thematic category (irrespective of the interviewee or the order in which the element was transmitted) until no further rearrangement was necessary and the placement of codes under each theme was considered exhausted. Thematic analysis resulted in two different publications (Papers 5 and 6) and the generated themes can be seen as subsections of the result sections of each publication. Translation from Portuguese to English was performed by the same researcher solely for the purpose of presenting exemplary extracts of the analysis.

Table 4: Code categories identified from all interviews. Codes are presented in alphabetical order along with their frequency (in terms of absolute number of coded segments).

| Code System | Frequency |
|--|-----------|
| Accessibility to data | 14 |
| Broader participation | 33 |
| Capacities | 18 |
| Collaboration | 35 |
| Communicating Science Diplomacy | 27 |
| Competition | 6 |
| Cross-border interests | 23 |
| Diplomacy for Science | 17 |
| Equity | 18 |
| Funding for research | 22 |
| Global interests | 34 |
| Intergenerational aspects | 10 |
| Limitations to advice | 35 |
| Linking national to international | 8 |
| National Interests | 47 |
| National Science Advice schemes | 30 |
| Northern perspectives | 22 |
| Operability of Science Diplomacy | 23 |
| Other advice/values beyond science | 11 |
| Researchers pushed to societal issues | 15 |
| Risk in decision making | 5 |
| Role of institutions | 23 |
| Science as a soft power | 11 |
| Science closed in itself | 33 |
| Science denial | 6 |
| Science Diplomacy examples | 24 |
| Science for Diplomacy | 49 |
| Science in Diplomacy | 24 |
| Science-policy conflict | 94 |
| Science-society clashes | 40 |
| Skepticism | 35 |
| Southern perspectives | 53 |
| Trans/interdisciplinarity | 27 |
| Unawareness of doing science diplomacy | 18 |
| Unseen ocean | 23 |
| Values of science diplomacy | 78 |
| What science diplomacy should be | 42 |

3 Results

As a field in need of empirical evidence and due to the urgency of understanding the importance of science diplomacy to global ocean affairs, this research adopted a strategy of publishing its results as arguments were developed. The compilation of these publications (Table 5), including those that are yet to be published, composes what is termed in Nordic countries as a “red thread”.

3.1 The Red Thread

The red thread is a common concept applied to Nordic Ph.D. dissertations⁴, by which a central argument is developed and the research unfolds while exploring this argument (Lantsoght, 2018, p. 84). Curiously, it makes reference to the Greek myth of Theseus and the Minotaur, where Ariadne, a Cretan princess, gives Theseus a red thread so he could navigate the maze where the Minotaur lived. Without this red thread, Theseus would not be able to kill the Minotaur and retrace his way out of the maze. Not that this research faces a threat such as the Minotaur, but its red thread is developed through a path that connects all the elements of this research with the central argument on the meaning and implications of ocean science diplomacy.

In order to answer the research questions, the logic thread illustrated in Figure 1 was developed. The results are concentrated in the series of publications produced within the timeframe of this research. This chain of publications tells a story that starts with the synthesis of the available theories and discussions on science diplomacy and how these are reflected in ocean affairs. Applying this paradigm led to the publication of Paper 1 (Polejack, 2021). It was also an objective of this publication to explore and frame the UN Decade of Ocean Science as essentially ocean science diplomacy in practice.

⁴ <https://patthomson.net/2018/04/02/thesis-knowhow-how-the-contribution-can-create-coherence/> accessed 24 February 2022.

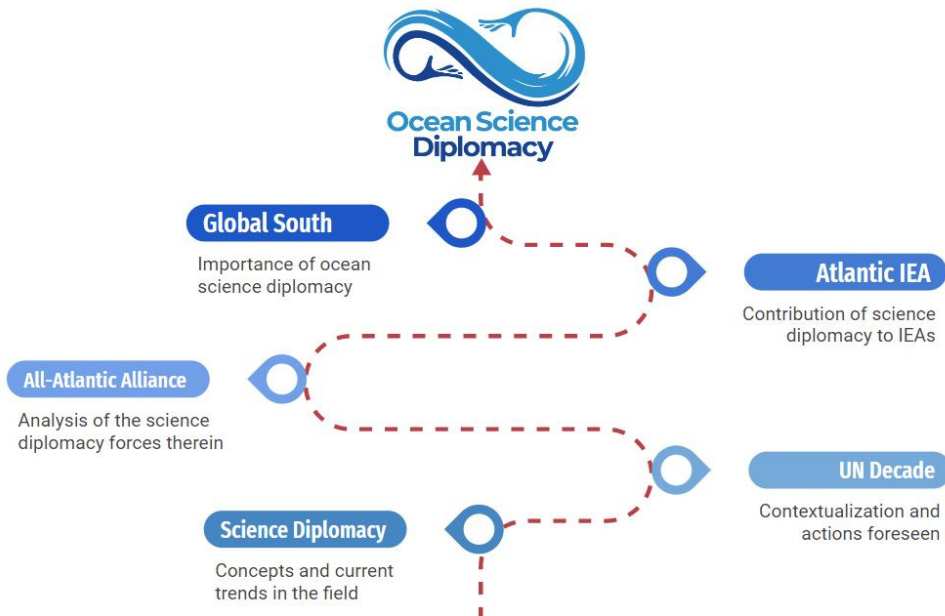


Figure 1: Schematic representation of the red thread that drove this research

Subsequently, the focus was shifted to the Atlantic Ocean and its inherent social dynamics, in particular the development of ocean science at the basin scale. Paper 2 (Polejack *et al.*, 2021) describes the setup of the All-Atlantic Ocean Research Alliance and analyzes the interests of the involved countries in engaging in this ocean science diplomacy practice. Focusing on one of the projects financed by the Alliance, stakeholders' perceptions of IEAs were analyzed. This was based on the assumption that international IEAs are to be developed across jurisdictions and thus are a tangible case of ocean science diplomacy in practice. Results are discussed in the draft manuscript of Paper 5 (Polejack, Ramírez-Monsalve, & Wisz, in progress).

In general, the current dominant discourse of ocean science diplomacy reinforces a perceived beneficial power of science in influencing international decision-making. The basis for such a claim is the universality and neutrality of science in presenting diplomacy with empirical evidence unattached to political ambitions. However, the regulatory framework provided by multilateralism, such as UN conventions and similar regulatory and hard law regimes, is far from being well implemented and fit for the purpose of allowing science to act as a powerful influence (Martin, 1992). Paper 3 (Polejack & Coelho, 2021) explores this perspective, focusing on how important ocean science diplomacy can be for countries in Latin America and the Caribbean region. Further, Paper 4 (Muelbert *et al.*, 2021) examined the challenges that countries in this region face when trying to contribute scientific input to ocean-related issues in the UNFCCC, revealing that global science is in fact unequal and

unbalanced. Both publications have a strong Global South perspective, which aligns with the narrative and underlying arguments of this dissertation.

The Global South perspective becomes even more evident in the last core paper of this red thread. In the Atlantic, ocean science diplomacy seems to be rooted in the historical relationships between countries and the communities therein. Consequently, a power dynamic between the clashing values of science and policy grounded in the interests of each group, as well as a colonial interrelationship between the North and South Atlantic seem to prevail in ocean science frameworks in the Atlantic Ocean. This singular critical analysis is subject to the yet unpublished manuscript of Paper 6 (Polejack, in progress). These results point to the urgency to improve understanding of the factual forces and powers at play in the practice of ocean science diplomacy. Along with these discussions, potential recommendations for the better entanglement of science and diplomacy in the ocean are suggested. Full texts of the above-mentioned publications are available as appendixes to this dissertation.

3.2 Resulting Publications

Table 5 presents the series of publications developed in the course of the current research, highlighting those which are central to and constitute specific sections in this dissertation (core publications), together with adjacent work that supports the arguments (supporting publications), but are not central to the red thread. Ongoing publications developed in light of the findings of this work (other work) are also included. In total, a series of 20 publications resulted from this research. This dissertation addresses the core publications in more detail as they compose the red thread. Supporting publications are only referenced in this document but can be accessed through their correspondent DOI number on the web. All the other work will be made available as soon as possible.

Table 5: A complete list of the publications developed in the course of this research with reference to the research questions addressed by them. Core publications represent work that is central to the development of the research questions and arguments presented in this dissertation. Supporting publications are not central to the dissertation but highlight specific fields to which this research has contributed and amplified scientific knowledge on the meaning and practice of ocean science diplomacy. Other work relates to publications developed on the course of this study in different stages of publication, and not targeted at developing this dissertation, but still relevant to the knowledge produced in the course of this research.

| Core Publications | Research Questions |
|--|--------------------|
| 1 Polejack, A. (2021). The Importance of Ocean Science Diplomacy for Ocean Affairs, Global Sustainability, and the UN Decade of Ocean Science. <i>Frontiers in Marine Science</i> , 8(March). https://doi.org/10.3389/fmars.2021.664066 | 1 and 3 |
| 2 Polejack, A., Gruber, S., & Wisz, M. S. (2021). Atlantic Ocean science diplomacy in action: The pole-to-pole All Atlantic Ocean Research Alliance. <i>Humanities and Social Sciences Communications</i> , 8(1), 52. https://doi.org/10.1057/s41599-021-00729-6 | 2 and 3 |
| 3 Polejack, A., & Coelho, L. F. (2021). Ocean Science Diplomacy Can Be a Game Changer to Promote the Access to Marine Technology in Latin America and the Caribbean. <i>Frontiers in Research Metrics and Analytics</i> , 6(April), 34–36. https://doi.org/10.3389/frma.2021.637127 | 1 and 3 |
| 4 Muelbert, M. M. C., Copertino, M., Cotrim da Cunha, L., Lewis, M. N., Polejack, A., Peña-Puch, A. del C., & Rivera-Arriaga, E. (2021). The Ocean and Cryosphere in a Changing Climate in Latin America: Knowledge Gaps and the Urgency to Translate Science Into Action. <i>Frontiers in Climate</i> , 3(November). https://doi.org/10.3389/eflim.2021.748344 | 1 and 3 |
| 5 Polejack, A., Ramírez-Monsalve, P., & Wisz, M. S. (submitted). What does Integrated Ecosystem Assessment mean to research and policy stakeholders working in the Atlantic ocean science diplomacy? (provisory). To be submitted to the special issue of <i>Frontiers of Marine Science</i> . https://www.frontiersin.org/research-topics/30943/atlantic-ocean-ecosystem-assessments-under-multiple-stressors | 1 and 2 |
| 6 Polejack, A. (submitted). Coloniality in Science Diplomacy – evidence from the Atlantic Ocean. Submitted to the special issue of <i>Science and Public Policy</i> (Oxford). https://academic.oup.com/spp/pages/call-for-papers | 1, 2, 3, and 4 |
| Supporting Publications | |
| 7 Wisz, M. S., Satterthwaite, E. V., Fudge, M., Fischer, M., Polejack, A., John, M. S., ... Rudd, M. A. (2020). 100 Opportunities for More Inclusive Ocean Research: Cross-Disciplinary Research Questions for Sustainable Ocean Governance and Management. <i>Frontiers in Marine Science</i> , 7(576), 1–23. https://doi.org/https://doi.org/10.3389/fmars.2020.00576 | 1 |
| 8 Hatje, V., Andrade, R. L. B., Oliveira, C. C. De, Polejack, A., & Gxaba, T. (2021). Pollutants in the South Atlantic Ocean: Sources, Knowledge Gaps and Perspectives for the Decade of Ocean Science. <i>Frontiers in Marine Science</i> , 8(March), 1–17. https://doi.org/10.3389/fmars.2021.644569 | 1 and 3 |
| 9 Franz, G., Garcia, C. A. E., Pereira, J., de Freitas Assad, L. P., Rollnic, M., Garbossa, L. H. P., ... Polejack, A. (2021). Coastal Ocean Observing and Modeling Systems in Brazil: Initiatives and Future Perspectives. <i>Frontiers in Marine Science</i> , 8(August). https://doi.org/10.3389/fmars.2021.681619 | 3 |
| 10 Polejack, A., & Barros-Platiau, A. F. (2020). A Ciência Oceânica como ferramenta de Cooperação e Diplomacia no Atlântico. In A. F. Barros-Platiau & C. C. De Oliveira (Eds.), <i>Conservation of Living Resources in Areas Beyond National Jurisdiction: BBNJ and Antarctica</i> (pp. 45–65). Rio de Janeiro: Lumen Juris. | 1, 2, and 3 |
| 11 Kelly, R., Elsler, L., Polejack, A., van der Linden, S., Tönnesson, K., Schoedinger, S. E., ... Wisz, M. S. (2021). Empowering Young People with Climate and Ocean Science: Five Strategies for Adults to Consider. <i>SSRN Electronic Journal</i> . https://doi.org/10.2139/ssrn.3961791 | 1 |

| Other Works | |
|--------------------|--|
| 12 | Polejack, A. (submitted). The UN Decade of Ocean Science stages of grief – skepticism, frustration, fear of failure, and hope. <i>Marine Policy</i> (under review) |
| 13 | Polejack, A. (in press). Introducing ocean innovation diplomacy to the maritime sector. In: <i>Autonomous Vessels in Maritime Affairs: Law & Governance Implications</i> (Vol. 1). Palgrave Macmillan |
| 14 | Polejack, A., Oostdijk, M., S. Wisz, M. & Cvitanovic, C. (drafting). The power of ocean science communication in the science-policy-diplomacy nexus for society. Polejack, A. & Machado, L. F. C. da S. (in press). The possibilities of ocean innovation diplomacy to promote transnational innovation ecosystems for the maritime sector. In: <i>Autonomous Vessels in Maritime Affairs: Law & Governance Implications</i> (Vol. 2). Palgrave Macmillan |
| 15 | Polejack, A. (2021). Há Direito do Mar sem Ciência? A Diplomacia Científica no Oceano. <i>O Estudo Do Direito Do Mar No Brasil</i> . ARRAES, 64–67. |
| 16 | Polejack, A. (in press). The challenge of conducting marine scientific research under the current COVID-19 pandemic. <i>Meridiano</i> 47. |
| 17 | Dalmas, L. & Polejack, A. (in press). Governança, cooperação e diplomacia no oceano. In: <i>Economia Azul como Vetor do Desenvolvimento Nacional</i> . Santos, T., Beirão, A., Araujo, M. & Carvalho, A. (eds). EGN, Brasília, Brazil. |
| 18 | Routledge, E., Vieira, F., Cavalli, R. O., Valenti, W., & Polejack, A. (2022). A Plataforma de Tecnologia e Inovação em Aquicultura: uma contribuição para a Década da Ciência Oceânica no Brasil. <i>Revista Parcerias Estratégicas</i> . CGEE, 27(52), 61–76. |
| 19 | Polejack, A., Goveas, J, Robinson, S, Flink, T & Ferreira, G. (drafting). Where is the Global South in the Science Diplomacy Discourse? |
| 20 | |

3.2.1 Framing Ocean Science Diplomacy

In Polejack (2021), presented in the appendix as Paper 1, the main goal was to position ocean affairs in the current debates of science diplomacy. Previous research had shown how influential science diplomacy was in the negotiation and further adoption of UNCLOS (Robinson, 2020a). This paper was a timely contribution to frame ocean science diplomacy by combining scholarship on science diplomacy and ocean affairs, as well as the law of the sea. The backdrop or broader context was the beginning of the UN Decade of Ocean Science for Sustainable Development (the Decade) in 2021.

Presenting the evolution of the concept of science diplomacy and analyzing how critically important it is to the implementation of UNCLOS highlights non-conventional provisions in the Convention where science plays a key role. Issues such as dispute settlement and boundary delimitation were brought to this analysis. These issues are non-conventional because UNCLOS clearly states the need for ocean science in Parts XIII and XIV, which are devoted to marine scientific research and the transfer of marine technology, respectively. The goal is to show how essential scientific evidence is to provisions not directly related to marine scientific research.

One of the weaknesses in UNCLOS is that it does not provide a legal basis for holding regular meetings of the Parties to allow consensual adjustments to the course of implementation or an interactive science regulatory dialogue. This contrasts with the UNFCCC, for example (Long, 2022). In light of this, ten years of the General Assembly omnibus resolution on oceans and the law of the sea were

reviewed to determine which issues State Parties were requesting science to inform diplomacy. Polejack (2021) presents extracts from those resolutions which contain references to marine science (please refer to Table 1 of Paper 1 in the appendix). In that context, science is frequently requested to provide knowledge on ocean conservation and environmental protection. In addition, for the last ten years, the UN has adopted a *chapeau* paragraph stating the importance of science to advancing knowledge, providing well-being to society and contributing to decision-making, the major expected outcomes of science diplomacy (Berkman, 2020).

The new treaty being negotiated for regulating access to biodiversity on the high seas was slightly touched upon in Paper 1 because recent work has already looked into that subject (Harden-Davies, 2018; Long & Chaves, 2015; Tessnow-von Wysocki & Vadrot, 2020), although it is very interesting from the ocean science diplomacy point of view. Instead, the focus on the start of the Decade was chosen. The Decade, as well as the UN 2030 Agenda and its related Sustainable Development Goals, are substantially ocean science diplomacy practices because both processes result from the available scientific evidence on the global ocean threats, which informed and put pressure for diplomatic action to be taken.

At least four features in which ocean science diplomacy can be instrumental were highlighted: enhancing inclusivity, promoting sustainability, addressing global inequalities in science and technology capacities, and advancing global community interests. Such a practice can offer powerful support towards a more just, equitable, and balanced ocean, in particular during the Decade (in support of Bennett, 2022).

Paper 1 is part of a special issue devoted to the implementation of the ocean Sustainable Development Goal and currently has over 9,200 views, 1,060 downloads, and eleven citations (according to Google Scholar in June 2022). It has proven to be a timely contribution to knowledge by raising awareness about the importance of ocean science diplomacy and stimulating the ocean community to explore this practice in a more coordinated manner. Paper 1 contributes to answering our research questions 1 and 3, as stated in item 1.2 of this dissertation. It began to unveil the genesis of the dominant discourse of what ocean science diplomacy means in practice to the global community.

3.2.2 The All-Atlantic Ocean Research Alliance

To advance from the theoretical perspective explored in Paper 1, it was necessary to focus on specific ocean science diplomacy practices. For a series of reasons, the All-Atlantic Ocean Research Alliance (hereafter, the Alliance) was chosen for analysis. First, the Alliance was not intentionally planned to scale up as it did. Initially, it was established in order to enhance marine scientific research while at the same time reducing costs by aligning the scientific superpowers of the North

Atlantic. Second, as the Alliance shifted to the South Atlantic, through the coordinated work of the European Commission in pursuing its interests, Brazil became an important participant in its activities. As a government official in the Brazilian branch of science and technology, I was involved in the process at a very early stage, giving me an insider (and Southern) perspective on ocean diplomacy in action and participatory research. Third, and subsequently, my previous experience in the Alliance facilitated the identification and engagement with relevant actors involved in this process. Consequently, Paper 2 (Polejack *et al.*, 2021) came to be both a descriptive article on the Alliance and a first attempt to analyze the interests of countries in establishing it. This aligns well with the core arguments used by Gluckman *et al.* (2018) to frame a new concept of science diplomacy based on interests, as shown in Table 1 of this dissertation.

Paper 2 describes the stepwise process of negotiating the establishment of the Alliance, which was initiated by the signing of the 2013 Galway Statement between the EU, Canada, and the United States and focused exclusively on the North Atlantic. Nations in the South, in particular Brazil and South Africa, proceeded to also align their research efforts in the South Atlantic, jointly signing a marine research South-South Framework in 2017. More than just defining research priorities and courses of action, this Framework also seeks ways to influence the Galway Statement with provisions devoted to using science diplomacy to advance Southern national agendas. Subsequently, bridging the South and the North, was the signing of the 2017 Belém Statement between the EU, Brazil, and South Africa, effectively creating the All-Atlantic Alliance. This stepwise process is illustrated in Figure 2.



Figure 2: Map of the Atlantic Ocean showing the process of creating the All-Atlantic Ocean Research Alliance with the involved countries' flags

The description of this process, as well as the working method of the Alliance, was missing from the academic literature. This was the principal reason why much of Paper 2 is devoted to showing the complexities involved in the process of its establishment. Also important was the comparison of the three basic documents setting up the Alliance, which showed the priorities defined by each region and the results of a combination of South and North perspectives. These results are summarized in Paper 2 and presented therein as Table 1.

Paper 2 also discussed how incremental the European Commission was in pursuing its interests in the Atlantic, as per the mandate in official EU documents. In this regard, we showed how impactful the role of the EU's interests were in shaping such an endeavor. Moreover, similar to previous work by Dolan (2012), we showed how the EU successfully used bilateral arrangements in pursuing its broader foreign policy goals for the Atlantic. We concluded by affirming that the All-Atlantic Alliance is a case of ocean science diplomacy in practice and presented a few suggestions on what the future may hold for it, in particular how influential the Alliance could be in implementing the UN Decade of Ocean Science in the Atlantic region.

As can be seen, our discussion focused on what the Alliance means to the ocean science community in the South. Most especially, how Brazil and South Africa were also successful in achieving their goals in influencing the North on setting the agenda for the South Atlantic. In the course of this research, new insights were provided into the role of the Global South in developing ocean science diplomacy schemes. Moreover, it came to influence the direction and content of further publications that rest at the core of this dissertation. To date (June 2022), Polejack *et al.* (2021) has gained international attention in the specialist literature, having over 3,000 accesses and 13 citations. Crucially, this article filled an important gap in the literature as it is one of only a few articles led by a Southern researcher published as part of a special issue that focusses on the past, present, and future of European science diplomacy in Humanities and Social Sciences Communication (formerly known as Palgrave Communications), a Nature group journal. This article contributes to answering research questions 2 and 3, as stated in item 1.2 of this dissertation.

3.2.3 Ocean Science Diplomacy as a Game Changer for Latin America & the Caribbean Region

Paper 1 (Polejack, 2021) and Paper 2 (Polejack *et al.*, 2021) narrowed the research conceptualization. Specifically, they came from the perspective of a broader analysis of science diplomacy applied to ocean affairs and offered a practical example of how influential ocean science diplomacy can be in building up an

Atlantic ocean science community. Both articles also set the stage for discussions on how beneficial science diplomacy could be for countries in the South. It is with this aim that Paper 3 (Polejack & Coelho, 2021) was published.

There is a widely held assumption that the provisions in UNCLOS were designed to balance science and technology capacities worldwide (Robinson, 2020b). They are, however, still failing to reach that goal (Harden-Davies *et al.*, 2020; Harden-Davies & Snelgrove, 2020; Harden-Davies *et al.*, 2022; Tolochko & Vadrot, 2021a, 2021b). Accordingly, we investigated what role ocean science diplomacy could have in promoting change in this *status quo* and achieve a more just and equitable international legal order, taking into account the special interests and needs of the Global South.

In combining our research, Mrs. Coelho, a legal scholar and fellow PhD candidate, and I were able to expose the struggles faced by the ocean science community in Latin America and the Caribbean countries and how ineffective UNCLOS provisions have been in building capacity and transferring marine technologies to the region. By analysing the provisions under Part XIV of UNCLOS, which is devoted to the transfer of marine technologies, and related instruments, our article discusses and shows how Latin America and the Caribbean count less on institutional action and more on individual researchers' agency. In addition, direct involvement of the private sector and international regulatory mechanisms for intellectual property rights are basic components of the transfer of marine technologies that have impeded further engagement and the realization of UNCLOS. In this context, we advocate that countries in the region can greatly benefit from adopting the strategy of ocean science diplomacy to fulfil national requirements and negotiate better international agreements, especially on the transfer of marine technology. We provide a few concrete examples of transfer of marine technology made under the ocean science diplomacy framework. Finally, we frame the UN Decade of Ocean Science as a timely opportunity for establishing the necessary diplomatic debate to better coordinate technology transfer mechanisms to meet the current needs of the Global South.

Paper 3 was an invited contribution to a special issue dedicated to Science Diplomacy and Sustainable Development: Perspectives from Latin America, in *Frontiers in Research Metrics and Analytics*. From an action research perspective, it achieved all of its aims in so far as it is currently the fourth most viewed paper in the special issue, which included sixteen articles in total. With over 6,800 views and 553 downloads, this article has been cited seven times in less than a year since its publication. Paper 3 contributes to answering research questions 1 and 3, as stated in item 1.2 of this dissertation.

3.2.4 Ocean-Climate Nexus for Latin America

Due to the progressive advancement of this research and its resulting publications, I was invited to join a group of ocean natural scientists, two of which were the only invited authors from Brazil and Mexico, in the recent IPCC *Special Report on the Ocean and Cryosphere in a Changing Climate* (SROCC) (IPCC, 2019). This dearth of representation from the Global South tells its own story, supporting a central finding of this thesis. These scholars wanted to address the unequal participation of researchers (and knowledge) from Latin America in producing this overdue ocean-dedicated report of the IPCC. From their experience, the ultimate goal of such reports, that is, to inform diplomacy on the possible courses of action to reduce the consequences of climate change, was hindered by this lack of inclusion and equity. They believed that ocean science diplomacy had much to offer if we are to move forward as a global ocean community. With all the authors being from the natural sciences, this interaction with a social scientist on defining the scope and advancing discussions was a positive sign of how ocean science diplomacy is already informing better coordination in Latin America. In fact, a similar situation happened with other supporting publications coming out of this research where I was frequently the only social scientist and the person presenting new perspectives on the potential of ocean science diplomacy to the benefit of the ocean science community in Latin America (e.g., Franz *et al.*, 2021; Goncalves & Polejack, 2022; Hatje *et al.*, 2021; Routledge *et al.*, 2022).

In Paper 4 (Muelbert *et al.*, 2021), we exposed the unbalanced representation of Latin America in SROCC concerning knowledge gaps and opportunities that we identified and organized under five themes: (i) climate assessment information and regional policies, (ii) knowledge production, (iii) knowledge accessibility, (iv) knowledge impact to policy, and (v) long-term monitoring for decision-making. After conducting a preliminary assessment of national official documents related to climate change, we were able to expose how tangential the ocean agenda is in climate adaptation and mitigation plans in the policies of the countries in Latin America.

We highlighted how local researchers are hindered from taking action in global reporting exercises such as SROCC, which results in less uptake of global scientific knowledge to local governments. As a result, we presented an appeal to increase the contribution of the Global South and bring forward national and regional perspectives to these reporting exercises. Climate change can no longer be seen solely from the Western perspective in the Global North and must embrace local realities and fight against hegemonic discourses in such reports (Spence, 2007).

We concluded by advocating that the uptake of the scientific findings of the Special Report could be enhanced in Latin America in four ways. First, by embracing local realities and knowledge producers. Second, by empowering local researchers and

other knowledge producers to inform global assessments and also to be able to adapt those findings to local realities. Third, by enhancing regional research capabilities and building excellence in science from the regional perspective. Lastly, by securing long-term ocean observations and including these results to better-informed decision-making.

Paper 4 was an invited contribution to the special issue of *Frontiers in Climate* addressing the knowledge gaps from the SROCC and recent advances. Although its publication is very recent (November 2021), there have been more than 2,200 views, with over two hundred downloads and two citations so far. This article aids in answering research questions 1 and 2, as per item 1.2 of this dissertation.

3.2.5 Ocean Science Diplomacy and Integrated Ecosystem Assessments

The manuscript of Paper 5 (Polejack *et al.* (in progress)) reports on the first results of my interviews. We assessed the meaning of IEAs as understood by key stakeholders pertaining to research and policy in the All-Atlantic Ocean Research Alliance. We focused on IEAs as the end goal of the Mission Atlantic Project⁵, an European Commission funded project in support of implementing the All-Atlantic Alliance, our case study. Mission Atlantic brings together a set of researchers from the South and North Atlantic looking at conducting international IEAs in different regions. International IEAs are transboundary, conducted across jurisdictions, or in international ocean spaces. This paper represents the first attempt to look at IEAs through the bifocal lenses of science diplomacy. We advocate that international IEAs are essentially the practice of ocean science diplomacy since, per the IEA process, they bring together stakeholders from different ocean sectors to evaluate and monitor the scientific results with a view to informing international managerial and decision-making processes.

The draft of Paper 5 analyses the perceptions of research and policy stakeholders on the meaning of IEAs. We interviewed government officials and scientists who are in positions of power of influencing IEAs in the context of the All-Atlantic Ocean Research Alliance. Most of these individuals stated not having had previous experience with IEAs, being generally unaware of IEAs concepts and process. However, this lack of understanding of IEA was no impediment for them to share what they believe IEA is or how it should proceed. According to their perceptions, IEAs have the main goal of co-producing knowledge with regard to manage human threats to the ocean. In this sense, humans are separate from the marine environment, with the power to both disturb and manage it. The scientists and

⁵ <https://missionatlantic.eu/> accessed 24 February 2022.

government officials I interviewed seemed to make sense of IEAs in different ways. Scientists reflected on the complexities of assessing integrated ecosystems and rarely placed economic benefit as a priority. Officials meant the IEA as the environmental component of a broader system devoted to maximize profit at lower environmental risk. We discuss that IEA in the Atlantic seems to be revolving around the provision of solutions from research to enhance economic profit, with the understanding of the complexity of the marine environment as a path to achieve that economic goal. We question whether it is possible to determine what a low environmental cost is and also who determines it. With regard to these perceptions, we draw a few recommendations, in particular for those marine IEAs that are transboundary. We advocate that the scoping phase of an IEA is of critical importance. It is during the scoping phase that stakeholders are identified and engaged. The involved stakeholders will bring along their sector's interests that need to be disclaimed and accounted for. During the scoping phase, a safe and open space needs to be secured, so these interests are negotiated and mutual understanding on concepts, roles in the process and the possible outcomes are achieved.

We also advocate that applying principles of science diplomacy, that is, bridging a diversity of communities of practice and revealing the stakes and power at play, can facilitate the conduct of international IEAs. We suggest the inclusion of diplomats in international IEA processes because of their training in negotiating successful outcomes and also because of their role in defending national interests with clarity. We advocate that using science diplomacy can be a benefit to those conducting international IEAs.

Paper 5 is an invited contribution to the special issue of *Frontiers in Marine Science* on Atlantic Ocean ecosystem assessments under multiple stressors. This article contributes to answering research questions 1 and 2, as per item 1.2 of this dissertation.

3.2.6 Colonialism in Atlantic Ocean Science Diplomacy

Following the red thread, the publications emanating from this research have reviewed both documental and empirical evidence of ocean science diplomacy from the Atlantic. The case choice for this study, the All-Atlantic Alliance, has been very interesting because it brings perspectives from not just between government officials and researchers, but also from the South and North Atlantic. This diversity in realities and perspectives has greatly enriched the evidence. We now turn to the last core paper of this thread. From identifying the dominant discourse in academia to researching in the field with the agents of science diplomacy, we have reached a critical understanding of what ocean science diplomacy entails.

Paper 6 (Polejack, in progress) analyses the perceptions of ocean science diplomacy revealed by the interviews in the All-Atlantic Alliance context. This evidence invites an in-depth analysis into the field. This analysis commences with a discussion around the power and the need for science to influence diplomacy. Science, in this perspective, is expressed by mainly as being cooperative, international, neutral, and powerful in leading to peace among nations. Diplomacy would openly welcome such science and consequently make better-informed decisions, awarding scientists with recognition, funding, and capacity development.

Going one layer down, a certain reality is evident due to clashing values between policy and science. Interviewed scientists do not feel part of the decision-making processes, nor wish to become so. They have experienced misuse of their research and goodwill, and are suspicious of the ethics involved in the political decision-making processes. Interviewed government officials were no different. They recognize the politics behind science-making and how influential this can be in diplomatic contexts. However, this is not always in a good, benevolent sense. Interviewed diplomats expressed their concerns about trusting processes grounded on scientific evidence presented by scientists from other countries. Further, some government managers believe that science needs to be limited on how and when it contributes to policy.

Furthermore, interviewees expressed a perceived segregation between the South and North Atlantic. The interviewed Northern government officials generally expressed science as a soft power (as opposed to the hard power of force and coercion, as per the description of Nye (1990)). Interviewed Northern researchers often identified their Southern peers as those in need of assistance and capacity. In turn, the interviewed Southern researchers often expressed experiences of tokenistic participation in ocean research projects that were led by their Northern counterparts. Similarly, the interviewed Southern government officials stressed how impactful inequalities in research capacities are to their national advising systems and resulting agency in international negotiations. Indeed this is also evident in relation to the concept of “parachute science” (Stefanoudis *et al.*, 2021; Vos & Schwartz, 2022). Figure 3, reproduced from the draft manuscript, presents examples of extracts taken from the interviews.

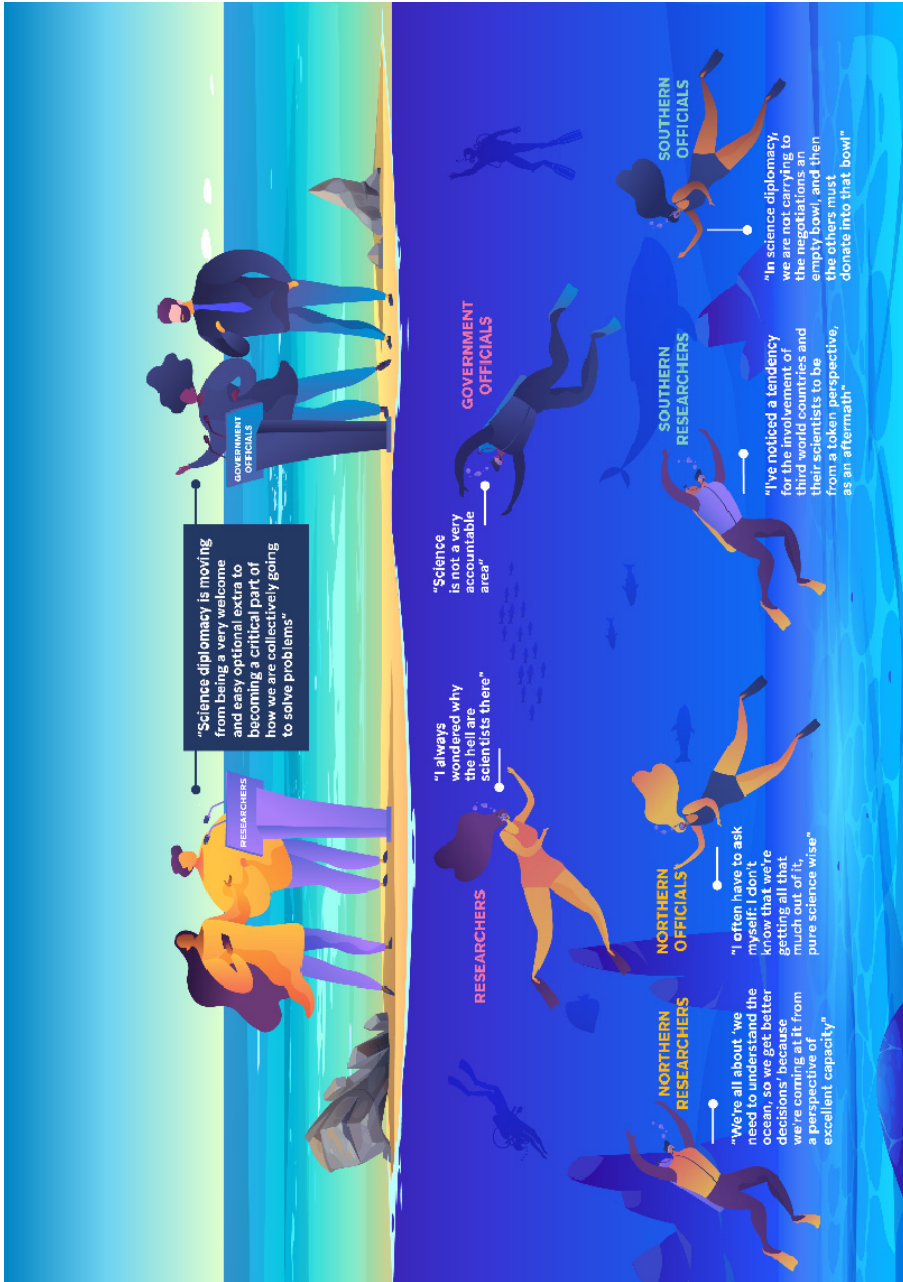


Figure 3: Notable and exemplary quotes extracted from the interviews conducted in the course of this research. The top of the image shows both government officials and researchers, irrespective of their region, signifying ocean science diplomacy as an overall beneficial practice. One layer down shows the existence of the clashing values between researchers and government officials. The bottom of the figure exemplifies different perceptions from the interviewed officials and scientists from North and South Atlantic.

Post- and decolonialism offers at least two relevant assumptions. First, the colonizer imposes a value system on the colonized, who consents to this alien system and starts to apply this value system to signify its very own existence (Said, 1978). Second, the colonized are cast as being lesser, as those in need of assistance, as those yet to become full beings, which can only happen by adopting the colonizer standards (Harding, 2008; Quijano, 2000). In ocean science diplomacy this feature has been detrimental to the full development of true bonding of the ocean community towards the common goal of sustainability (Polejack, 2021). The evidence presented in Paper 6 deconstructs these perceptions of ocean science diplomacy as being a powerful tool to foster better-informed decision-making internationally. Instead, it shows how critical it is to acknowledge these different perspectives of reality and to embrace these differences to produce a framework in which both science and diplomacy can reach their full potential.

Paper 6 aligns very well with the arguments developed in previous articles and aggregates the results from this dissertation. By doing so, it greatly contributes to answering the four research questions. It also paves the way for future work on ocean science diplomacy in terms of justice and equity. Polejack (in progress) is an invited contribution to the special issue on science diplomacy in the Global South, from the Oxford journal *Science and Public Policy*.

4 Discussion

The main topics and arguments developed in this research are summarized by the relevant publications derived from it. In each academic paper, a separate discussion section addresses the specific arguments and findings in light of current theory and practice. The aim of the discussion section of this dissertation is different in so far it focuses on issues that cut across and are in some instances common to those publications, with a view to answering the research questions addressed by this dissertation. Figure 4 presents a visualization of the interrelation between the research questions with the core publications of this dissertation.

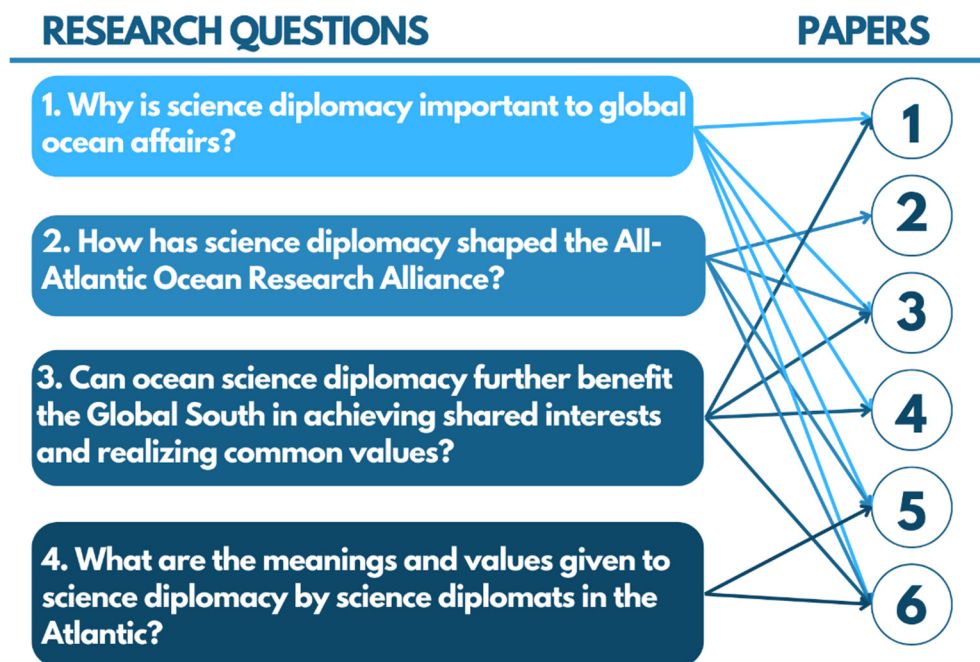


Figure 4: Schematic representation of the links between the research questions with the core publications that are part of this dissertation.

4.1 Why Is Science Diplomacy Important for Global Ocean Affairs?

Advocates of science diplomacy often highlight that international relations scholarship has undermined the role of science in influencing foreign affairs, probably because issues of science do not fit well under traditional international relations theoretical schools and paradigms, such as realism (Flink & Schreiterer, 2010; Nye & Welch, 2017). Policy-makers raised the value of science in official international engagements, particularly in building trustful and peaceful relationships between countries, prominently after the Cold War (Flink & Schreiterer, 2010; Hennessey, 2019; Lord & Turekian, 2007). Consequently, academics became interested in understanding the processes that form the basis of the interrelationship between research and foreign affairs. This push resulted in an emerging field of interdisciplinary research known as science diplomacy. Today, science diplomacy scholarship seeks empirical evidence to ascertain the assumed benefits of science diplomacy. Further, there is also a rise in the critical analysis of the power play behind and the motivations of those engaging in science diplomacy practices (Flink, 2020; Rungius & Flink, 2020). Naturally, this quest has been dominated by Western perspectives of science diplomacy, whereas the search for Global South epistemes is still incipient in academic papers (Soler, 2021).

In general, science diplomacy scholarship is focused on land-based themes of analysis. This might be because it is simpler to deal with geographical boundaries that are historically set and have defined jurisdictional spaces. Science diplomacy themes that are truly global and affect humanity despite geography and citizenship are only a few. They are more challenging due to overlapping jurisdictions, conflicting regimes, and limited reinforcement measures. Among such themes where science diplomacy plays a critical role are outer space, Antarctica, climate change, and, of course, the ocean (Berkman *et al.*, 2011; Robinson, 2020a; Ruffini, 2018). Antarctica and outer space are subject to international arrangements that curtail certain countries from taking action, with only a few determining the possible outcomes. The ocean and climate, on the other hand, are still on the verge of implementing sophisticated regulatory regimes that are science dependent (Polejack, 2021; Polejack & Coelho, 2021). Despite the apparent modernity in the international climate regime (Ruffini, 2018), there are still setbacks in its implementation, in particular issues of equity and justice (Muelbert *et al.*, 2021). The regulatory regime for the ocean is complex and multilayered (Ramírez-Monsalve & van Tatenhove, 2020). As such, it also faces critical challenges in its implementation, and yet is expected to provide just and fair transitions to sustainability (Bennett, 2022; Bennett *et al.*, 2021; Österblom *et al.*, 2020). Moreover, legal provisions under the framework of UNCLOS, such as the common

heritage of (hu)mankind principle (Wolfrum, 1983), extend inequality and injustice to those less privileged (Vadrot *et al.*, 2021).

It seems logical to ascertain that ocean science diplomacy is dependent on the unique *milieu* it occurs in. Ocean science diplomacy seems inevitably intertwined with the particular context in which it takes form, both in terms of the actors/stakeholders involved as well as the institutional framework within which it unfolds. It also seems logical to assume that contexts change over time and in face of a constantly changing regulatory and political landscape. In the European context, for example, ocean governance related to environmental protection is such a complex scenario that researchers developed what they call a “horrendogram” (Boyes & Elliott, 2014), reproduced in Figure 5 to illustrate this complexity.

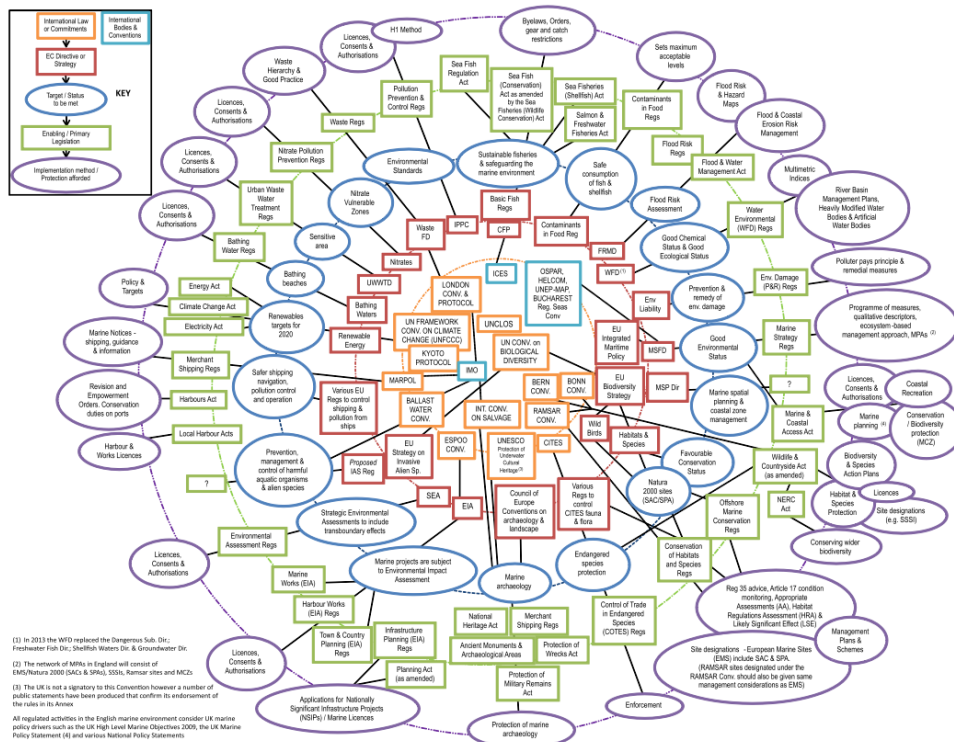


Figure 5: The “horrendogram” developed by Boyes & Elliott (2014) featuring the international, European and English legislation with reference to marine environment protection. Source: Boyes & Elliott (2014).

Assuming ocean science diplomacy to be context-dependent would pose a necessity to assess a framework similar to the above ‘horrendogram’, an issue that was not possible to accomplish during the timeframe of this research. Even in light of the case study analysed through this work, addressed in the next section, it would be

virtually impossible to survey the institutions and actors involved in all countries pertaining to the All-Atlantic Alliance. Nonetheless, science diplomacy in the ocean appears to be more challenging to understand although equally fascinating from research, public policy and epistemic perspectives.

Clearly, science was and still is present in the global ocean regime, informing on ocean thresholds, issues of concern to the global community, and possible solutions to these problems that should be debated in diplomatic settings (Chambers *et al.*, 2022; Tessnow-von Wysocki & Vadrot, 2020). However, the influence of ocean science in traditional diplomacy goes well beyond any such expected contribution or outcome. For example, the level of scientific capacity influenced countries' positions when negotiating UNCLOS and led to many of the Convention's outputs (Robinson, 2020b). In this context, even issues not usually related to science, such as dispute settlement and boundary delimitation, are influenced intrinsically by the input of ocean science (Polejack, 2021). Thus, one can analyse UNCLOS as a core framework for the application of ocean science diplomacy (Harden-Davies, 2018; Polejack & Coelho, 2021). A recent development illustrates the veracity and compelling nature of this argument. The adoption of a Decade of Ocean Science for Sustainable Development by the UN General Assembly ascertains how timely and necessary it is to study the products of scientific input to multilateral decision-making. The Decade is requesting that UN Member States align research efforts and budgets to jointly produce scientific knowledge that improve marine ecosystem conservation and societal well-being along the lines of the leitmotiv: "The ocean we need for the future we want" (Ryabinin *et al.*, 2019). Consequently, it is clear that ocean science diplomacy is an unrecognized pillar of the Decade and an underlying process in almost all contemporary international negotiations on the ocean and related issues (Polejack, 2021). It can be argued that the Decade is in its early, formative stages, and it would be hasty to jump into conclusions about the critical role of ocean science diplomacy in its implementation. However, this argument dismisses the long negotiation process of the Decade itself, both at the level of the IOC as well as at the UN General Assembly. This feature points to the argument that ocean science diplomacy has ever been present in the discussions that triggered the adoption of such a Decade. Being focused on ocean science instead of raising threats on economic endeavours, such as lucrative fisheries and the yet-to-accomplish seabed mining, the Decade negotiation also assumed science to be value neutral and necessary from the global ocean community standpoint. It will be interesting to further observe the implementation of the Decade through the means of its programs, actions and projects, to assess whether this implementation has reproduced old habits of concentrating agency, budget and capacities in the Global North, as seems to be the case with current projects, such as the one called Seabed

2030⁶, where almost all research vessels and scientists come from countries in the North.

Throughout this research I have advocated for the critical importance of understanding the different incentives and interests at play in international engagement around ocean affairs. Ocean science diplomacy research is an effective framework to pursue such a goal. Ocean science diplomacy is important at the UN or similar multilateral frameworks, where traditional diplomacy works at its fullest. Ocean science diplomacy is also present in usual scientific international collaboration on issues such as to combatting marine pollution (Hatje *et al.*, 2021), pursuing better public engagement with science (Kelly *et al.*, 2021; Wisz *et al.*, 2020), advancing mutual understanding and management of marine ecosystem threats (Polejack *et al.*, in progress), or even fostering national coastal observing systems (Franz *et al.*, 2021). Indeed, all of these issues were dealt with during and by this research. It is thus critical to understand, on one hand, the current practices of science diplomacy that could leverage ocean international affairs, and, on the other, unveil the powers and stakes at play, which are often driven by the interests of a few. In other words, one has to look behind the veil. Power is not a linear phenomenon, but rather diverse in terms of policy arrangements (Arts, Tatenhove, & Leroy, 2000), as well as at different ocean governance levels (Ramírez-Monsalve & van Tatenhove, 2020). Consequently, it is evident that research on the power disputes between interest groups in ocean international affairs where science and diplomacy are closely interrelated becomes an absolute prerequisite for ensuring successful outcomes from the Decade.

4.2 How Has Science Diplomacy Shaped the All-Atlantic Ocean Research Alliance?

National interests may be determinant in justifying a country's engagement in ocean science diplomacy practices (Gluckman *et al.*, 2018). Evidence supports such a statement in regard to the All-Atlantic Ocean Research Alliance (Polejack *et al.*, 2021). The interests that drove the EU, Brazil, and South Africa to pursue the strengthening of this Alliance may be different, but are certainly compelling examples of current practices in ocean science diplomacy. The EU used science diplomacy as a strategy in achieving its foreign policies in the Atlantic, while both Brazil and South Africa sought to influence the investment in research and development in the North Atlantic by pushing their interest agenda further in the Alliance. In the All-Atlantic Alliance, ocean science diplomacy was used as a force

⁶ <https://seabed2030.org/> accessed in August 2nd, 2022

to bring together a set of diverse countries, each at a different development stage in terms of ocean science capabilities. By doing so, the Alliance's aim of applying science diplomacy was as much present from a governmental perspective as it was from a scientific community standpoint. Researchers were interested in opening channels for collaboration by accessing critical environmental features in the South Atlantic, as well as research infrastructure in the North.

How the Alliance was established can also be examined from a science diplomacy strategy standpoint. By exploring bilateral agreements with each of the partners in the North and in the South, it is clear that the European Union leveraged an ocean-basin regional diplomatic arrangement, which might raise European influence over the regional priorities in the many fields of ocean science. A natural outcome of such regional coordination is the influence of this agenda-setting in the overall organization of the Decade of Ocean Science. At least in the Atlantic Ocean, the communities are engaged and organized through the Alliance and can coordinate their activities to support the goals of the Decade. In this sense, there is a chance that the Alliance will also influence the global ocean community by working regionally towards achieving the Decade's outcomes and thus become a model for other basins. It will be interesting to witness whether European influence in the Decade will be facilitated by the actions of the All-Atlantic Alliance.

The Alliance should not be seen as a single entity, for it encompasses a diversity of political and developmental frameworks within the countries that are part of it. From a social perspective, the Alliance is an intriguing case of ocean science diplomacy exactly due to these differences. By bringing South-South, North-North, and finally, South-North cooperative arrangements together, implementing such an Alliance reproduces much of the impacts that accrue from the inequality in science capacity noted in official documents such as the *Global Ocean Science Report* (IOC-UNESCO, 2020a). These impacts include the power exercised by the North in pursuing national political agendas, defining research priorities, and allocating funds for research, among others. The South, in contrast, seems to use ocean science diplomacy to improve research capacity and international cooperation agreements (Paper 2, Paper 6). As a result, the Alliance tends to reinforce colonialism in ocean science, which then becomes a strong asset in ocean science diplomacy, a subject addressed in the next section. At this point, I wish to highlight that this is a central finding of my research and analysis that goes directly to the core of this dissertation.

4.3 Can Ocean Science Diplomacy Further Benefit the Global South in Achieving Shared Interests and Realizing Common Values?

The Global South is a contested definition that refers to less privileged countries in terms of socio-economic development as well as research capacity and infrastructure (Kloß, 2017). The term Global South is preferred in contrast to others, such as developing countries or Third World countries, because it captures the notion of former colonies that still struggle with power asymmetries, although countries may not physically be located in the Southern Hemisphere, making geography less important in applying such a term (Tripathi, 2021).

In general, a perspective of science diplomacy in the South is missing and often expressed from the perspectives of Northern researchers (Bonilla *et al.*, 2021; Kraemer-Mbula *et al.*, 2020, p. 21). In this sense, there is currently a call for countries in the Global South to identify what science diplomacy means from their realities and assess what it should encompass (Mencia-Ripley *et al.*, 2021). In ocean affairs, countries in the Global South have applied ocean science diplomacy since the inception of the UNCLOS negotiations, even without the formal concept of science diplomacy having been developed (Robinson, 2020a). In this case, it was because of the lack of scientific capacity and the fear of being left behind in technology developments that those countries were able to adopt Parts XIII and XIV of UNCLOS, with the specific aim of securing fair development of marine scientific research and just transfer of marine technologies (Harden-Davies, 2016; Robinson, 2020b). For countries in the Global South, ocean science diplomacy strategies are a matter of balancing the diplomatic power game by allowing equal opportunities to access marine technologies (Polejack & Coelho, 2021), influencing the research agenda in the North (Polejack *et al.*, 2021), and ascertaining their value by voicing their local realities and other local epistemologies (Muelbert *et al.*, 2021; Rodrigues, 2021).

Ocean science diplomacy can be beneficial to the Global South as a means to negotiate better international agreements in search of fulfilling countries' foreign policies. As a first step towards this goal, each country needs to nationally identify, organize and coordinate ocean research efforts based on local needs (Polejack & Coelho, 2021; Polejack & Machado, in press). In view of their ocean science and technology systems, as well as the limits in their advisory schemes, countries in the South can identify Northern foreign strategies disguised as international scientific cooperation which are in fact looking at expanding markets, accessing marine natural resources beyond national limits, or even testing new products and technologies abroad, just to name a few (Hoogvelt, 2001; Ruffini, 2020a). Therefore, adopting a strategy to foster ocean science diplomacy brings both

internal and external benefits, and countries in the Global South should pursue such a goal (Bonilla *et al.*, 2021; Echeverría King *et al.*, 2021).

While conducting this research, a specific case in time triggered the debate around the coloniality of science diplomacy. In 2022, a European academic event on science diplomacy, entitled “Science Diplomacy, Diversity and the Global South” had the ambition to “address different, sometime conflictual, perspectives on how a new vision and practice of science diplomacy may be critical to bridge the Global North and the Global South interests and contribute to finding common, albeit diverse, solutions”⁷. Unfortunately, this event reproduced a Eurocentric pattern, whereby the Global South was only represented by seven speakers, in contrast with the fifty-eight panellists from the Global North. The justifications for such a lack of representation presented by the organizers ranged from time-zone differences to unavailability of speakers. Nonetheless, the sole fact that the event was held without proper representation of the South while debating it from a Global North perspective denotes the coloniality behind this line of thinking (Quijano, 2000). Consequently, I am currently leading the draft of a manuscript on the coloniality of science diplomacy together with a group of researchers. This specific draft manuscript is a spin-off of this research, thus not presented as a core paper in this dissertation. This draft manuscript presents science diplomacy from a postcolonial perspective, pointing to timely issues of equality and parachute science (Stefanoudis *et al.*, 2021; Vos & Schwartz, 2022), as well as the value behind North-South relationships. It is hoped to be submitted to the Research Policy Journal in 2022.

Naturally, science diplomacy is put into practice by its agents, the science diplomats (Melchor, 2020). It is through science diplomats that this social phenomenon and concept flourishes. Individual science diplomats differ in their instruments and mandates between the North and South Atlantic, as their local realities also differ. Therefore, it is imperative to understand the meaning that these science diplomats attach to engaging in ocean science diplomacy practices, and the perceived value fostering those practices through various processes and strategies that permeate contemporary ocean affairs (Polejack, in progress; Polejack *et al.*, in progress).

⁷ <https://insscide-lisbon2022.ciuhct.org/program-overview/> accessed 14 June, 2022

4.4 What Are the Meanings and Values Given to Science Diplomacy by Science Diplomats in the Atlantic?

The discussion above has shown a difference in the perceptions and goals applied to ocean science diplomacy between the North and South Atlantic. In this context, postcolonial and decolonial theories shed light on how such engagement between empires and colonies has shaped current reality and influences the current meaning of ocean science diplomacy. Postcolonial theory states that current reality cannot be seen without acknowledging and referencing the results of historical colonial and imperial rule (Said, 1978). Colonies were explored, catechized, and educated to adopt an alien value system to signify their very existence, to differentiate right from wrong (Fanon, 1965; Harding, 2011; Losurdo, 2020). By doing so, the colonizer sets up a rank of humanity, with the colonizer as the normative fully human, while the other is less human, less capable, and thus seeking by all means to become the colonizer (Tripathi, 2021). In addition, the colonizer utilizes its dominance to interpret and make sense of the other, ignoring the colonized perception of self. On the other hand, colonized beings adopt the settler's value system by which they signify their existence (Gramsci, 1971, p. 12). Being oppressed by this system of values, the colonized wants at any cost to approach their existence to the normative, to resemble the colonizer (Freire, 2005, p. 62).

It could be said that colonialism saw its epilogue with the political independency of colonies. However, this Eurocentrism has continued to rank and segregate humanity in terms of class, gender and race (Mignolo, 2009). While postcolonial theory postulates that the modern social fabric cannot be understood without acknowledging this 'colonial wound' (Losurdo, 2020; Santos, 2009; Spivak, 2010), decolonial scholars attribute this persistent legacy of colonialism to be a redesign of power relations and dominance in modern international relations, termed as coloniality of power (Mignolo 2007; Quijano 2000). Coloniality then represents the new colonial project, referring to the social, economic and political consequences of historical colonialism that gives the backbone for the core-periphery relationships today (Mignolo, 2009). Coloniality can also provide an explanation to how resources still flow from peripheric (and semi-peripheric) countries to enrich core countries, as addressed by dependency theorists (Furtado, 2020). In this sense, colonialism would be a social formation, while coloniality a "political and symbolic condition" (Lissovoy & Bailón, 2019).

Historically, the Atlantic has been the main stage for colonization and imperial expansion (Games, 2006). Colonialism was responsible for the wealth that European empires enjoyed from exploring Atlantic colonies (Mignolo, 1995). Colonialism was possible due to the technological advancements in navigation,

intensified in the sixteenth century with the Atlantic Ocean at the heart of the matter (Kohn & Reddy, 2022). Apart from exploring natural resources, colonialism systematically selected what was considered beneficial to the wealth of the crown, expropriating local knowledge, specially about the local natural environment, and repressing those that were considered unfit (Quijano 2007). Consequently, colonialism established a relationship between the settlers and the colony based on dominance. Scholars argue that the colonialization of what today is termed as Latin America facilitated the creation of Europe as a socially and politically constructed identity, where the European would be the civilized and superior to the colonized, who were perceived as the savage deprived of civility and enlightenment (Quijano 2007). The differences in the physical traits of the colonized and the settler would have nurtured the notion of race as a social classification, placing non-Europeans as the inferior other, persistent in current social fabric as a means of dominance (Harding, 2008; Said, 1978). As a result, these relations of superiority and inferiority legitimized dominance and permitted the Eurocentric perspective to be the standard of civility and scientific epistemology (Quijano 2000). The historical and political colonialism (and its subsequent Eurocentrism) is relevant to understand the modern international relations between former colonies and empires in the Atlantic (Alejandro, 2019), and hence composes the backstage of this research.

In the Atlantic, perceptions of ocean science diplomacy seems to reinforce such coloniality. It has been observed that interviewees from the North Atlantic often refer to their Southern partners of the All-Atlantic Alliance as those seeking assistance, which naturally results in the North as the assistance provider, denoting a sense of superiority. Southern subjects, in turn, voiced the deleterious consequences of this assistance philosophy and tokenism, both in research as in diplomacy. This feature is not exclusive to this Alliance, but rather a common practice in international aid, particularly on issues of health, as recently discussed by Khan *et al.* (2022). Thus, coloniality of power would advise on South-North relationships in ocean science diplomacy. From the manner by which Northern individuals make sense of their Southern peers to issues of equity in the access to funding, research infrastructure and human capital, all could be rooted in a project of coloniality. This project would seek to maintain countries in the Global North as the holders of scientific capabilities, culminating in more influential roles in the international agenda setting on ocean affairs, which seems to happen with regard to the negotiations on the conservation and sustainable use of the biodiversity that occurs out of national jurisdictions, for instance (Tolochko & Vadrot, 2021b; Vadrot *et al.*, 2021). Examples of this coloniality in science diplomacy could include the incipient participation of Southern scientists in developing critical scientific reports to influence diplomatic negotiations (Muelbert *et al.*, 2021).

As part of the colonial wound, Southern scientists are bound to Western criteria of excellence, even if these criteria are largely unfit to the reality in which they exist

(Kraemer-Mbula *et al.*, 2020). This criteria of excellence not only affect scientists, but also traditional and indigenous knowledge, the millennium survival kit for individual decision making in every Southern former colony. Western science determines which epistemes are fit and valuable to the eyes of the modern, widely accepted and, of course, Western scientific method (Hesselmann, 2019; Sharma, 2021; Smith, 2012). This epistemicide, or the murder of knowledge (Santos, 2016), translates how ineffective coloniality has been on *de facto* producing knowledge that is fit-for-purpose, questioning if science has ever been either universal or apolitical (Latour, 1993). In addition, this epistemic injustice has shown how detrimental epistemicide is to build any possibility of a better planet (Koskinen & Rolin, 2021).

Considering these views, ocean science diplomacy in the Atlantic is still in its infancy in reaching the goal of becoming a uniting force for building a true and peaceful All-Atlantic community. Before this goal can be reached, ocean science diplomacy should undertake an evaluation of internal procedures to seek balance in research capacities as well as a mutual understanding of these diverse realities, and determine where action is needed to foster a better governed Atlantic ocean. In sum, ocean science diplomacy needs to be decolonized so it becomes the desired powerful tool to bridge communities and foster better-informed decision-making. Otherwise, we run the risk of reinforcing ancient divisive values that have created the challenges the Atlantic historically faces.

At this point in time, it seems inevitable to also question whether the very concept of science diplomacy makes sense to Southern communities as it seems to do for those in the North. As a concept developed in the USA with further debates in Europe, science diplomacy may be yet another manifestation of coloniality of power. According to the interviews reported in Paper 6, diplomacy is distinctively influenced by science in the North and South, turning the definition of what would be a Southern-centered science diplomacy a matter of interest, if indeed this definition is desired by the South. Noteworthy, the search of what a Southern science diplomacy would look like can greatly differ between epistemic communities and countries, reinforcing the artificiality of the term South as including many different realities. However, science diplomacy has been reported as a tool for the globalized advancement of humanity as a single entity (Berkman, 2019; Gluckman *et al.*, 2018), so caution is necessary with the Northern approach to using science as a source of power to chase political interests abroad, what could reinforce relationships of dominance and coloniality of power with the South, all things considered (Flink 2020; Ruffini 2020b; Rungius & Flink 2020). It is time for the many countries and communities in the Global South to signify science diplomacy to local realities and build meaningful international engagements for these communities' benefit (Mencía-Ripley *et al.*, 2021).

4.5 The Contribution of this Work to Scholarship

In addition to the questions answered in previous sections, this research may represent a decisive step in elucidating the values attributed to science diplomacy by key agents in the Atlantic Ocean. In this context, it contributes to the debate on the meaning of science diplomacy, exposing the ocean as a fascinating stage and cognitive area for the development of further studies. This work also showcases how ocean science diplomacy can act as an influential practice underlying multiple negotiations in ocean affairs. By illustrating the role of ocean science diplomacy in issues ranging from the implementation of international regimes to fostering better ocean observing systems, this research has shown how timely and critical it is to elucidate the mechanisms and dynamics produced by the mutual influence of science and diplomacy.

As inductive research, this work did not aim to test theories and thus it was not my goal to unveil the relationship between science and diplomacy from a colonial perspective. Rather, it was because of the perceived values and inherent positionality of the individuals contributing to the interviews that coloniality was centrally placed in this discussion and in the narrative that underpins this dissertation.

The sense these individuals make of ocean science diplomacy reflects the way they perceive the interaction between science and diplomacy in international negotiations. This sense-making reveals conflictual oppositions as a binary logic. However, I acknowledge that reality goes beyond binary and fairly simplistic relationships. There exists a multitude of shades and tones between these green and blue positions. As Chimakonam (2019) suggests, binary logic contributes less to decolonizing reality because it naturally places the colonized and the colonizer as different entities in dispute. Chimakonam argues that if we simply substitute one power for another, there will still be opposing forces, following the detrimental logic of the “winner takes it all”. This is not the case. Humanity should seek ways to abandon this binary opposition and find the opportunity for dialogic encounters where science and diplomacy acknowledge, respect and thrive because of their differences. As defended by Freire (2005), humans should seek the humanization of us all, liberating the oppression that limits our capacities and knowledge development. On the other hand, it seems timely that we, as ocean stewards, recognize this colonial past, this open colonial wound. Recognizing this non-binary reality, expressed by many of the interviewees to be reflection of coloniality, is possibly a necessary step to negotiating more just and fair international agreements for scientific development. In this case, the momentum created by the Decade of Ocean Science can be the opportunity to start a serious assessment of the underlying power disputes that seem to fuel ocean international agendas. Furthermore, it can kick-start a badly needed process of reform.

Following a similar line of argumentation, the use of the terms “Global South” and “Global North” results in conflicting perceptions and an inaccurate generalization of these regions as a binary system. I acknowledge that there is as much diversity within the Global South as there is in a Global North. Both terms are highly criticized (Haug, Braveboy-Wagner, & Maihold, 2021; Schneider, 2017), but were adopted in this research for the sake of making arguments clearer and as an analytical paradigm. Indeed, using Global South as a term tends to detract a certain notion of subalternity that similar terms tend to evoke, such as “Third World”, “developing” and “underdeveloped” (Spivak, 2010). The use of such language tends to position these countries to a lesser degree than those which are developed or belong to a “first” world. The main idea behind the use of Global North or Global South is the core-periphery relationship, where privileged countries enjoy better conditions because of the historical exploitation of less-privileged countries in the periphery (Tickner, 2013).

The consequences of such a difference in privilege go much beyond the simple use of a term. De Sousa Santos (2016) advocates that it is because of this core-periphery relation that we experience today an epistemicide, that is, the destruction of knowledge that does not attain and satiate Western values and norms. Dainotto (2017), supported by decolonial reasoning, questions if what we experience today in peripheral countries is the production or the consumption of knowledge. Carchedi & Roberts (2021) present interesting evidence on the economic profit that core countries continue to enjoy as a result of imperial and colonial exploitation of the periphery.

Pragmatically, countries on the periphery have less access to research infrastructure (Polejack & Coelho, 2021), struggle to do science in English (Márquez & Porras, 2020), are less visible to the core scientific community (Gomez, Herman & Parigi, 2022), and tend to be negatively impacted by open access fees in scientific journals (Kwon, 2022; Smith *et al.*, 2022). However, periphery countries have also found ways to foster cooperation among their peers (Gray & Gills, 2016), finding grounds for transformative acts (Pereira *et al.*, 2020), as science matters equally to those on the periphery as it does to core countries (Rodrigues, 2021). Therefore, beyond the term in itself, it seems critical that contributions are made in relation to the perspective of this periphery, even if these countries are idealized as those with less scientific capability and excellence (Kraemer-Mbula *et al.*, 2020; Tolochko & Vadrot, 2021b). Therefore, this research should greatly contribute to the body of knowledge necessary to understanding the reality faced by periphery countries, despite the recognized limitations that come along with using the term and framing the narrative around the Global South.

4.6 Limitations of this work

4.6.1 Methodological

This research being inductive implies in a certain set of limitations in its scope. First, its exploratory characteristic drove the search for individual realities and truths, by means of collecting impressions from key interviewees. No previous assumptions on testing theories were made. Consequently, results are limited to the specific set of individuals assessed in a given context and time, not to be extrapolated to a population or any sort of generalization. It is acknowledged, however, that this specific set of individuals are indeed very influential in the agenda-setting in the Atlantic Ocean science landscape. Second, results indicate a snapshot of a certain social and historical context, but are also limited to the representation of twenty individuals. If this research goal was to test previously assumed hypothesis, then a higher sample would be required. Third, we present this work in light of constructed discourses, among which those which can be perceived as hegemonic. The conducted thematic analysis along with the sample size limit this work to identify individual perceptions rather than ascertain what are the discourses around ocean science diplomacy, including the identification of hegemonic discourses. In this sense, this work contributes by bringing forward evidence of how these perceptions can indeed influence the overall landscape of science diplomacy in the Atlantic Ocean science-policy community. Further work desiring to unveil hegemony would require a larger sample encompassing other countries' key respondents, actors from other societal sectors and the analysis of official documents and possibly media discourses, none of which were the goal of this work. Lastly, applying reflexive analysis of the produced texts resulting of this research has also exposed my own positionality as a key factor to both determine the methodology and the theoretical basis of the discussion of results. My own involvement with the general context of this research should be taken into consideration as a limiting factor of analysis.

4.6.2 Theoretical

Along the lines of this inductive research, I was undressed of theoretical assumptions when designing the research protocol. Exactly because of the truths generously shared with me by interviewees that I then started to study theories that could aid in explaining the results. In addition, as a transdisciplinary research, this search included theories of siloed fields of scholarship, such as International Relations, Political Sciences, and even Behavioral Psychology, among many others. The effort of combining siloed theoretical schools of thought was in itself challenging. A few theories seemed adequate to address the results, as shown in Table 2 of this dissertation. Among these theories, it was a personal choice to

discuss results in light of postcolonialism and decolonial thought. Both theories challenge the very basic concepts one adopts when inferring about the institutional setup of ocean science diplomacy, or even what this new concept means, on which grounds it is being shaped. It felt timely to open this discussion on decolonization once the UN Decade of Ocean Science is just starting to be implemented. Rather than investing in already established research programs that have traditionally informed diplomacy, mainly coordinated by Global North institutions, we should amplify our efforts in search for equity in the development of ocean science and better equipped advisory schemes to policy-making. Thus, postcolonialism and decolonialism rightfully present alternatives to decolonize science diplomacy that should be further considered. In this sense, once again my own positionality has major influence over this theoretical choice, but nonetheless explore truths brought from interviewees as how their world operates, particularly in South-North cooperative frameworks.

4.6.3 Contextual

This research explored ocean science diplomacy practices in the context of the All-Atlantic Ocean Research Alliance. However, it focused on assessing individual truths. The research design could have had a focus on the existing institutional frameworks and policy networks developing ocean science diplomacy in the Atlantic Ocean, which would be one way to evaluate their roles in the conduct of science diplomacy in the region. Indeed, it would be important to unveil the institutional setups and individual agency in promoting ocean science diplomacy in the Atlantic in order to understand the stakes at play and drivers of action. However, this approach could only be developed once an understanding of the role of science diplomacy in the region, along with the individual perceptions of this phenomenon were explored, which was successfully achieved through the lines of this research. Assessing the institutional discursive practices and individual agency will require a surplus effort in first navigating through the ‘horredogram’ of ocean governance in the Atlantic region (Boyes & Elliott, 2014), which I recommend as a future research.

4.7 Recommended Further Research

A few unresolved issues have been highlighted throughout this work, which require further research. In particular, the power clashes between science and policy in international settings would be an interesting question to explore further. In this context, I would recommend assessing other stakeholders involved in ocean science diplomacy, such as industry, civil society and non-State actors in general. It was not within this research’s scope to evaluate the perceptions of these groups, although I

have identified their critical role in different places of this dissertation and throughout the publications that derive from it. Moreover, the institutional framework influencing the exchange between science in diplomacy in the region and also in intergovernmental arenas would complement the research done with individual/groups agency.

It would also be interesting to follow the implementation of the UN Decade of Ocean Science in terms of programs and actions that involve countries from the Global North and the Global South. It would be of particular interest to study the interactions between stakeholders self-identified as belonging to the North or South and evaluate if coloniality is a matter of routine work or a perspective given in a certain time and context by this research interviewees.

Overall, I expect this research to have contributed to raising the important topic of ocean science diplomacy as a critical process that requires further studies and engagement by epistemic communities. The international ocean governance framework can benefit from such assessments to find more equitable and suitable ways to promote better decision-making in all aspects of ocean affairs that rest at the science policy interface.

5 Conclusions

This work provides a baseline on what ocean science diplomacy entails by demonstrating the importance of science diplomacy as a fundamental phenomenon in global ocean governance. This is due to the role of science in informing ocean management and also to the role of diplomacy in increased requests for scientific advice in face of the insufficient knowledge about the ocean. As a result, it is suggested that the term ocean science diplomacy be adopted to differentiate the challenges in dealing with the multidimensional and plural systems at sea, including the intrinsic differences from land in terms of regulatory, legal, and socio-economic frameworks. Ocean governance is realized through overlapping regulatory mandates and anarchic systems in which science (or the lack of sufficient scientific evidence) plays a critical role. Science diplomacy in the context of ocean governance becomes dependent on the context in which it occurs. Thus, further research could consider analysing institutional structures and practitioners' agency, including the study of policy networks and institutional dynamics involving the broad range of actors termed as 'science diplomats'. In the dawn of the UN Decade of Ocean Science for Sustainable Development, an apt stage for the further development of ocean science diplomacy frameworks, practitioners should consider strengthening dialogic encounters amongst different sectors by means of enhanced communication and exchange of multiple forms of knowledge. Actions regarding the building of alliances during the Decade should go to heart of this international effort, by which enhanced access to research inputs and equitable, inclusive and non-discriminatory participation of stakeholders must be promoted. Opportunities need to be co-created with the involvement of all so we truly aim for the "science we need for the ocean we want".

Ocean science diplomacy is a mainstream policy option as a beneficial strategy to bring communities together around shared goals with the ultimate objective of improving the state of the ocean and safeguarding human life. Deriving from this work's findings, it is noted that practitioners of ocean science diplomacy share a perspective of it that is based on specific assumptions of science and of diplomacy. Science is usually referred to as a neutral, apolitical and universal practice, while diplomacy is viewed as pertaining exclusively to governments and shaped by countries' foreign policies. However, science is, as all other social phenomena, influenced by the contextual setup in which it is developed and results from a

socially constructed contract that establishes the criteria to qualify its practices, a contract that is itself shaped by other socio-cultural phenomena. Diplomacy, in turn, has been progressively influenced by non-State actors that engage internationally in spite of countries' foreign policy objectives, a feature termed as public diplomacy. Those general assumptions about science and diplomacy that tend to perceive science as apolitical and diplomacy something that occurs only under the power of States denote a hegemony of Western values in detriment of other epistemologies. It seems necessary to acknowledge and understand how grounded in inequality and elitism ocean science diplomacy can be. For ocean science diplomacy to act as a driver of unity and peace, as desired by many, science diplomats ought to recognize the power disputes that appear to be at the core of engagement in its practices. Therefore, ocean science diplomacy is a complex phenomenon that is context-dependent and can go far beyond being limited to Western perceptions of science and diplomacy.

The individuals surveyed in the course of this research have kindly shown me their colourful truths about science diplomacy. In a humble attempt to analyse their truths, I became part of the process absorbing their truths to my own self, and, to a certain extent, developing the narrative. It is in such a realm that colonialism gained attention as one possible way of looking at these truths. This self-perception posits fundamental challenges to the development of ocean science diplomacy practices. Issues such as tokenism in the scientific peer-to-peer relationship and top-down decision-making frameworks with questionable ethical procedures reflect tensions resulting from power disputes among sectors. Because of this multiple sense making, I invested in postcolonial and decolonial thought to challenge the very fundamentals of the social fabric pertaining ocean science diplomacy. Questions on agents' boundary limitations and disputes between epistemic communities are raised in an attempt to decolonize modes of reasoning ocean science diplomacy. Inevitably, and by reflexively looking back at my writings, I find myself as an intellectual-activist, concurring with Boaventura de Sousa Santos:

“By calling myself an intellectual-activist I wish to suggest a possible way of living the impossibility of communicating the unsayable in a productive way, thereby creating new possibilities. (...) I am part of a collective by being aware of how I separate myself from it in order to write.” (Santos, 2016).

In the context of this work, a few attempts of recommending further actions from science diplomats were made. These recommendations should be carefully taken as contextual frameworks differ greatly and influence the mode of operation of ocean science diplomacy. In addition, recommendations depart from the narrative developed throughout this dissertation and encompass the author's positionality. All things considered, interviewees have argued for a need of improved South-South cooperation, for abandoning colonial practices in science and for seeking equity in

the access and use of science. In practical terms, it could be argued that countries in the South should enhance marine advisory mechanisms, broadening the participation of all ways of knowing, seeking support for beneficial international engagement around science and improved science-based international informed decision-making. Similarly, countries in the Global North should engage in dialogue with peers in the South to understand their realities and promote actions in support of those views, by leveraging capital and human resources abroad and enhancing scientific capabilities locally. Science diplomacy as an emerging term might represent a social construct with intrinsic Western values that are adopted by communities in the Global South without much understanding of the power disputes that it entails. By concurring with this somehow naive view of an apolitical and neutral science as a driver to promote better international relationships, the Global South might be missing the opportunity to realign science diplomacy to local realities and develop a fit-for-purpose concept, applicable as a strategy to pursue their interests and needs. In sum, I argue for the decolonization of science diplomacy. As a principle of this research, decolonization pertains to social institutions, but mostly a call to decolonize the self, a process by which includes myself. This means to undress ourselves from preconceived assumptions in order to find a worldview in which liberation of us all is critical and overdue. In this last attempt of decolonizing ourselves, I end by quoting Boaventura Santos once again:

“We live on the other side of the line that someone traced while thinking of us but aiming at not thinking of us anymore. We are invisible, inaudible, and illegible because the success of previous revolutions decided not to include us. If our here is invisible, our now is even more so. According to those revolutions, we have, at most, a past, but no future. We were never allowed to write the history books.” (Santos, 2016)

Let us liberate ourselves to change the history books.

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7 Appendix 1: Internationally Peer Reviewed Publications that Form the Core of this Dissertation

- Paper 1 **Polejack**, A. (2021). The Importance of Ocean Science Diplomacy for Ocean Affairs, Global Sustainability, and the UN Decade of Ocean Science. *Frontiers in Marine Science*, 8(March). <https://doi.org/10.3389/fmars.2021.664066>
- Paper 2 **Polejack**, A., Gruber, S., & Wisz, M. S. (2021). Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance. *Humanities and Social Sciences Communications*, 8(1), 52. <https://doi.org/10.1057/s41599-021-00729-6>
- Paper 3 **Polejack**, A., & Coelho, L. F. (2021). Ocean Science Diplomacy can be a Game Changer to Promote the Access to Marine Technology in Latin America and the Caribbean. *Frontiers in Research Metrics and Analytics*, 6(April), 34–36. <https://doi.org/10.3389/frma.2021.637127>
- Paper 4 Muelbert, M. M. C., Copertino, M., Cotrim da Cunha, L., Lewis, M. N., **Polejack**, A., Peña-Puch, A. del C., & Rivera-Arriaga, E. (2021). The Ocean and Cryosphere in a Changing Climate in Latin America: Knowledge Gaps and the Urgency to Translate Science into Action. *Frontiers in Climate*, 3(November). <https://doi.org/10.3389/fclim.2021.748344>
- Paper 5 **Polejack**, A., Ramírez-Monsalve, P., & Wisz, M. S. (in progress). What does Integrated Ecosystem Assessment mean to research and policy stakeholders working in the Atlantic ocean science diplomacy? Submitted to *Frontiers in Marine Science*.
- Paper 6 **Polejack**, A. (in progress). Coloniality in Science Diplomacy – evidence from the Atlantic Ocean. Submitted to *Science and Public Policy*.

Polejack, A. (2021). The Importance of Ocean Science Diplomacy for Ocean Affairs, Global Sustainability, and the UN Decade of Ocean Science. *Frontiers in Marine Science*, 8(March). <https://doi.org/10.3389/fmars.2021.664066>



The Importance of Ocean Science Diplomacy for Ocean Affairs, Global Sustainability, and the UN Decade of Ocean Science

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The ocean is highly impacted by human activities, and ambitious levels of science are urgently needed to support decision making in order to achieve sustainability. Due to the high cost and risk associated with ocean exploration and monitoring in time and space, vast areas of the oceanic social ecological system remain under-sampled or unknown. Governments have recognized that no single nation can on its own fill these scientific knowledge gaps, and this has led to a number of agreements to support international scientific collaboration and the exchange of information and capacity. This paper reviews current discussions on ocean science diplomacy, i.e., the intersection of science with international ocean affairs. Ocean science is intrinsically connected with diplomacy in supporting negotiations toward a more sustainable future. Diplomacy supports essential aspects of scientific work such as capacity building, technology and information/knowledge exchange, and access and sharing of research platforms. Ocean science diplomacy underlies the work of many intergovernmental organizations that provide scientific guidance, such as the Intergovernmental Oceanographic Commission (IOC), the Intergovernmental Panel on Climate Change (IPCC), and the International Council for the Exploration of the Sea (ICES), and United Nations Convention on the Law of the Sea (UNCLOS). To illustrate how critical science diplomacy is to global ocean affairs, this paper examines examples of the influence of ocean science diplomacy in UNCLOS. Furthermore, this paper discusses the utility of ocean science diplomacy in support of the UN 2030 agenda, and the UN Decade of Ocean Science.

Keywords: science diplomacy, United Nations (UN), sustainability, Decade of Ocean Science, 2030 Agenda and SDGs, Law of the Sea (UNCLOS), transdisciplinary science

SCIENCE AND INTERNATIONAL RELATIONS

Science is a universal language that through empirical observation and evidence-based testing stands on grounds of replicability, transparency, and merit in search of the truth (Oreskes, 2019, p. 24). Science facilitates communication and cooperation as scientists seek ways to compare results across time and space to understand reality and socio-ecological phenomena (Wagner, 2002).

Science is generally perceived by society as apolitical and free of values, a search for evidence that enlightens our knowledge (Iniguez et al., 2012). Despite the important debate in Academia on the political basis of science (Jasanoff, 1998; McCain, 2016), this public perception promotes science as a reliable source of knowledge that is widely used by policymakers and diplomats, from advising policy to reinforcing political values (Weiss, 2005; Pielke, 2007; Oliver and Cairney, 2019).

Modern diplomacy can be understood as a statecraft in building non-violent international relations advising, shaping, and implementing foreign policy (Barston, 2019; Boyd et al., 2019), whereby diplomats protect and promote national values and interests abroad (Kaltofen and Acuto, 2018a). In international relations, science can act as a country's soft power, as opposed to the traditional hard powers of force and coercion (Nye, 2017), reinforcing and spreading national views and values (e.g., House of Lords, 2014). Evidence-based negotiations bridge international relations and science (Kaltofen and Acuto, 2018b), posing a necessity to strengthen the participation of national science and technology communities in negotiation processes (Colglazier, 2016).

As the global community increasingly meets Anthropocene challenges, the integration of science and diplomacy is pivotal (Steffen et al., 2011; Kotzé, 2014). One current example involves climate science feeding diplomatic negotiations at the UN level. The Intergovernmental Panel on Climate Change (IPCC) reports have informed diplomatic discussions and resulted in progressive commitments from countries. From Kyoto to Paris, scientific advice has informed more assertive commitments to reduce greenhouse gas emissions (Ruffini, 2018). A new field of study has emerged to understand this interlinkage between science and international relations under *le chapeau* of science diplomacy (Fedoroff, 2009). Science diplomacy, though a new term, is being increasingly used by policymakers as a way of promoting international engagement around evidence-based decision making (e.g., Pandor, 2017; Moedas, 2019).

This paper aims to present current discussions on science diplomacy and its application in the context of ocean affairs. Here, I review different examples of what constitutes ocean science diplomacy by briefly analyzing the work of some key intergovernmental organizations, such as the International Council for the Exploration of the Sea (ICES) and the Intergovernmental Oceanographic Commission (IOC). A more in-depth analysis is presented for the United Nations Convention on the Law of the Sea (UNCLOS) (hereafter the Convention) and its implementing institutions as critical avenues for the application of ocean science diplomacy practices and power play among States in vital matters concerning ocean affairs. In addition, I explore the relationship between the UN 2030 Agenda for Sustainable Development and the upcoming UN Decade of Ocean Science for Sustainable Development (2021–2030), as both processes result from ocean science diplomacy practices and contribute to the implementation of the Convention. Finally, I discuss the current and future importance of ocean science diplomacy in global governance frameworks, in particular with a view to enhancing sustainability and regional ocean science and technology capabilities.

METHODS

The work presented here results from a literature review and a desktop analysis of the Convention and related implementing instruments. I analyzed the current theoretical discussions around science diplomacy and framed these into practical examples of the Convention's implementation. The evolution of the implementation of the provisions in the Convention can also be assessed by analyzing the annual UN General Assembly (UNGA)'s Omnibus resolutions for Oceans and the Law of the Sea, where States Parties agree on mutual issues of concern and calls for action with regard to ocean health, sustainability, and use. Therefore, I reviewed the last 10 years (2009–2019) of the omnibus resolution in search of the terms "science," "scientific," "research," and "knowledge." I extracted and compiled the full text of the agreed paragraphs that addressed ocean science at some level, to look for the main themes that States called for scientific expertise. By doing so, I present the recent updates on the role of science to international ocean affairs after the adoption of the Convention, as a means to illustrate the role of science diplomacy in progressing matters of common concern in the law of the sea and ocean affairs among States.

PROGRESSIVE EVOLUTION OF A NEW CONCEPT: SCIENCE DIPLOMACY

Science diplomacy practices date back to ancient times (e.g., Turekian et al., 2015). Reports from the negotiations of the Treaty of Kadesh, in a conflicted Egypt in 1300 B.C., show letters asking for doctors to be exchanged between the powers in dispute (Turekian, 2018). Contemporary examples of science diplomacy include the SESAME synchrotron light facility in the Middle East. SESAME has allowed researchers to cooperate in a politically tense region, arranging member countries to form a dialogue based on science (Rungius, 2020).

There is much debate on what science diplomacy means. International relation scholarship has traditionally placed science exogenous to theoretical discussions (Mayer et al., 2014), a picture that is slowly changing due to the political power that science can exercise in international negotiations, in face of global environmental uncertainties. Consequently, science diplomacy has emerged as a new field to understand the interplay between science and international relations, in particular where there are global, transborder, and regional issues of common concern or interest (Berkman, 2019; Flink and Ruffin, 2019). Studies in this field include the influence of science in diplomatic relations, the dynamics of science acting as a source of power between nations, and the support that diplomacy can provide to research and innovation (Flink and Schreiterer, 2010; Leite et al., 2020). In this sense, science diplomacy can be framed as a discipline grounded on the fields of international relations, science-policy interface, and Science and Technology Studies (Fährnich, 2017). Science diplomacy can also be described as a practice, and some have advocated that this is the dominant view in the literature, based on practitioners' perspectives and requiring further empirical basis (Ruffini, 2020). Science diplomacy as

a practice involves the collection, synthesis, and presentation of evidence to international decision-making processes, joint research projects acting as a dialog hub between nations, and scientific cooperation calling society to address humanitarian challenges (Rungius et al., 2018).

Discussions in science diplomacy generally frame the results into two distinct taxonomies due to the lack of a generally accepted definition of the concept. One of those taxonomies was provided by the Royal Society and the American Association for the Advancement of Science as a result of an event held in 2010 (The Royal Society, and AAAS, 2010). The concept is categorized as shown and exemplified in **Figure 1**.

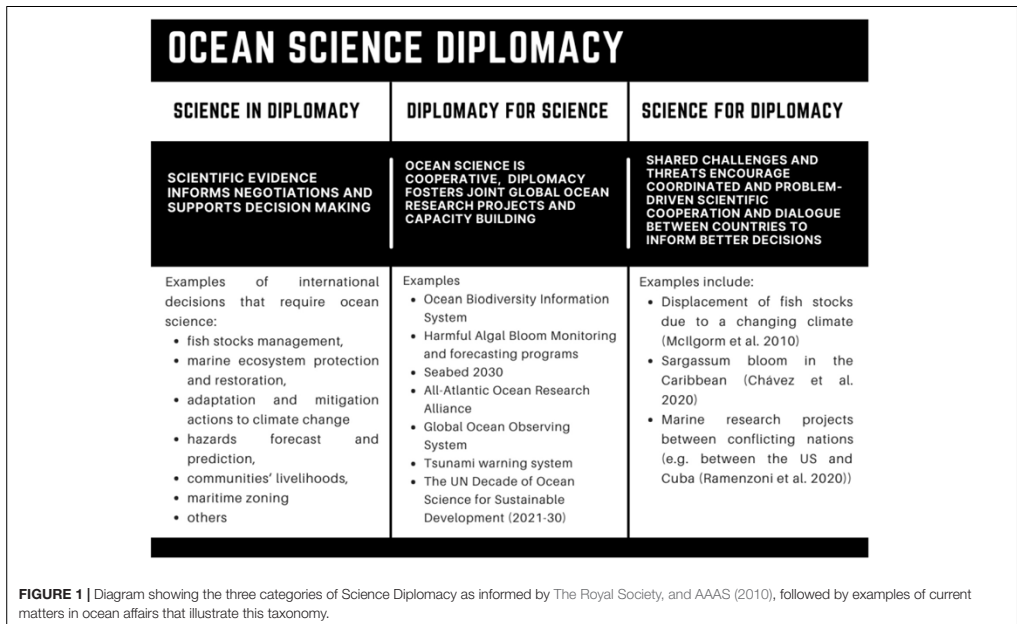
Subsequently, Gluckman et al. (2018) proposed another set of categories that highlight the utility of the concept in transnational relations. According to those authors, science diplomacy practices would fall into three categories, namely:

- i Actions designed to directly advance a country’s national needs;
- ii Actions designed to address cross-border interests; and
- iii Actions primarily designed to meet global needs and challenges.

Both taxonomies, when confronted, show a progressing evolution of the concept. The Royal Society and AAAS taxonomy disregarded the role played by national interests in advancing science diplomacy, being brought to the discussion by Gluckman and colleagues in 2018. National interests are an essential part of

diplomacy, and science is one of the many features considered in the decision-making process (Ruffini, 2020). In this case, science can both influence but also be influenced by diplomacy, grounded in national political agendas (Flink, 2020).

Globalization has provided many pathways for researchers to collaborate in global environmental agendas and engage with international decision makers, without undue regard to national political agendas (Leguey-Feilleux, 2017). Non-State organizations have been particularly active in engaging society and calling attention to environmental concerns grounded in scientific findings. These organizations, which include non-governmental and intergovernmental organizations, provide scientific evidence to international discussions by preparing policy briefs, community white papers, and side events in Convention of the Parties, for independent discussion based on science. This track 2 diplomacy, parallel to State-led diplomacy, has being identified as a more flexible and forthcoming form of international relations by which science can exercise its freedom and best address societal benefits and community interests (Jones, 2015; Gore et al., 2020). One example of such is the ongoing negotiation at the UN on a new legally binding instrument to regulate the access and benefit sharing of the marine biodiversity in areas beyond national jurisdiction (Harden-Davies, 2018). Science diplomacy facilitates how national political agendas can be brought into balance with community interests, with researchers centrally placed to provide evidence and inform future joint decisions (Legrand and Stone, 2018). As a pay-off, researchers are provided with access



to infrastructure and international funding (Berkman, 2019). Consequently, global environmental conundrums are excellent cases for science diplomacy.

THE OCEAN AS A RICH FIELD FOR SCIENCE DIPLOMACY

The ocean supports life on the planet by providing food (Food and Agriculture Organization of the United Nations, 2020), climate regulation (IPCC, 2019), and other essential ecosystem services (Lubchenco and Petes, 2010). Perceived as humankind's last frontier (Gibney, 1978), our relation to the ocean is not only economical (Fleming, 2010), but also social and spiritual (Costanza, 1999). At the same time, the ocean is highly impacted by human activities, including overfishing (Jackson et al., 2001), the loss of biodiversity and ecosystem services (Worm et al., 2006; Hughes et al., 2018), ocean warming (Poloczanska et al., 2013; Cheng et al., 2020), and sea level rise as a direct consequence of climate change (Small and Nicholls, 2003). Ocean ecosystem services are beneficial to humanity in its entirety. Land-locked and geographically disadvantaged States, with low or no proximity to coastal areas, still depend on marine transport systems, as well as food provision, climate regulation, and leisure services from the ocean (Nash et al., 2017).

The marine environment is considered as a global commons, and it is on humanity's best interest to preserve and sustainably use its resources and services (Vogler, 2012; Rudolph et al., 2020). Ocean management relies both on national policies and regulations and on international cooperation (Attard, 2018). Scientists are best placed to identify and comprehend hazardous anthropomorphic phenomena in the ocean, seeking answers to inform policy (Nurse-Bray et al., 2014; Tengö et al., 2014; Sudhakar, 2020). Therefore, ocean science is essential both to assess ocean environmental limits (Baähr, 2017; Nash et al., 2017) and to provide evidence to sustainably limit our efforts on crossing those ocean boundaries (Ingeman et al., 2019).

International non-governmental and intergovernmental organizations play an important role in the international ocean decision-making. For instance, ICES, a North Atlantic intergovernmental scientific body, has been advising policy since 1902, in particular with regard to fisheries management. ICES provides evidence to support regional and national decision making, but also assists countries on crafting their positions in international fora when requested to do so. Advice is delivered by a broad network of scientists who use their peer collaboration to reach out even further and conduct scenario-building, so information is policy-relevant (ICES, 2019). In fact, Robinson (2020a) advocates that ICES has developed subsequent ocean science diplomacy mechanisms, describing ICES critical role in shaping ocean science diplomacy. Historically, ICES is well respected and cooperates closely with other relevant international organizations, such as the IOC of UNESCO.

The IOC is broadly recognized as the international scientific body for ocean affairs at the UN level (Pavliha and Gutiérrez, 2010). It is an institution that has combined science and diplomacy since its inception in 1960. With 150 Member States,

IOC has been central in organizing and pushing ocean science under the mandate of the UN General Assembly (UNGA). IOC relies upon at least two definitions of ocean science. First, ocean science includes all disciplines related to the ocean, i.e., the classical fields of oceanography: physical, biological, chemical, and geological, as well as hydrography, health and social sciences, engineering, the humanities, and multidisciplinary research on the relationship between humans and the ocean (IOC-UNESCO, 2017, p. 19). Second, and more recently in the context of the UN Decade of Ocean Science for Sustainable Development, this definition has been expanded to include the supporting infrastructure (observations, data systems, etc.); societal benefits, such as knowledge transfer and applications in regions that are lacking science capacity; science-policy/user interface; and local and indigenous knowledge (IOC-UNESCO, 2020b, p. 2). Although both definitions are debatable, the key message is that ocean science is transdisciplinary in essence and is now being used to fulfill other roles, such as producing goods for social benefit and fostering transfer of technology and capacity development.

THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

The Convention on the Law of the Sea sets the rights and obligations of State Parties in relation to the law of the sea and ocean affairs, thereby providing a global ocean governance framework that is almost universally accepted (Koh, 1982). The Convention is a living example of how national interests are balanced with global interests regarding the exploration and conservation of the ocean (Long, 2007). National interests included States claims to extended maritime spaces. Global interests were mainly the expanding threat of unregulated natural resources exploration (Brown and Fabian, 1974). Consequently, the United Nations General Assembly convened the Third United Nations Conference on the Law of the Sea—UNCLOS III in 1973 to discuss ocean matters in plenitude (Koh and Jayakumar, 1977). It was only after 9 years of long and intense negotiations at the UN that the Convention was finally adopted in 1982 and entered into force in 1994. Today, it is the globally recognized regime dealing with all matters relating to the law of the sea, being ratified by 167 States Parties and the EU (United Nations, 2019b).

Science was at the very core of negotiations at UNCLOS III (1973–1982) (Hayes, 2011). Diplomats needed to be supported by scientific information to negotiate Convention matters as well as to rebut evidence presented by other parties. This power of science was very influential to inform the agenda setting as well as the advancement of the negotiations (Brown and Fabian, 1974). For example, during the process of framing the draft provisions of the new treaty, it became evident that countries with better scientific capabilities could drive negotiations by presenting strong evidence that anchored discussions around that information, something called in negotiation theory as the anchoring effect (Furnham and Boo, 2011).

One example of this anchoring effect in ocean negotiations involves the discussions on deep sea mining, which were central

to the successful conclusion of UNCLOS III. Evidence on mineral richness and potential commercial value resulted in the creation of the International Seabed Authority (ISA) under the Convention. The ISA is an organization by which States Parties organize, administer, and control activities in the “Area,” i.e., the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction [Convention’s Art 1 (1)]. The Authority organizes and controls activities guided by the principle that sets the Area as a common heritage of (hu)mankind (Wedding et al., 2015) as adopted by the Convention and later reinforced in the Convention’s 1994 Implementation Agreement (Lodge and Verlaan, 2018). Therefore, even States which are not part of the Convention are still bound to the Authority’s role in regulating this common heritage as part of customary international law, overseeing equitable opportunities in the Area (Willaert, 2021). ISA’s *raison d’être* is basically to apply scientific evidence to regulate both mining and environmental protection, making sure that any resulting benefits are shared among all. The ISA continually develops and enhances codes of conducts and technical guidelines, all based on evidence presented by States Parties. Considering that our knowledge of the deep sea is still inadequate, the lack of sufficient scientific evidence is a common ground, a situation in which the precautionary principle is generally applied (Ardron et al., 2018). However, most Member States to the Convention lack the capacity to produce or evaluate scientific evidence in relation to the deep ocean, leaving those States with higher capabilities to drive the regulatory framework for mining and environment impact assessments of this common heritage of humankind (Wolfrum, 1983).

Historically, disparities in science and technology capacities drove countries to adopt distinct positions in negotiating the Convention. Developing countries recognized their lack of scientific and technological capabilities as a threat, undermining their ability to properly address technical issues as well as progressing on the potential exploration of the marine natural resources and resulting incomes (Hayes, 2011). In addition, sociotechnical imaginaries¹, i.e., technologies that were not yet available or commercially viable, drove developing countries’ concerns in relation to sovereignty rights, access, and potential benefit sharing of those explorations (Robinson, 2020b). Developed countries, in turn, were concerned whether the Convention would pose obstacles on the conduct of marine research abroad, limiting their access to foreign waters and therefore any potential prospective research on marine resources (Shapley, 1973), in addition that it would require the mandatory exchange of ocean technologies to developing countries. Consequently, the Convention recognized the importance of ocean science in adopting Parts XIII and XIV, addressing Marine Scientific Research and the Development and Transfer of Marine Technology, respectively.

Part XIII calls for international scientific cooperation for peaceful purposes, seeking to diminish the gaps between Member

States’ technical capacities to implement the Convention. The same applies to Part XIV, in which countries are called to share and transfer marine technologies to less capable nations, so that they can manage their jurisdictional waters and gain the benefits of the resources therein, as well as avail of their rights and discharge their obligations under the Convention. Although essential to the implementation of the Convention, these provisions are among the least implemented (Salpin et al., 2018).

Science in the Convention goes beyond Parts XIII and XIV. For instance, Part XV sets a complex compulsory dispute settlement mechanism for resolving disputes concerning the interpretation and application of the law of the sea (Doelle, 2006). Disputes must be solved peacefully and by negotiation in the first instance, and thereafter by recourse to judicial settlement, such as international arbitration. Resolving disputes are often dependent on the evidence tendered by the parties. For example, if the dispute is about maritime delimitation, countries need to present data on baselines and geological features such as islands, rocks, and low-tide elevations. If it is on natural resources, such as fisheries, evidence on aspects such as fish population dynamics and ecosystems health is needed. In this context, research capacities become a matter of statecraft in international ocean negotiations. Countries with high technical capabilities are best placed to provide stronger arguments that can result in solving disputes in their benefit. Furthermore, scientific experts and their opinions can have a major bearing on the outcomes of judicial settlement (Boyle and Harrison, 2013). Scientific evidence is increasingly decisive in the resolution of international disputes concerning damage to biodiversity and degraded ecosystems (Long, 2019).

CURRENT EXAMPLES OF THE ROLE OF OCEAN SCIENCE IN THE LAW OF THE SEA

There are many examples of how ocean science is essential to implement the Convention, from direct provisions such as Parts XIII and XIV, to provisions indirectly impacted by ocean science, such as dispute settlements and maritime delimitation. We will address a few of these examples regarding how ocean science can be impactful in defining maritime boundaries, setting limits for the exploration of natural resources and regulating access to ocean areas out of national jurisdictions. This non-exhaustive list of examples aims to illustrate the importance of evidence provision to international decision making in ocean affairs.

Boundary Delineation and Delimitation

States Parties to the Convention have the right to define and claim the outer limit of their continental shelf where it exceeds 200 nautical miles. According to Article 76 of the Convention, this right only applies to the seabed and ocean floor and subsoil, not the water column and air space above. This can result in large oceanic areas under States Parties’ rights to commercially explore living and non-living resources such as minerals, oil, and gas. As a rule, the establishment of maritime boundaries is within the sovereign powers of countries,

¹Sociotechnical imaginaries are defined by Jasanoff and Kim (2009) as “collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects.” Robinson (2020b) further explores how the ocean imaginaries caused uncertainty in the international community leading to the UNCLOS negotiations.

with the sole exception of establishing the outer limit of the continental shelf beyond 200 nautical miles, which is subject to an important international oversight process and procedural obligations regarding the tendering of scientific evidence to the Commission on the Limits of the Continental Shelf (CLCS). The latter is the body responsible for analyzing States Parties submissions and drawing recommendations on the outer limits of the continental shelf beyond 200 miles. Scientific evidence is all that matters to CLCS, made up of scientific and technical experts, and the outer limit established by the coastal State on the basis of the recommendations of the Commission are final and binding (as per paragraph 8 of article 76 of the Convention). These recommendations can impact demanding States Parties economically, geopolitically, and socially (Suarez, 2013). States Parties had 10 years after the entry into force of the Convention, or until 2004, to submit their claims (as per article 4 of the Annex II of the Convention). Countries with less capabilities to provide such evidence are disadvantaged in exploring their rights over any potential extension of their continental shelf or in meeting the required timeline for making a submission to the CLCS. This shows how technical capacities and scientific evidence are determinant to the Convention's implementation by coastal States. Noteworthy, some countries still proclaim extensions of the continental shelf unilaterally despite the requirements of the Convention (Morales, 2020).

Exploration and Regulation of Living Resources

Another good example of ocean science interaction with the law of the sea is the regulatory framework for the exploration of straddling and migratory fish stocks. This framework was the outcome of its own diplomatic negotiation after the adoption of the Convention and once again ocean science played a central role in its adoption. In 1995, an implementing agreement was adopted under the Convention, with a very long title, namely: the Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, or "Fish Stocks Agreement" (FSA) (United Nations, 1995). The FSA sets the general procedures to manage and conserve fish stocks and is given effect in regional fisheries management organizations (RFMOs), where intense diplomatic negotiations take place, regarding the allocation of fishing entitlements and the setting of conservation and management measures to prevent the collapse of the overall fish stocks. Scientific evidence in the form of stock assessment advice has a bearing on decisions, on the one hand, to close highly lucrative commercial fisheries or, on the other, to facilitate the over exploitation of fish populations. The Agreement provides a solid legal basis for the application of the best available scientific knowledge, the precautionary approach², and the ecosystem-based management. Thus, the Agreement is aimed at ensuring that scientific evidence is an intrinsic

component of decision making in fisheries with potentially huge economic, social, and environmental consequences (Robinson, 2020a). Ocean science diplomacy has a major bearing on how this evidence is used by RFMOs to address these complex issues and, once again, scientific and technical capacities are of pivotal importance to statecraft and to redressing global conservation concerns (Worm and Branch, 2012).

Unknowns abound in vast parts of the ocean. Many questions remain unanswered by ocean science. Diplomacy walked hand in hand with science even in face of great uncertainties at UNCLOS III and subsequent negotiations on the seabed mining regime in 1994 and the straddling fish stock agreement in 1995. Both science and diplomacy inform all aspects of this engagement. As more evidence becomes available due to progressive availability application of new ocean technologies and research tools, the possibility arises that States and intergovernmental organizations can press ahead in addressing some of the issues left unresolved by UNCLOS III. A case in point relates to the regulation of the access and benefit sharing arising from the exploration of the biodiversity beyond national jurisdiction, or simply BBNJ (Long and Chaves, 2015). The BBNJ negotiating process is currently underway, based on a draft text for this new implementing agreement (United Nations, 2019a). Negotiations are centered in four main themes: marine genetic resources, including questions on the sharing of benefits; measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity-building, and the transfer of marine technology. The current draft posits the use of the best available scientific knowledge as a guiding principle. Ocean areas beyond national jurisdiction are among the least known by science, so this agreement, if successfully negotiated, can improve the scientific endeavor needed to unveil almost half of the Earth's surface (St. John et al., 2016). Scientific evidence will be determinant to identify the source of living resources and to advance in marine omics. Diplomacy will be essential to foster programs of capacity building and transfer of marine technology. In addition, the governance of international marine protected areas and the conduction of ecosystem impact assessments will rely intensively on the dynamics between science and diplomacy. Thus, BBNJ is a new interesting case of science diplomacy in action, as pointed out by Harden-Davies (2018).

OCEAN SCIENCE IN THE UN GENERAL ASSEMBLY RESOLUTIONS

In the previous section, we presented examples of major aspects of the law of the sea which require science to inform State practice as well as diplomatic processes under the Convention. Since the Convention does not hold regular Conference of the Parties as other UN conventions do (e.g., Climate Change Convention), the evolution of themes that concern States about ocean health can be assessed in the annual omnibus resolution on the ocean and law of the sea adopted by the UNGA. These UNGA resolutions reflect the progress that is being made and the challenges that arise in implementing the Convention, along with emerging issues of States Parties' concern.

²Art. 6 (2)—States shall be more cautious when information is uncertain, unreliable, or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

Table 1 presents the full extract of the adopted paragraphs in a 10-year timeline (2009–2019), with the corresponding numbering of each paragraph for further reference.

Over the past 10 years, ocean science issues of concern have increased, resulting in UNGA's omnibus resolutions to expand each year in term of the number of paragraphs as well as in terms of themes covered. Three issues have been present for the past 10 years. First, the UNGA has adopted a *chapeau* paragraph stating how important ocean science is to advance knowledge, provide well-being, and contribute to decision making. Second, ocean science was acknowledged as essential to improve risk management tools in conserving and managing vulnerable marine ecosystems. Lastly, ocean science is essential to the establishment of marine protected areas. Another recurring theme since 2010 is the use of ocean science to identify and protect ecologically or biologically significant areas. In brief, science was identified as relevant for social, economic, and cultural benefit as well as more generally to promote marine conservation. More recently, there has been a distinct focus on the issue of pollution in the UNGA's resolution, with marine litter and underwater noise being addressed since 2016 and 2018, respectively. Looking at this 10-year sample, we can identify that once a subject is incorporated into the UNGA resolution, it remains there. Such a feature opens to the possibility of two hypotheses: (i) there is an inefficiency of the adopted measures to solve those issues or (ii) there is a lack of sufficient scientific evidence to support effective conservation measures. These two hypotheses open a series of questions on the efficiency of UN actions toward ocean conservation. Efficiency in this case is of course dependent on States' national policies and regulations, which are very diverse on the use of the available scientific information. Further research on how UNGA's annual resolutions are impacting national policies shall be necessary and the Sustainable Development Goals (SDGs), as we will discuss later, can present a good case. Science diplomacy can be challenged in this sense on how effectively it is producing better policies and public goods. For now, provisions on the importance of ocean science are thus recurring items of the UNGA's resolution. Accordingly, it can be expected that the progressive implementation of the UN Decade of Ocean Science for Sustainable Development (2021–2030) shall be continuously updated in years to come.

THE UN DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

The Decade of Ocean Science shall be an important opportunity for science diplomacy to target global community interests in spite of national interests in the ocean.

The Decade targets seven societal goals, with ambitions to achieve a clean, resilient, productive, safe, well-observed, documented, and predicted ocean (Ryabinin et al., 2019). It also envisages engaging with society and delivering results for an evidence-based decision making, based on sustainability and peace. Ocean scientists are being urged to break the silos

and work closely with international affairs and purveyors of traditional knowledge.

Scientists are answering this call and are expecting much from the implementation of this UN Decade (Claudet et al., 2019). The Decade presents itself as “an important opportunity to address gaps in ocean science, increase knowledge, improve synergies, and support the sustainable conservation and management of marine resources” (A/RES/74/19, para. 301, **Table 1**). The Decade's roadmap (IOC-UNESCO, 2018) highlights how critical it is to coordinate and cooperate in ocean sciences to progress sustainable development. Four distinctive aspects of the role of ocean science diplomacy are highlighted below around the thematic areas of inclusivity, sustainability, inequality, and community interests.

Enhancing Inclusivity

Perhaps, a major oversight to date is that official documents from this Decade primarily highlight natural science's evidence, with far limited participation from social sciences. The seven societal goals themselves very much reflect the gaps identified by traditional natural science, such as oceanography and hydrology. These gaps have been already identified in several documents (e.g. Inniss et al., 2017; IOC-UNESCO, 2017, 2019; Miloslavich et al., 2018) which, up to this point, have been largely unsuccessful in producing the desired change through decision maker's actions.

In times when Governments are failing to implement effective solutions to global problems and trust in science is diminished, public engagement becomes essential (Colglazier, 2020). Social sciences can provide evidence in support of actions to improve public engagement and science uptake in decision-making processes (Bennett et al., 2019). Thus, this UN Decade of Ocean Science should be a turning point for a more equitable participation of knowledge producers and users (along with the difficulties in identifying them). In this context, it needs to be transdisciplinary. Transdisciplinary actions in the Decade of Ocean Science need to start by building up research questions and hypotheses among different disciplines and stakeholders (as in Rudd, 2014). As Jahn and colleagues propose:

Transdisciplinarity is a critical and self-reflexive research approach that relates societal with scientific problems; it produces new knowledge by integrating different scientific and extra-scientific insights; its aim is to contribute to both societal and scientific progress; integration is the cognitive operation of establishing a novel, hitherto non-existent connection between the distinct epistemic, social-organizational, and communicative entities that make up the given problem context. (Jahn et al., 2012, p. 8)

Therefore, the UN Decade of Ocean Science for Sustainable Development is an opportunity to change how scientists organize themselves around a common goal, as well as interact with policymakers and society in general (Wisiz et al., 2020). In turn, it can represent an avenue for society to better acknowledge science and engage in science making through citizen science (Schrögel and Kolleck, 2019) and be empowered through Ocean Literacy (for further readings on the later, please refer to Santoro et al., 2017; Squarcina and Pecorelli, 2017; Marrero et al., 2019).

TABLE 1 | Exact extracts from the United Nations General Assembly resolutions on oceans and the law of the sea in which references to marine science or scientific are made. Ten years of excerpts (2009–19)^a.

| Original text in the resolution | Year and corresponding paragraph in the original text | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|------|------|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Recalling that marine science is important for eradicating poverty, contributing to food security, conserving the world's marine environment and resources, helping to understand, predict, and respond to natural events, and promoting the sustainable development of the oceans and seas, by improving knowledge, through sustained research efforts and the evaluation of monitoring results, and applying such knowledge to management and decision-making | | 150 | 173 | 190 | 206 | 221 | 227 | 249 | 252 | 254 | 260 |
| Reaffirms the need for States, individually or through competent international organizations, to urgently consider ways to integrate and improve, based on the best available scientific information and the precautionary approach and in accordance with the Convention and related agreements and instruments, the management of risks to the marine biodiversity of seamounts, cold water corals, hydrothermal vents, and certain other underwater features | | 153 | 176 | 195 | 211 | 226 | 232 | 254 | 259 | 261 | 267 |
| Reaffirms the need for States to continue and intensify their efforts, directly and through competent international organizations, to develop and facilitate the use of diverse approaches and tools for conserving and managing vulnerable marine ecosystems, including the possible establishment of marine protected areas, consistent with international law, as reflected in the Convention, and based on the best scientific information available | * | 156 | 178 | 194 | 210 | 225 | 231 | 252 | 257 | 259 | 265 |
| Encourages States, in this regard, to further progress toward the establishment of marine protected areas, including representative networks, and calls upon States to further consider options to identify and protect ecologically or biologically significant areas, consistent with international law and on the basis of the best available scientific information | * | * | * | * | * | * | * | 205 | 209 | 210 | 218 |
| Recognizes the need for better understanding of the sources, amounts, pathways, distribution, trends, nature, and impacts of marine debris, especially plastics and microplastics, and to examine possible measures and best available techniques and environmental practices to prevent its accumulation and minimize its levels in the marine environment, and welcomes in this regard the work conducted under the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, led by the Intergovernmental Oceanographic Commission, and its report entitled "Sources, fate and effects of microplastics in the marine environment—a global assessment," and the report of the Executive Director of the United Nations Environment Program on marine plastic debris and microplastics, which reviews best-available knowledge and experiences in this regard and gives recommendations for further steps to reduce plastic litter and microplastic in the oceans | * | * | * | * | * | * | * | * | * | 275 | 281 |

(Continued)

TABLE 1 | Continued

| Original text in the resolution | Year and corresponding paragraph in the original text | | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|------|------|-----|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | |
| Notes the discussions at the twentieth meeting of the Informal Consultative Process, from 10 to 14 June 2019, on the theme of ocean science and the United Nations Decade of Ocean Science for Sustainable Development, during which delegations, <i>inter alia</i> , stressed the importance of marine scientific research, international cooperation and coordination, as well as of a stronger science-policy interface in understanding and effectively addressing the unprecedented pressures on the ocean, provided input to assist in preparing for the Decade and considered that the Decade will be an important opportunity to address gaps in ocean science, increase knowledge, improve synergies, and support the sustainable conservation and management of marine resources, and during which several delegations underlined the important and complementary role of traditional knowledge held by indigenous peoples and local communities | * | * | * | * | * | * | * | * | * | * | * | 301 |

*** means the absence of a paragraph in that year's UNGA resolution.
 * Documents included were A/PRES/64/71; A/PRES/65/37A; A/PRES/66/231; A/PRES/67/76; A/PRES/68/70; A/PRES/69/245; A/PRES/70/235; A/PRES/71/257; A/PRES/72/73; and A/PRES/73/124; A/PRES/74/19. Accessed in June, 2020 at https://www.un.org/Depts/los/general_assembly/general_assembly_resolutions.htm.

Surprisingly, neither the UNGA resolutions nor the Decade's official documents express the importance of science diplomacy as a concept that bring about transformative change in relation to the ocean. All the elements associated with science diplomacy are, however, evident expressly or implicitly in the UNGA resolutions (as discussed above) and the Decade's official documents: science advising policy making, diplomacy relying on evidence, and promoting further research in answer to global challenges, countries overcoming political tensions to address global concerns, and building a science-based dialog. The Decade of Ocean Science is an opportunity to recognize and highlight the importance of science diplomacy in achieving the objectives of the Decade. On this basis, there is a compelling case that ocean science diplomacy should be one of the pillars of this UN Decade for it highlights how multi-stakeholder partnerships are built to deal with global ocean matters, as was done during UNCLOS III negotiations and other international multilateral mechanisms.

Promoting Sustainability

The Decade should be recognized as a science diplomacy process intended to feed into another UN process based on science diplomacy: the 2030 Agenda on the Sustainable Development Goals (SDGs). The Decade's motto "The science we need for the future we want" is a clear reference to the UN document "the Future we Want" that constitutes the basis for the 2030 Agenda (United Nations, 2012), making one effort directed to achieve the other.

The SDGs were established by the UNGA in 2015 as agreed goals negotiated by UN Member States to achieve a more sustainable world. It brings society, economy, environment, policy, and international relations together around 17 goals (Nilsson et al., 2016). The goals deal with social challenges such as poverty, education, equality, as well as environmental concerns related to the ocean, land and atmosphere. They are a result of diplomatic negotiations underpinned by information and knowledge, most of which is scientific, in particular to Earth's capacities to sustain life as we know (Sachs et al., 2019).

Science is particularly important to achieve ocean sustainability, which is addressed by Goal 14—life under water (hereafter, SDG 14) (Visbeck, 2018). SDG 14 has been identified as the most transversal of the 17 (Singh et al., 2018; Nash et al., 2020), although not considered as a priority in almost all political settings in different regions (Custer et al., 2018). When it comes to investment and development, leaders typically choose other priorities which are not environment themed, like education (Goal 4), peace and justice (Goal 16), and decent work (Goal 08) (McDonnell, 2018). Goal 14, however, is the only one that has an explicit call for more investment in science and technology³, which complements the aims of the UN Decade of Ocean Science.

³Objective 14.A—Increase scientific knowledge, develop research capacity, and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries.

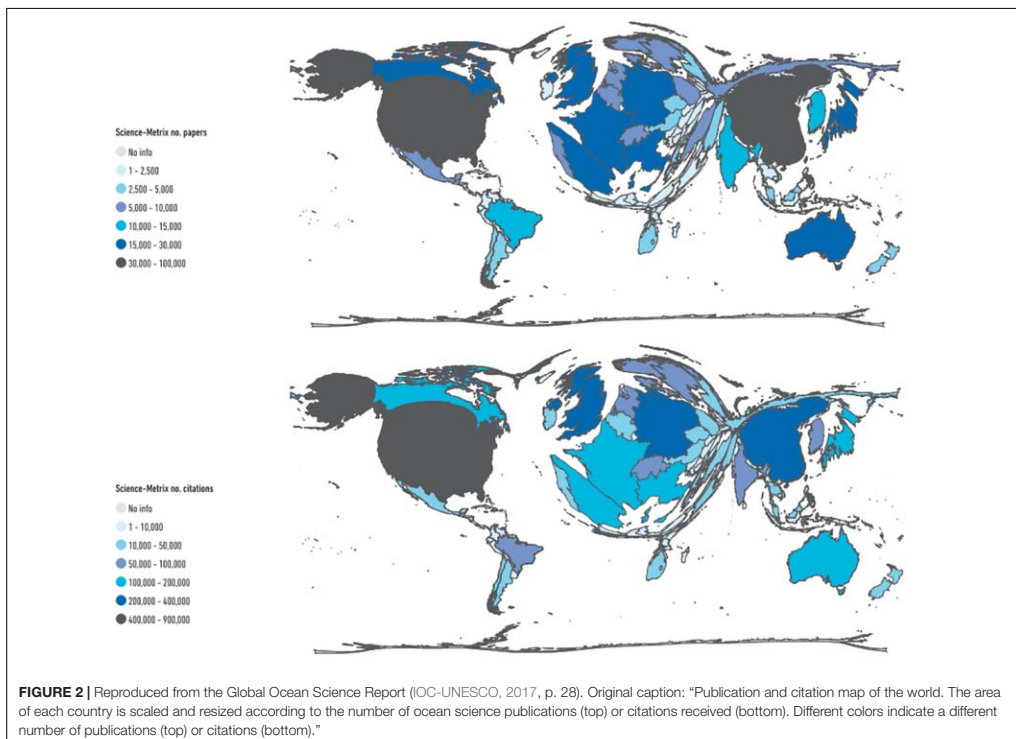
The existence of SDG 14 was made possible through an intense science diplomacy process at the UN. Small Islands Developing States (SIDS, but also known as Large Ocean States), pushed for an ocean related SDG that would bring their concerns forward and were skillful in presenting sufficient evidence on how their livelihoods are affected by a healthy ocean system (Quirk and Hanich, 2016). This diplomatic effort exemplifies how democratic ocean science diplomacy can be. SIDS countries usually have limited research capacities and international cooperation is a useful tool to access foreign research infrastructure. By building these partnerships, SIDS have the potential to access foreign funding and infrastructure and drive research projects to their own needs, generating evidence to feed their domestic policies. As a result, the civil understanding of the importance of a healthy ocean has influenced these countries' external policies in search for more just international relations.

Most developing countries and SIDS need to pool resources to access ocean research infrastructure and undertake projects that will enable them to implement SDG 14. Thus, international cooperation is also an important tool to deliver capacity for the 2030 Agenda. Ocean science diplomacy can present the necessary mechanisms for countries to advance their scientific capacities in exchange of granting foreign access to their waters,

in a win-win situation. It is therefore necessary to identify where developing countries and SIDS strengths and weakness lie so as to negotiate directly or through competent international organizations in demanding the "fair and reasonable terms and conditions" in agreements, as predicated by the Convention [Article 266 (1)].

Addressing Global Inequalities

As seen previously, the disparities in ocean science and technology capacities between countries are determinant of their success in implementing the Convention and related instruments. Implementing Goal 14 and the UN Decade of Ocean Science will be particularly challenging for developing countries. Not many countries in the world have access to the necessary technology and human capacity to deliver ocean science, especially due to the high costs associated with marine research infrastructure and the challenges to develop and maintain scientific capacities domestically. UNESCO's Global Ocean Science Report (IOC-UNESCO, 2017) highlights the global disparities in science indicators, particularly the production of ocean science publications and citations (Figure 2). These disparities result, *inter alia*, in large sampling and knowledge gaps for immense ocean spaces, in particular the Southern parts of the



Atlantic and the Pacific (on the need for a more comprehensive assessment, see Inniss et al., 2017).

While most developing countries depend on foreign research capacities to explore their waters and offshore resources, developed countries gain benefits from accessing other coastal States' waters and exploiting the natural resources therein. Developing countries need to take their geopolitical needs into consideration when negotiating access to infrastructure and scientific capacities with more capable nations. By working together through science diplomacy schemes, they can then enhance their scientific capacities and gain the necessary knowledge to promote better ocean management and sustainability nationally and internationally. In this context, ocean science diplomacy can be a game-changer in finding common grounds of understanding and promoting research capacities worldwide by providing access to research infrastructure and human capacities (Harden-Davies and Snelgrove, 2020). The central issue to be resolved is to understand and apply science diplomacy as an aid to reorganize relevant stakeholders internationally to solve wicked humanitarian puzzles.

Advancing Community Interests

Governments frequently fail to apply the best available scientific knowledge for making decisions, and the ocean science diplomacy framework proposed in this paper shall aid authorities to recognize the benefits in further applying evidence to international policymaking. A force in this regard pertains to organizations that are not under the scrutiny of governments. Non-governmental organizations can have a leading role in presenting updated research evidence and call States to promote change. Non-State actors and international organizations have proven to be effective in promoting the linkage of science and international affairs on urgent ocean matters (Kaltofen and Acuto, 2018a). Experience in international and national decision-making processes over the past three decades demonstrates that NGOs in particular are very effective in gathering experts on certain topics and promoting public concern and engagement around what can be understood as a community interest (Cohen, 2011), communities here being defined as a group of individuals who share common values and concerns (Besson, 2018). Thus, NGOs and other non-State stakeholders promote evidence provision and community interests in international negotiations by organizing the technical debate and assisting delegations with experts and the organization of events. In this regard, these actions should also be considered as science diplomacy practices and a form of Track 2 diplomacy, i.e., diplomacy that happens beyond the formal State channels (Jones, 2015). This para-State form of international relations gives voice to societal concerns and foster community interests that are not necessarily aligned with any country's political view.

As official UN documents call for a stronger participation of knowledge producers and users in both the science and policy making, it will be critical to promote inclusiveness and transparency. Ocean science diplomacy practices in the past and present have broken silos and promoted better communication. It thus represents a tool to assess and foster community interests,

by promoting citizenry engagement in both research and decision making. In this regard, the role of indigenous and traditional knowledge has been gaining much attention in ocean affairs and that specific community shares important interests that both scientists and diplomats must consider (Kaiser et al., 2019).

CONCLUSION

Science diplomacy research can promote better coordination and transdisciplinary science in global ocean affairs. Ocean science diplomacy can also ensure the conduct of more effective equitable negotiations and the attainment of fair agreements between States and other entities, including international organizations, by balancing national interests with regional and global shared goals, as prescribed by the Convention. Understanding past negotiations in ocean affairs can help us shape future scenarios where science and international relations leverage expertise and scientific capacity to inform transnational decision making, as exemplified by the success of UNCLOS III and subsequent law of the sea negotiations. Clearly, there is a historical gap in scientific capacities between developed and developing countries (IOC-UNESCO, 2020a). This gap shaped different positions at the UNCLOS III negotiations. However, diplomacy, supported by scientific evidence, was successful in advancing on the adoption of the Convention and establishing mechanisms to address these differences. The necessary diplomacy to overcome those differences involved clustering (e.g., G77 + China, Landlocked, etc.) and trade-offs among States in achieving the compromises and the package of issues codified by the Convention. Capacity building and access to research infrastructure were some of those elements being traded over negotiations, in particular by countries with less capabilities (Nordquist et al., 1990). However, as shown by the Global Ocean Science Report (Figure 2), the mechanisms in place to boost research capacity and technology transfer have not yet been effective (Salpin et al., 2018; IOC-UNESCO, 2020a).

With the upcoming UN Decade of Ocean Science for Sustainable Development, there is a chance to look back and to learn from previous lessons in successful law of the sea negotiations. Ocean science diplomacy will be essential in advancing coordination of the necessary elements needed to overcome historical difficulties. The Decade should be an opportunity to understand how ocean science happens in the global south and what is needed to balance these inequalities to deliver the expected results, for instance, in the 2030 Agenda. The Decade not only represents an opportunity to continue long identified but necessary science initiatives, like mapping the entire seafloor (about this ambition, please refer to the Seabed 2030 Project in Mayer et al., 2018) and improving ocean forecast, but also to capture these certainly important actions in a broader framework. This framework will be cognizant of enabling developing countries to thrive in their national ocean scientific capacities in order to contribute over time with the necessary evidence for future decision making. The ocean community needs to leave the assistance provider view and adopt a co-ownership and co-development perspective in relation to

transnational processes, so finally “no one is left behind” becomes an imperative for a sustainable future (United Nations, 2016).

Fairness and justice would entail properly addressing intellectual property rights of ocean technologies, discussing benefit sharing mechanisms, investing in local communities, and establishing researchers in key areas so innovation and development would follow. The Decade is a global movement that needs to be dealt with through diplomacy, informed by cross disciplinary ocean science. The invisibility of local researchers that do not have access to ships and equipment, nor are able to calibrate and maintain oceanic instruments, needs to be properly addressed by diplomacy. Business as usual will not solve the problems. The Decade, however, can if it genuinely and successfully encourages partnerships through which change can be made.

Indeed, the effective management of current ocean issues demands broader participation and better communication between sectors, not just scientists and policymakers, but also society, private sector, coastal communities, educators, NGOs, and so on. Since there is still much to be revealed about the functioning of the ocean and science is being called upon to have a stronger societal role, investments need to be made in research infrastructure and human capacities, so our collective will be able to produce the necessary knowledge to feed into public policies and international negotiations.

Our dependency in the ocean is clear: as our life-supporting system or as the basis for many economies, life cannot thrive without healthy oceans. On the other hand, food provision in face of exponential population growth calls for a wise change in the use of marine resources. Science can certainly provide information, but not in the necessary pace. Thus, stakes are high, so are uncertainties, a scenario that fits well within the post-normal science theory (Funtowicz et al., 1991; Funtowicz and Ravetz, 1993). Post-normal science states that if science is to keep producing knowledge in the normal mode, established under the Kuhnian scientific method, it will not be effective enough to address community interests as fast as necessary. Academia needs to break the silos and allow a broader peer review community, encompassing the views from non-Academics into the scientific process (König et al., 2017). By doing so, reorientations can be promoted in accordance with user's needs and results can be combined with traditional and indigenous knowledge, for example (Nurse-Bray et al., 2014). This approach facilitates better communication and mutual understanding would be triggered around a shared goal, exactly as the UN Decade for Ocean Science and the SDG's 2030 Agenda are requesting. Further research will be needed to understand the connecting dots on how post-normal science theory can boost science diplomacy mechanisms since both call for a break of silos and stronger interaction.

Society's participation in science and policymaking should not be undermined (Kahan et al., 2011; Stilgoe et al., 2014; Porter and Dessai, 2017; Squarcina and Pecorelli, 2017). Therefore, further

studies on public engagement, public perception of science, and ocean literacy will certainly be key to inform the implementation process of the Decade of Ocean Science. In this context, ocean science diplomacy is one of the possible ways of promoting this post-normal science, allowing inclusive participation of non-experts, and bridging communities. Further research on this aspect should also be promoted.

From a national perspective, countries need to build internal mechanisms to align researchers with policymakers and society to identify gaps and strengths in its science and technology domestic frameworks. This will help enable States to negotiate internationally on fairer grounds. Science diplomacy research can provide good examples of practices that have progressed in this sense, such as the designation of science attachés to Embassies to act together with diplomats in both identifying opportunities for collaboration as well as promoting national's endeavors abroad (AAAS, 2017). Domestically, appointing science advisors to high Government hierarchies has proven to be an effective way to advance in the science-policy interface that desirably should connect to the country's external policy in negotiating possible solutions to national challenges (Gluckman, 2014).

Ocean science diplomacy can significantly contribute to global agendas on sustainable uses of the ocean that rely on national policies and international frameworks. It can be a change in balancing ocean research capabilities, allowing a broader participation of scientists and communities in the international decision-making process, and finding some hope for a more sustainable ocean in the future.

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The author confirms being the sole contributor of this work and has approved it for publication.

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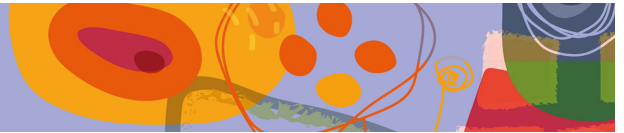
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Atlantic Ocean science diplomacy in action: the pole-to-pole All Atlantic Ocean Research Alliance

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The ocean provides important ecosystem services to society, but its health is in crisis due to the impacts of human activities. Ocean sustainability requires ambitious levels of scientific evidence to support governance and management of human activities that impact the ocean. However, due to the size, complexity and connectivity of the ocean, monitoring and data collection presupposes high investments, and nations need to cooperate to deliver the ambitious, costly science that is required to inform decisions. Here, we highlight the role that ocean science diplomacy plays in facilitating the science needed to support ocean governance and management from domestic, regional to international scales in the Atlantic region via the All Atlantic Ocean Research Alliance. This Alliance is supported by the Galway Statement (2013), the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and the Southern Oceans (2017), and the Belém Statement (2017). We discuss the national and international interests that drove the processes of negotiating these agreements, as well as their challenges to date. We also discuss the potential future of the All Atlantic Alliance, as well as its significance in emerging global initiatives such as the UN Decade of Ocean Science for Sustainable Development (2021–2030).

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Introduction

The ocean is essential to human life. It regulates our climate by storing carbon and heat (Cheng et al., 2020), produces half of our oxygen (Körtzinger et al., 2004), provides food for billions of people (Food and Agriculture Organization of the United Nations, 2020), as well as alternative sources of energy (Pelc and Fujita, 2002). The ocean lays mineral resources (Cuycers et al., 2018) and hosts a rich, and yet unknown biodiversity, which holds the potential for the development of new materials, medicines and other products (Halvorson and Quezada, 2009). Nearly 40% of the global population lives within 100 km of a coastline (Small and Nicholls, 2003), and for many, the ocean is a workplace supporting fishing, transport, shipping, and tourism.

The ocean is, however, under threat from human activities. Examples of these threats range from climate change, overfishing and destructive fishing, marine pollution, ocean acidification, under water noise, habitat degradation/loss, invasive species, eutrophication, and the cumulative impact of these and many other pressures (Halpern et al., 2008; Rockström et al., 2009). Human activities have changed the ocean, undermined its health and impaired its capacity to deliver benefits to humanity (Lubchenco and Petes, 2010). For these reasons, the ocean has been recognized as a global commons: it is in humanity's best interest to maintain a healthy and sustainable ocean for future generations (Vogler, 2012).

Human activities must be managed and governed in order to maintain ocean health, resilience and function so that it will continue to safely deliver benefits to humankind (Lubchenco and Gaines, 2019). Such management and governance requires ambitious levels of scientific evidence to inform decision making (Stenseth et al., 2020; Visbeck, 2018). Science is needed to understand the way the ocean functions and to predict the state of the ocean. It is also needed to inform decisions about how to plan and regulate human activities that impact the ocean. It is also needed to establish safety and warning systems and to help society to respond and adapt to a changing environment and climate (Bax et al., 2018; Duarte et al., 2020).

Ocean science requires high technological capacity, equipment, and data sharing in order to investigate the complexities of the globally connected ocean (deYoung et al., 2019). Ocean observations and monitoring apply a multiplicity of research platforms, ranging from moored and drifting buoys to satellite imagery, often governed by intergovernmental coordinating mechanisms (Tanhua et al., 2019; Todd et al., 2019). Science at this scale is very costly, and must be coordinated over wide regions in space and time (Miloslavich et al., 2018). Such coordination of efforts and co-investment between Nations can be facilitated through science diplomacy, i.e., the intersection between science and international relations (Wagner, 2002).

Although science diplomacy is not a new practice (for a historical perspective, see Turekian, 2018; Turekian et al., 2015), the concept is relatively new and still debated (Flink and Rüffin, 2019; Ruffini, 2020). The taxonomy provided by The Royal Society & AAAS (2010) frames this intersection as science in diplomacy, i.e., scientific evidence feeding diplomatic decision making; diplomacy for science, where diplomatic mechanisms facilitate research and development; and science for diplomacy, where countries build a dialog by establishing joint research endeavors.

The ocean international regime has been centered on ocean science (Robinson, 2020). Nevertheless, ocean science diplomacy has largely been overlooked in marine science and ocean policy academic literature. To highlight the important role that ocean science diplomacy has on scientific collaboration and international agreements, this paper examines the case of ocean science diplomacy in the Atlantic. The Atlantic offers a very interesting example of ocean science diplomacy for a number of reasons. First,

the Atlantic is rich in ecosystem services, and challenged by a diversity of threats (Inniss et al., 2017). Second, The Atlantic is bordered by a wide diversity of nations. These countries differ significantly in culture, politics, wealth, and scientific capacity, and must collaborate to deliver basin-scale ocean science (Brunelle, 2013). Third, several international agreements have emerged to promote science diplomacy in the Atlantic region and have given rise to rapidly expanding scientific collaboration between nations.

In this paper, we will describe the All Atlantic Ocean Research Alliance (the Alliance) as science diplomacy in action. First, we present an overview on the Atlantic Ocean research landscape. Second, we describe the three specific international science and technology instruments that support the Alliance: the Galway Statement (2013), the South–South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and the Southern Oceans (2017) and the Belém Statement (2017). Third, we analyze the political and scientific motivations for the adoption of the Alliance. Finally, we discuss the results achieved and potential future outcomes of this ocean science diplomacy endeavor.

International relations to support ocean science collaboration in the Atlantic Region

The Atlantic Ocean Research landscape. Atlantic ocean research is concentrated in higher latitudes (Inniss et al., 2017). Research capacities, both in terms of marine research infrastructure as in human capital, are concentrated in Northern countries (IOC-UNESCO, 2017), as is the majority of the research fleet (Nieuwejaar et al., 2019). UNESCO's Intergovernmental Oceanographic Commission—IOC dataset on marine experts show that the absolute number of researchers auto-declared as Atlantic experts is similar between the South (731 researchers) and the North (807 researchers) (IOC-UNESCO, 2017). Most of the publications in marine science, however, come from North America and Europe with a focus on the North Atlantic (as per the assessment from 1996 to 2013 presented in Inniss et al., 2017). Consequently, the South Atlantic, the region between the Equator and the Southern Ocean at 60°S, is one of the least known, under mapped and under sampled ocean spaces on Earth (Miloslavich et al., 2011).

Knowledge gaps undermine the potential for societies to properly understand and manage ecosystem services that impact countries throughout the Atlantic (Duchez et al., 2016; Lopez et al., 2016). Countries in the Atlantic seek to intensify research on the interconnections and dynamics between South and North Atlantic, by which southern countries' research capabilities are enhanced through the access to ocean research infrastructure, human capacities and funding. Over the years, Atlantic-wide scientific institutions have demonstrated an interest to cross disciplines and establish cooperative ties between South and North Atlantic (Mackenzie et al., 2019; Schmidt et al., 2019). Such cooperative ties require international alliances to define priorities, investments, and desired outcomes, such as policy-relevant knowledge to be applied to a better management of the Atlantic (deYoung et al., 2019). Consequently, diplomatic negotiations were commended to strengthen ocean science in the Atlantic.

The backdrop for the establishment of the Alliance

The need for cooperation between nations on ocean research in the Atlantic basin created an opportunity for the practice of ocean science diplomacy. The All Atlantic Ocean Research Alliance is the result of a stepwise diplomatic negotiation process with the goal of producing knowledge-based solutions for an improved

management of the Atlantic Ocean. The Alliance results from a science diplomacy effort that bridged countries, aligning research capacities, sharing costs and co-developing knowledge for societal benefit. The European Commission triggered the

negotiation process in 2013 involving first the US and Canada, followed by Brazil, South Africa, Argentina and Cape Verde to implement the internationalization of the European Atlantic Strategy (Fig. 1).



Fig. 1 EU's strategic framework in support of the All Atlantic Ocean Research Alliance. This figure is covered by the Creative Commons Attribution 4.0 International License. Reproduced with permission from Andrei Polejack; copyright © Andrei Polejack, all rights reserved.

The European Union's Integrated Maritime Policy coordinates fragmented marine policies at the EU level and establishes sea basin specific strategies that oversee cooperation with third countries (European Commission, 2007). The Atlantic Maritime Strategy (European Commission, 2011a) and its subsequent action plans (European Commission, 2013, 2020) are the implementing arm of the Integrated Maritime Policy for the Atlantic. This Atlantic Strategy is relevant because it gives the mandate to the Commission to reach out for partners in the Atlantic Ocean for further collaboration. Part of the success of the EU's Atlantic Strategy depends on international cooperation.

The first step in implementing the internationalization of the Atlantic Strategy was the Galway Statement. The Galway Statement is a North-North coalition on ocean science and technology signed between Canada, the European Union and the United States of America in 2013. The second step was the South-South Framework. The South-South Framework joined Brazil and South Africa in bilateral ocean science and technology arrangements and was informed by the Commission on the outcomes of the Galway Statement. Finally, South and North were bridged by the signing of the Belém Statement between EU, Brazil and South Africa, setting up an All Atlantic Ocean Research Alliance. The following sections will describe the history and development of these three agreements.

The three international Science and Technology Statements which applied science diplomacy in the Atlantic

North-North—The Galway Statement. In 2013, the European Union (EU), the United States of America (USA) and Canada started a negotiation process that would trigger a North-centered Atlantic Ocean Research Alliance through an instrument called the Galway Statement on Atlantic Cooperation (hereafter the Galway Statement). The Galway Statement was signed as a result of a large bottom-up consultative process with scientists, government officials and industry (European Union, Canada, and United States of America, 2013). The Galway Statement builds upon the bilateral Science & Technology agreements between the EU and Canada and between the EU and the USA. The document also highlights the relevance of the EU's Atlantic Maritime Strategy.

The Galway Statement's main purpose is to "(...) increase our knowledge of the Atlantic Ocean and its dynamic systems including interlinks with the portion of the Arctic that borders Atlantic-by aligning our ocean observation efforts to improve ocean health and stewardship and promote the sustainable management of its resources".

The priorities set therein are as follows: i. to align ocean observation efforts; ii. to improve ocean health and stewardship; iii. the sustainable management of the resources; iv. to coordinate data sharing and interoperability; v. seabed and benthic habitat mapping; vi. ocean literacy; vii. researcher mobility; and viii. harness public-private partnerships. By doing so, the expected outcomes were: better ecosystem assessments and forecasts; deeper understanding of vulnerabilities and risk (specially climate related); and new tools to increase resilience, conserve rich biodiversity, manage risk and determine social, environmental and economic priorities (European Union et al., 2013).

A Trilateral Galway Statement Implementation Committee was established in 2013 to oversee the work needed to achieve this Statement's goals. The institutions that lead this Committee are the European Commission's Directorate General on Research & Innovation, the USA's National Oceanic and Atmospheric Administration and Canada's Department of Fisheries and Oceans.

The European Commission launched a series of calls for proposals in 2014 in support of the implementation of the Galway Statement through the Horizon 2020 Framework Programme for Research and Innovation (European Commission, 2017b, 2019). Proposals involved not only research projects, but also the interesting mechanism of the Coordination and Support Actions—CSA. The CSAs are intended to accompany measures such as standardization, dissemination, awareness-raising and communication, networking, and coordination or support services. CSAs also support policy dialogs and mutual learning exercises/studies, aiding activities of strategic planning, networking and coordination between programs in different countries. As such, CSAs function as support mechanisms for policy, bridging Academia, Government, Civil Society and Industry in and out Europe.

One Coordination and Support Action was funded to support the implementation of the Galway Statement: the Atlantic Ocean Research Alliance Coordination and Support Action, or AORAC-SA¹. This CSA, due in 2020, was coordinated by the Marine Institute Ireland and involved a consortium spread across key marine organizations in Europe. AORAC-SA overall objectives were to improve the international cooperation framework under the Galway Statement and to create a foundation for the development of large scale joint international marine research programs. AORAC-SA established a High-Level Advisory Board to follow the implementation of the project and make further recommendations and guidance. The High-Level Advisory Board was composed of representatives from the three signatories plus representatives from Brazil and South Africa. AORAC-SA was meant to support the implementation of the Galway Statement and thus lacked research institutions from Brazil and South Africa in the consortium. The participation of Brazil and South Africa in this board was important to exchange relevant information on actions in the South and in the North. The High-Level Advisory Board acted at the CSA level, advising the Trilateral Galway Statement Implementation Committee. This Implementation Committee, composed by the three signatory parties, was responsible to guide, propose and implement concrete actions to the Galway Statement.

The Trilateral Galway Statement Implementation Committee established working groups to operationalize the political commitments taken by the cosignatories of the Galway Statement on specific areas of common interest. These working groups were: Ocean Literacy; Aquaculture; Ecosystem Approach to Ocean Health and Stressors; and Seabed Mapping. The Committee decided not to create a specific group for ocean observations because the AtlantOS project (Optimizing and Enhancing the Integrated Atlantic Ocean Observing Systems), as we will address in detail further, was mandated to coordinate observational systems in the Atlantic. The working group on Seabed Mapping was responsible for coordinating the North Atlantic seabed mapping. This coordination included ship time and equipment sharing that has proven to be effective (AORA, 2018; Raineault and Flanders, 2019). The findings of the seafloor-mapping working group resulted in a special issue of the research journal *Frontiers in Marine Science*².

The European Commission first negotiated the terms of the Galway Statement bilaterally, by establishing specific ocean working groups in each of the existing bilateral science and technology agreements with the US and Canada. The Commission used this strategy to establish strong diplomatic and political grounds tied to the bilateral formal agreements. As a consequence, the bilateral working groups resulted immediately into trilateral working groups after the signing of the Galway Statement. The Commission applied similar strategy southwards in the Atlantic, as we will present further.

South–South: the Framework. In 2013, the same year the Galway Statement was signed, the EU-Brazil Joint Steering Committee on Science and Technology decided to create a Working Group on Ocean Science and Technology. Co-chairs from both the European Commission and the Brazilian Ministry of Science, Technology and Innovations were assigned to coordinate this work. As a result, a bilateral ocean-specific agreement was signed in 2015 (European Union and Brazil, 2015). Similar process occurred in South Africa, with a resulting agreement in 2016 (European Union and South Africa, 2016).

Brazil and South Africa had closely followed the developments under the Galway Statement both because of the bilateral negotiations with the European Commission and their participation in the advisory board of the AORAC-SA. Both Southern countries realized the benefit arising from such a coordination and resolved to develop a similar process in the South Atlantic. As a result, a South–South scientific agenda was crafted for the South Atlantic and Southern Ocean. The initial partners in this discussion included Academics and government officials from Argentina, Namibia, Angola and Uruguay. Brazil and South Africa decided to extend the invitation to the European Commission and European researchers involved in projects in the South Atlantic. The South–South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans was developed after a series of two technical seminars that were financially supported by the European Commission (Brazil and South Africa, 2017). The Framework is centered in the inputs from the South Atlantic community, including the views from those Northern researchers who work cooperatively with the South (Claassen et al., 2019).

The South–South Framework is a bilaterally agreed plan for scientific cooperation in oceanic research between South Africa and Brazil. The process of negotiating the Framework included inputs from Argentina, Angola, Namibia, and Uruguay. The final document was adopted only by Brazil and South Africa because internal political processes prevented the other countries to adopt it immediately. Thus, the Framework is open to all countries in the region and is intended to promote scientific cooperation and capacity building among South Atlantic countries. The Framework promotes the exchange of expertise and knowledge of ocean science and technology for the environmental and socio-economic benefits of countries in the region.

The priorities defined in the South–South Framework include three broad themes that are followed by a more detailed program. The priorities are: i. Climate Variability and Change; ii. Ecosystem Variability and Controlling Processes; and iii. Living and Nonliving resources, and biodiversity. Three cross-cutting areas were identified: human capital development; development and deployment of various platforms for data collection; and collaboration on relevant aspects of big data.

The South–South Framework goes beyond the typical research cooperation to aim also in contributing to the greater economic, political and diplomatic alignment of South Atlantic nations. The document ambitions the development of common and joint imperatives for the South and Tropical Atlantic and the Southern Oceans. The Framework also states the intention to position South Atlantic Ocean countries as global focal points leading joint and individual observational and research endeavors in the South Atlantic.

The will to align the South–South with the Galway Statement can be seen in at least two statements present in the Framework. *“Ultimately, it is hoped that the Framework will guide not only South–South, but also South–North scientific cooperation (p. 2)”*. Also, *“(the Framework) is intended to address and build-on current collaborative research programs between Southern countries, and in alignment with Northern countries, with the aim of*

developing basin scale ocean science and technology development, enhancing human capacity, strengthening ongoing projects, and identifying potential activities and opportunities for further development within this cooperation (p. 9)”.

South–North: the Belém Statement. The South–South Framework, through its organization of the Southern nations, was an important pre-requisite toward the development of a basin-scale Atlantic scientific cooperation. Upon the establishment of the South–South Framework, the European Commission, Brazil and South Africa organized a series of seminars to propose a new instrument to establish the All Atlantic Ocean Research Alliance. This instrument is the Belém Statement.

The Belém Statement on Atlantic Research and Innovation Cooperation (European Union, South Africa, and Brazil, 2017) was signed in the Belém Tower of Lisbon in 2017. The Statement main purpose is to improve the collaborative scientific efforts in the Atlantic Ocean and sustainably cooperate on marine science, research and innovation. The Belém Statement highlights the mutual benefit on linking research activities in the South Atlantic and Southern Ocean with those in the North Atlantic. Moreover, the Belém Statement aims to leverage from already existent endeavors, such as the Benguela Current Commission.

The Belém Statement is based on the principles of shared responsibility and mutual benefit. The aims of the Statement are to: promote and facilitate human capital development and scientific exchange; provide a platform and opportunities for scientific and technological cooperation resulting in joint activities; and, encourage new models for cooperation on a coordinated and partnership-based approach to tackle the scientific and societal challenges of the Atlantic Ocean. The Statement connects oceans and climate change, oceans and food, and oceans and energy systems, as well as the dynamics of the Atlantic Ocean and its interconnected circulation systems from Antarctica to the Arctic, representing a pole to pole research effort.

The priority areas set in the Belém Statement are aligned with those decided in the documents forging the North–North and the South–South cooperation (Table 1). The common areas of interest are: 1. Climate variability and ecosystem approaches; 2. Ocean observation (including seabed mapping), forecasting and monitoring processes and systems; 3. Food security, fisheries management, aquaculture and biodiversity; 4. Oceans technology (including for observation and renewable marine energy); 5. The effects of emerging pollutants; and, 6. Polar research (especially interconnections between the Atlantic, the Southern Ocean and Antarctica).

The proposed outcomes of the Belém Statement include: better monitoring and forecasting capacities; improved safety at sea, human health and well-being; sustainable use of marine resources; new and emerging technologies to service societal needs and new value chains; and, ocean-engaged citizens through enhanced ocean literacy activities.

The European Commission allocated funding of approximately 64 million euros in the Horizon 2020 Work Programme to implement the Belém Statement, more precisely under the Blue Growth calls for proposals (European Commission, 2017a). A Coordination and Support Action (CSA) was also funded to support the implementation of the Belém Statement, similar to what was done for the Galway Statement. The All Atlantic Cooperation for Ocean Research and Innovation Coordination and Support Action–AANCHOR CSA aims to support the international cooperation between Europe and South Atlantic countries. AANCHOR also seeks the connection with the different ongoing initiatives and projects in the North Atlantic beyond Europe.

Table 1 Comparison among the priority areas defined by each of the negotiation processes of the three Atlantic international arrangements on ocean research and development (STI: Science, Technology, and Innovation).

| | Galway Statement (2013) | South-South Framework (2017) | Belém Statement (2017) |
|--|-------------------------|------------------------------|------------------------|
| STI priority areas | | | |
| Ocean observation (including seabed mapping), forecasting and monitoring processes and systems | X | X | X |
| Ocean health, including pollutants | X | | X |
| Sustainable management of the resources | X | X | X |
| Data sharing and interoperability | X | X | X |
| Seabed and benthic habitat mapping | X | X | X |
| Ocean Literacy | X | | X |
| Climate Variability and Change | | X | X |
| Ecosystem Variability and Controlling Processes | X | X | |
| Nonliving resources | | X | |
| Biodiversity | X | X | X |
| Food security, fisheries management & aquaculture | X | X | |
| Oceans technology (including for observation and renewable marine energy) | X | X | |
| Polar research (especially interconnections between the Atlantic, the Southern Ocean and Antarctica) | X | X | |
| Earth system model | | X | |
| Inter-ocean exchanges and large scale circulation | X | | |
| Air-sea exchanges and storage | | X | |
| Paleo evolution | | X | |
| Biological production and biogeochemistry | X | | |
| Continent-Shelf-Ocean continuum | | X | |
| Surface Ocean-Deep Ocean links | | X | |
| Marine biotechnology | | X | |
| Cross-cutting areas | | | |
| Researcher mobility | X | X | X |
| Public-private partnerships | X | | X |
| Human capital development | | X | X |
| Sharing of research infrastructures | | X | X |

AANCHOR differs from its North Atlantic sister project, the AORA-CSA, on including institutions from Latin America and Africa as part of the consortium. A High-Level Board was established to guide AANCHOR. Membership include each of the three signatories plus representatives from the USA, Canada, Argentina and Cape Verde. The High-Level Board in the Belém Statement is similar to the one set up for the Galway Statement in the sense of including partners that are not signatories to the Statement. In fact, Argentina and Cape Verde were included in AANCHOR just after signing bilateral science and technology implementing arrangements for ocean research with the European Commission (European Commission and Argentina, 2018; European Commission and Cabo Verde, 2018). The High-Level Board acts at the CSA level. The implementation of the Belém Statement at a higher political level is done by a trilateral committee composed by the three cosignatories, similar to what was done for the Galway Statement.

AANCHOR assembles experts from around the Atlantic in multi-stakeholder platforms to identify collaborative activities. There are currently five platforms acting as think tanks under AANCHOR. These platforms are: 1. reinforcing capacity building; 2. promoting academia-industry knowledge transfer; 3. developing common standards (including data); 4. enhancing citizen awareness and ocean literacy; 5. converging and aligning R&I infrastructure initiatives. These multi-stakeholder platforms are expected to define long term measures for the cooperation framework of the Belém Statement, beyond the project's lifetime.

Part of the scope of the Belém Statement is about capacity development, particularly for younger generations. The All

Atlantic Ocean Youth Ambassadors program was a response to that objective. The program targets young ocean leaders who are required to promote ocean literacy, outreach and communication strategies. Ambassadors should act both in local community engagement as well as in regional/global communities, advancing their role as early career science diplomats. The first Ambassadors' training happened in 2019 with participants from Argentina, Brazil, Canada, Cape Verde, Europe (several countries), South Africa and the USA (AORA and AANCHOR, 2019b). Recently, the European Commissioner for Innovation, Research, Culture, Education and Youth, Mariya Gabriel officially launched the program³ and announced a second round of training, planned for 2021⁴.

The Belém Statement implementation is underway with ongoing efforts in research and engagement. As the Belém Statement implementation progresses, interest in the region arises. For example, the European Commission and the Kingdom of Morocco signed in December 2020 an administrative arrangement on marine research and innovation, which highlights the work undergoing in the Belém Statement⁵. Moreover, the African Union has shown interest in the capacity development component. In general, these statements of interests are done at the All Atlantic Forum, an event that has gathered this new Atlantic community to discuss common issues of concern. The Forum happens once a year and have started in Brazil, followed by one edition in Europe and, in 2020, in South Africa⁶. Hopefully, this Alliance will also attract other international initiatives and donors, such as philanthropy, private agents, and NGOs. It will be interesting to follow how impactful this Alliance will be in the future.

Discussion

The All Atlantic Ocean Research Alliance as an example of science diplomacy. The process of adopting and creating the All Atlantic Ocean Research Alliance can be framed in the taxonomy proposed by The Royal Society and AAAS (2010). First, it is an example of “science in diplomacy” because scientific advice supported the process of the three above-described international instruments, identifying priority areas and targeted countries. Second, it is an example of “diplomacy for science” since the official documents supporting the Alliance, i.e., bilateral and multilateral agreements, foster research projects and access to infrastructure. Finally, it is an example of “science for diplomacy” because the science-based dialog is bridging countries in the Atlantic around the common goal of societal benefit. This dialog is set in both the existing diplomatic instruments, as well as in the funded research projects.

Science diplomacy addresses goals shaped by (i) national interests and needs; (ii) cross-border interests; and (iii) global needs (Gluckman et al., 2018). The All Atlantic Ocean Research Alliance uses science diplomacy to address goals shaped by similar interests. First, the Alliance was triggered by national interests, in particular the Commission’s interests in internationalizing its Atlantic Strategy. Second, the stepwise process of implementing the Alliance covers cross-border interests ranging from North–North and South–South coalitions to a whole basin coordination. Lastly, the aims of the Alliance cover global ocean community interests.

Europe’s early role in science diplomacy strategies in the Atlantic. In 2011, the Directorate-General for Research and Innovation of the European Commission, promoted the event “The Atlantic Geopolitical Space: common opportunities and challenges”, discussing the Atlantic values to economy and trade, to energy provision and security (European Commission, 2011b). The report of this event highlighted the Atlantic as of major importance to Europe and recommends that alliances are built, by which scientific cooperation should be both a pillar and a facilitator (European Commission, 2011b). The EU’s Atlantic Strategy was launched in 2011, stressing scientific cooperation. The Atlantic Strategy offered the political mandate for the European Commission to explore alliances as part of the Strategy’s internationalization component. This political context facilitated the signing of the Galway Statement and the bilateral agreements with Brazil and South Africa 2 years later, triggering the process of building up the All Atlantic Ocean Research Alliance. Europe’s initiation of a basin-scale ocean science diplomacy endeavor could help to inspire similar initiatives in other basins.

In the All Atlantic Ocean Research Alliance, bilateralism provided the backbone for multilateral science diplomacy. The European Commission used bilateral formal agreements on ocean science and technology with each partner country to progressively build the All Atlantic Ocean Research Alliance. These bilateral agreements included first the US (2012) and Canada (2012), second Brazil (2015) and South Africa (2016) and more recently Argentina (2018), Cape Verde (2018) and the Kingdom of Morocco (2020). This strategy allowed the Commission to establish commitments and compliance from each partnering country when progressing to a multilateral setting. Bilateral science and technology agreements were reported to be useful in promoting science diplomacy (Dolan, 2012).

According to Ruffini (2020), science diplomacy is fueled by national interests. The three science diplomacy instruments in the All Atlantic Ocean Research Alliance support multi-national collaboration on scientific research and potentially also the national interests of the countries involved. For example, the European Commission has been very successful in pushing

forward its views, strategies and policies at the international arena, utilizing science diplomacy tools to pursue its goals in the Atlantic (European Union, 2019; López de San Román and Schunz, 2018). European interests in the Atlantic go beyond than acquiring evidence on essential natural assets (European Union, 2020). The Atlantic is an essential part of Europe’s Blue Growth agenda to generate jobs and advance industrial development and recovery through ocean and coastal innovation (European Commission, 2013). The Atlantic is also essential to the new European Green Deal in terms of renewable sources of energy and technology developments for food provision and other ocean services (European Commission, 2019).

The Southern interests in the All Atlantic Ocean Research Alliance. Southern Countries, in particular Brazil and South Africa, have had a long running history of scientific cooperation in ocean science that precedes the All Atlantic Ocean Research Alliance.

Since 2005, Brazil and South Africa are both part in the IBAS (India, Brazil, and South Africa) dialog on ocean science (Arkhangelskaya, 2010) and more recently, in 2017, in the BRICS (Brazil, Russia, India, China, and South Africa) working group for ocean and polar sciences⁷. Moreover, Brazil and South Africa have shared an ocean observing system in the South Atlantic since 2010 as a result of the engagement in multilateral ocean science endeavors (Ansoorge et al., 2014). These activities allowed ocean science communities from Brazil and South Africa to interact overtime, and to define research priorities and gaps. As a result, researchers from both countries informed the negotiation of the South–South Framework and ultimately the Belém Statement.

By the means of the South–South Framework, Southern nations were able to coordinate their national interests and exercise this power with the North, influencing the Atlantic research agenda and further investments. On the signing event of the Belém Statement, the then Commissioner for Research and Innovation, Carlos Moedas announced a political and financial commitment to promote joint research projects under the implementation of the Belém Statement. This was further promoted and consolidated through the Horizon 2020’s Blue Growth calls for research proposals. Proposals in these calls were encouraged to partner with institutions from Brazil and South Africa. This was particularly important for Brazilian researchers because of the current national science budget crisis (Angelo, 2017, 2019; Rodriguez Mega, 2019). Therefore, access to research funding can be seen as national interests to Brazil and South Africa.

The South–South Framework highlights the willingness of Brazil and South Africa to align their national interests and build regional, science-based coalitions aimed at influencing global ocean agendas. The Framework makes explicit reference to the United Nations Convention on the Law of the Sea, the Convention on Biodiversity, the goals of the Food and Agricultural Organization and the International Whaling Commission.

South–South cooperation in this space would address high-profile scientific questions that could provide relevant information to address national priorities as well as lead to opportunities to play an active role in the global sphere (Brazil and South Africa, 2017).

The Alliance’s impact in addressing global interests. The Atlantic Ocean is of critical importance to the global ocean and climate dynamics. The All Atlantic Ocean Research Alliance

contributes to the global ocean knowledge by intensifying research in the Atlantic. One of the main goals of the Alliance is to generate knowledge for social benefit. It is a global community interest to promote an improved ocean governance through the application of the scientific knowledge in decision making (Wiszc et al., 2020). The upcoming UN Decade of Ocean Science for Sustainable Development shall be a good opportunity for the All Atlantic Ocean Research Alliance to contribute with research to address global ocean concerns (Claudet et al., 2019).

The Decade of Ocean Science was approved by the UN General Assembly in 2017. UNESCO's Intergovernmental Oceanographic Commission (IOC) was mandated to prepare an implementation plan in consultation with Member States, UN partners and other relevant stakeholders for the 2021–2030 period (United Nations, 2017). IOC has then prepared a Decade's roadmap as an initial guide for the steps and processes needed to develop the requested plan (IOC-UNESCO, 2018; Ryabinin et al., 2019). In this roadmap, international cooperation is urged. Although not explicitly stated, science diplomacy seems essential to implement this Decade.

It is hoped that coordinated region-wide efforts, such as the Belém Statement, will facilitate the implementation of the Decade of Ocean Science. Efforts are currently underway to identify how the Belém Statement's implementation will contribute to the Decade (AORA and AANCHOR, 2019a). In addition, the North Atlantic and South Atlantic Ocean Decade planning workshops were coordinated to align with the work of the All Atlantic Ocean Research Alliance. The Decade of Ocean Science and the Galway and Belém Statements will interact promoting science diplomacy in the Atlantic. It is so far unclear which drivers will guide this interaction, such as governance issues (top-down) or scientific-technical criteria (bottom-up) or a combination of both.

As the Decade of Ocean Science is intended to support sustainable development, the science must support societal needs. Both the Decade and the All Atlantic Ocean Research Alliance aim to address societal needs by making scientific information relevant, useful and accessible (Ryabinin et al., 2019). The Alliance has put mechanisms in place for public engagement that can be leveraged by the Decade of Ocean Science implementing process. It will be interesting to monitor how countries will incorporate scientific results from the All Atlantic Ocean Research Alliance into their national strategies, which in turn shall support the implementation of the Decade of Ocean Science.

So far, the Alliance is a valuable vehicle to bring people together, work on commonly identified challenges and ensure that results of this cooperation will deliver what coastal communities need in terms of scientific output and translated tools. Thus, there is an added value of ongoing cooperation as a model to inspire others within the wider context of the Decade of Ocean Science.

The future of the All Atlantic Ocean Research Alliance. Some of the Galway projects such as AtlantOS (Optimizing and Enhancing the Integrated Atlantic Ocean Observing Systems) resulted in an important basin-scale coordination of ocean observatories. There is a proposal that AtlantOS continue as a new program connected to IOC's Global Ocean Observing System—GOOS (deYoung et al., 2019). There is a clear link between the new AtlantOS program and the objectives of the Belém Statement, which indicates a future integration towards users' needs and societal benefit (Fritz, 2016). Science diplomacy will be at stage in promoting the means to facilitate research, ranging from national budgets to an international basin-wide collaboration, as well as absorbing the data and results that can feed back into national policies on ocean forecast and monitoring.

A new set of research projects have been funded by the Horizon 2020 Programme in support of the implementation of

the Belém Statement and beyond. These research projects will act in large geographical areas, covering the whole Atlantic basin. For example, the Mission Atlantic project aims to conduct integrated ecosystem assessments in the Atlantic basin, a challenge in addressing environmental concerns and commercial activities. Integrated ecosystem assessment is a tool to support the ecosystem-based management by applying an Integrated Ecosystem Approach—IEA (Levin et al., 2009). IEA is the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem, and its dynamics, in order to identify and take action that will support ecosystem health, integrity and sustainability (Smith and Maltby, 2003; UNEP, 2009). A legitimate IEA needs to address different scales (e.g., local, to regional, to basin to global) to better understand the intrinsic relations between different systems (Levin et al., 2009). Ocean science diplomacy can facilitate the work of Mission Atlantic by identifying options to internationally bridge the science needed to support decision making. Mission Atlantic will need to consider the regulatory diversity in the Atlantic and develop practical ways to feed scientific evidence into ocean management in diverse settings. Its IEA framework will help give stakeholders a practical view on how research projects under the All Atlantic Ocean Research Alliance can impact the relations between the countries and provide the relevant knowledge for better decision making.

The new Research and Innovation Program of the European Union, Horizon Europe, will incorporate research and innovation missions to increase the effectiveness of funding by pursuing clearly defined targets (Mazzucato, 2018). One of the five target missions is on healthy oceans, seas, coastal and inland waters. The recently proposed Mission Starfish 2030 establishes several priorities for ocean research that are very much aligned with the All Atlantic Ocean Research Alliance (Lamy et al., 2020). Mission Starfish 2030 also posits international cooperation as part of the desired outcomes and makes explicit reference to the All Atlantic Ocean Research Alliance as an action to be supported.

The All Atlantic Ocean Research Alliance's Youth Ambassadors pilot program has called the attention of different countries, showcasing the Atlantic science diplomacy through ocean literacy and citizen engagement. In only six months of campaigns, the Ambassadors have reached and promoted the Belém and Galway Statements in >100 events. It is proving to be effective in promoting the All Atlantic Ocean Research Alliance and in fulfilling Belém's mandate on better engaged citizens. The program should now be broadened to other donors and countries in the region, so the Ambassadors would mainstream ocean science diplomacy throughout the Atlantic.

Finally, there is a potential for the All Atlantic Ocean Research Alliance to serve as a model for other ocean basins. If that shall be the case, ocean science diplomacy practices will have to adapt to different regions' realities and lessons can be learned from the All Atlantic Ocean Research Alliance.

Conclusion

This article presents a case of ocean science diplomacy in action in establishing an All Atlantic Ocean Research Alliance. The All Atlantic Ocean Research Alliance has emerged from three agreements between different Atlantic bordering countries (the Galway Statement, the South–South Framework, and the Belém Statement). These agreements and the All Atlantic Ocean Research Alliance have triggered EU funding calls, new research projects (e.g., AtlantOS, AANCHOR, and now Mission Atlantic). These projects have bolstered scientific collaboration, scientific exchange and capacity building through the Atlantic in the generation and sharing of new scientific data, knowledge, forecasting and early warning/decision

support tools. Moreover, the All Atlantic Ocean Research Alliance has already contributed to a diversity of other EU's strategies. Examples include the Blue Growth Strategy, the European Green Deal, and the EU Science, Research and Innovation Policies.

Science informed the diplomatic negotiations of these agreements on priorities and actions needed to provide society with relevant knowledge. Moreover, European Commission played an important role in triggering the negotiation process, motivated by the implementation of the European Union's Atlantic Maritime Strategy, and in particular its international dimension. The process of creating the All Atlantic Ocean Research Alliance resulted in a balance between national/European and ocean community interests. On one hand, we presented European Commission interests in implementing its Atlantic Maritime Strategy. On the other, we discussed the interests of Brazil and South Africa in advancing national gaps in ocean research. The main goal of the All Atlantic Ocean Research Alliance is to develop science to serve global community interests regarding ocean sustainability. Science diplomacy was applied as a tool to balance national interests and broader ocean community interests in the case of the All Atlantic Ocean Research Alliance.

We highlighted the pro-active role that the European Commission played in the Atlantic science diplomacy. The European Commission was very effective at overcoming challenges presented by its multi-level governance, and diverse internal differences within member states (Flink and Schreiterer, 2010; Rüffin, 2020). The Commission based the construction of this Alliance on the existing bilateral agreements with each of the involved countries to support a multilateral alliance. In so doing, ocean science diplomacy was used by the European Commission via the All Atlantic Ocean Research Alliance to achieve political reach in the Atlantic.

The results from the Alliance will both provide scientific evidence in support of national decision making, as well as contribute to international debates on the global ocean environment. The upcoming UN Decade of Ocean Science for Sustainable Development (2021–2030) is an opportunity for the Alliance to inspire the development of global ocean affairs. Through this example, the Alliance can both provide its experience coordinating a basin-wide mechanism between countries for the generation and sharing of ocean science, as well as by making more scientific evidence, tools, and expertise available.

The All Atlantic Ocean Research Alliance bridges countries around common interests, facilitating research and evidence-based dialog that fuels and supports additional international research collaboration. The All Atlantic Ocean Research Alliance exemplifies the need to collectively develop research, human capacity, technology employment and cost sharing mechanisms to better address mutual responsibilities over an ocean basin of utmost importance. A major remaining challenge for this Atlantic Ocean science diplomacy is to ensure the co-creation of policy-relevant science that will support society in the most effective way through an inclusive diversity of disciplines and stakeholders.

Data availability

No primary data were generated or analyzed for this paper.

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Notes

1 <https://www.atlanticresource.org/aora>.

2 The Special Issue can be found at: <https://www.frontiersin.org/research-topics/8873/sea-floor-mapping-of-the-atlantic-ocean>.

3 <https://sway.office.com/8hFw3qpVfWA2o8kD?ref=Link&loc=play>.

4 <https://allatlanticocean.org/view/news/launch-of-the-selection-process-of-the-new-cohort-of-all-atlantic-ocean-youth-ambassadors->

5 https://ec.europa.eu/info/news/commissioner-gabriel-signs-administrative-arrangement-marine-research-and-innovation-kingdom-morocco-2020-dec-08_en.

6 <https://allatlanticocean.org/view/events/all-atlantic-ocean-research-forum>.

7 <http://land-ocean.ru/brics/>.

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The authors declare no competing interests.

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Ocean Science Diplomacy can Be a Game Changer to Promote the Access to Marine Technology in Latin America and the Caribbean

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Ocean science is central in providing evidence for the implementation of the United Nations Law of the Sea Convention. The Convention's provisions on transfer of marine technology to developing countries aim at strengthening scientific capabilities to promote equitable opportunities for these countries to exercise rights and obligations in managing the marine environment. Decades after the adoption of the Convention, these provisions are under implemented, despite the efforts of international organizations, such as IOC-UNESCO. Latin America and the Caribbean struggle to conduct marine scientific research and seize the opportunities of blue economy due to the limited access to state-of-the-art technology. Ocean science communities in these countries are subject to constraints not foreseeing in international treaties, such as unstable exchange rates, taxation, fees for transportation, costs of maintenance and calibration of technology, challenges to comply with technical standards, and intellectual property rights. Action is needed to overcome these challenges by promoting a closer tie between science and diplomacy. We discuss that this interplay between science and international relations, as we frame science diplomacy, can inform on how to progress in allowing countries in this region to develop relevant research and implement the Convention. We provide concrete examples of this transfer of marine technology and ways forward, in particular in the context of the UN Decade of Ocean Science for Sustainable Development (2021–2030).

Keywords: science diplomacy, access to technology, Latin America, caribbean, UN decade of ocean science

INTRODUCTION

For the past decades, as the same time as scientific discoveries allowed us to acknowledge the critical importance of the ocean to our livelihood, it was also significant to demonstrate the serious consequences of anthropogenic impacts on the marine environment threatening this life-supporting system (Rockström et al., 2009). It is a humanitarian solicitude to preserve and sustainably use the ocean, conserving its essential ecosystem services for generations to come (Griggs et al., 2013). However, science and technology have not served all countries equally (Harden-Davies and Snelgrove, 2020; Ocampo and Vos, 2008, pp. 34–36). As the UN Decade of Ocean Science for Sustainable Development makes its debut, this paper seeks to assist it by discussing current limitations hampering countries in Latin America and the Caribbean from

accessing and using marine technologies to develop the science needed to inform decisions and international negotiation processes in an equitable basis.

Science has been responsible for both acknowledging the critical importance of the ocean as well as identifying its multiple stressors and delicate ecological limits (Nash et al., 2017). With the increasing significance of environmental and ocean related discussions in international fora, scientists are called to provide evidence on life-threatening issues, such as natural and human induced hazards or food security and pollution. More recently, science has been pushed in the ocean international arena to assume a more relevant social role rather than just unveiling the unknowns (Wisiz et al., 2020). Scientists are requested to provide empirical inputs to global decision-making processes, with the potential to build international partnerships to overcome these collective humanitarian challenges (Fedoroff, 2009). Ocean scientists are also being urged to deliver social goods and foster capacity development and transfer of marine technology (IOC-UNESCO, 2020b)¹. Nevertheless, ocean knowledge production depends upon the access and application of available marine technologies. These include not just research vessels, underwater vehicles and oceanic instruments, but all sort of expertise and knowledge-based materials, including databases and information, as formatted by the Intergovernmental Oceanographic Commission (IOC) of UNESCO (IOC-UNESCO, 2005). Therefore, accessing marine technologies is critical to develop ocean research that can ultimately provide evidence to decision-making.

Developing countries struggle to develop or access marine technologies in spite of some attempts to address this issue (Alexander et al., 2020). Vast ocean areas are still unmapped and unknown to humanity, in particular the Southern parts of the Atlantic and of the Pacific, mostly due to the lack of access to marine technologies and incipient human capacities of countries in these regions (Inniss et al., 2017; IOC-UNESCO, 2017). The asymmetrical distribution of scientific knowledge and technologies not only impinge discoveries, but also reduce possibilities of developing countries to table their needs in international negotiations on ocean affairs based in sound evidence. As one of the major historical battlefields between developing and developed countries, the United Nations Convention on the Law of the Sea (LOSC) enshrines provisions to promote international cooperation on marine scientific research (MSR) and the transfer of marine technology (TMT)² (Anand, 1982; Soons, 1982; Nordquist et al., 1990; Gorina-Ysern, 2004). However, these provisions are among the less implemented in the LOSC (Long, 2007; Long and Chaves, 2015; Salpin et al., 2018).

Enforcing the LOSC rules on MSR and TMT in an equitable manner has been in the forefront of the international agenda for developing countries, as for instance in the current negotiations of a legally binding implementing agreement to regulate the conservation and sustainable use of marine biodiversity beyond national jurisdiction (BBNJ agreement) (Long and Chaves, 2015; Harden-Davies, 2018). The UN Decade of Ocean Science also lies within this background, focused on balancing countries' capabilities to promote sound science for social and environmental benefit. Nonetheless, it is uncertain how the geopolitical interactions between the actors negotiating these processes will occur, as well as which roles will be played by scientific evidence.

The Decade is a diplomatic movement to foster marine research in search of fulfilling the targets established under the Sustainable Development Goal 14, Life below Water (SDG14), in which ocean science is pivotal (Visbeck, 2018). As a coordination effort to this end, the Decade will need to deal with the transfer of marine technology to the Global South, without which ocean science cannot progress globally as requested. The Decade's ambition to involve other ways of knowing in science making, plus improving this knowledge uptake in society's decision making, will need to involve social scientists further (Ryabinin et al., 2019). Social sciences are called to the front to ask the correct questions and bridge all ways of knowing (Claudet et al., 2019). In this context, science diplomacy will be pivotal for the Decade's success.

International Relations scholarship has overseen the role of science and technology in theorizing the relations of power and influence between countries (Mayer et al., 2014). Globalization, for instance, has been mostly researched in economical contexts, whereas science has been described as an influential soft form of power, attracting partner countries to one's interests and values, rather than using force and coercion (Nye, 2017). Science diplomacy is a recent field of academic research that investigates exactly the relationship between science and international relations, opening a new horizon for scholarship in International Relations (The Royal Society, 2010; Gluckman et al., 2018; Rungius et al., 2018). Although its definition is still disputed [a good debate can be found in Flink (2020) and in Ruffini (2020b)], for the purpose of this piece, science diplomacy is framed as a practice by which international relations support and are supported by scientific research, evidencing sometimes conflicting national, regional, and global interests. The current debate around the topic has provided insightful perspectives to think about fostering the access to marine technology for developing countries (Griset, 2020).

This paper assesses how science diplomacy can be a significant tool for Latin America and Caribbean States to overcome challenges in negotiations related to accessing marine technologies and capacity building at the international level, ultimately enhancing the regions scientific capacities. Profiting from the opportunity presented by the implementation of the UN Decade of Ocean Science for Sustainable Development (2021–2030), we propose recommendations that could leverage the implementation of the legal rights and obligations on transfer of marine technologies reducing global inequalities in the access and use of marine technologies.

¹For the purpose of this paper, marine technology encompasses the "instruments, equipment, vessels, processes and methodologies required to produce and use knowledge to improve the study and understanding of the nature and resources of the ocean and coastal areas" (IOC-UNESCO, 2005, p. 9)

²In the absence of a clear-cut definition of marine scientific research in the United Nations Law of the Sea Convention (LOSC), we understand this activity as "any study or related experimental work designed to increase [hu]man's knowledge of the marine environment" (Soons, 1982)

METHODS

We conducted a legal analysis of the provisions adopted in the LOSC regarding the promotion of MSR and TMT, focusing on the rules with especial provisions for developing countries. Additionally, official documents aiming at implementing such provisions were analyzed, in particular those from the Intergovernmental Oceanographic Commission from UNESCO (Gonçalves, 1984; Harden-Davies and Snelgrove, 2020). Some of the perspectives and examples provided were drawn from the authors' experience in managing scientific programs in the region and through the collection of views from researchers in the field over time. We acknowledge the importance of analyzing how social, cultural and political relations can add layers of complexity in the discussion of implementing the transfer of marine technology obligations, however, this has not been the focus of this paper.

Reasons Why Marine Technology Transfer Is Critical in Latin America and the Caribbean

Globalization is usually themed after economic relations but became a facilitator movement of international scientific cooperation, in particular in issues of global concern, such as ocean health (Held et al., 1999; Carter, 2008). With a more engaged global scientific community, the knowledge produced could reflect a form of scientific consensus that could inform diplomacy. However, the uneven participation of researchers from Latin America and the Caribbean in global ocean assessments show that this consensus might be reflecting views from a narrow group of scientists, lacking inclusivity (IOC-UNESCO, 2020a; Tessnow-von Wysocki and Vadrot, 2020). Thus, globalization has provided good opportunities for the evolution of Science but has still much to progress in terms of accommodating knowledge from other communities, in particular researchers from the Global South (Biermann and Möller, 2019; Kraemer-Mbula et al., 2020).

Researchers from developed countries often access funding and infrastructure to conduct research in Latin America and the Caribbean waters. As principal investigators of such research projects, these researchers usually apply only a small portion of the funding in the foreign field, leaving local contributors with limited access to research equipment. This has been evident in the current Covid-19 pandemic, with Northern scientists regretting having lost their field work access due to travel bans, thus jeopardizing entire research projects (de Vos, 2020). What should be regretted is that those research projects did not provide a well-equipped and trained personnel on the ground. If done so, research would have been preserved, so as capacity development and access to technology provided, a win-win situation.

Ocean scientists in Latin America and the Caribbean struggle in many ways to develop world-class marine research. First, research budget is limited and allocated in local currency, subject to high fluctuating exchange rates. This conversion is necessary to import equipment and other research inputs from foreign companies, usually from developed countries. Research

proposals' budget are challenged in predicting this currency fluctuation as well as adding the high costs related to taxation and transportation. As a result, research inputs and equipment can become prohibitive. Managing these discrepancies becomes a fundamental part of doing ocean science in the Global South.

Second, once an equipment is imported, it needs to be calibrated and maintained by certified services so results can be compared, and data defined as accurate. In general, these certified services are only provided by the same companies that manufacture the devices. The contracting party is usually hold accountable to cover the costs of the technician's travel and accommodation, plus the service itself. Establishing local or regional offices in the region would provide not only a solution, but also foster jobs and boost small enterprises and start-ups. Ocean technology companies claim that the market share in Latin America and the Caribbean is insufficient for opening branches in the region. Indeed, limited funding results in less acquisition of equipment, making the market share low for those companies. Countries could develop certified laboratories to provide maintenance and calibration. Brazil, for example, has this capacity established in universities. Those laboratories are however unable to be certified due to the high international standards for accreditation, costly to comply with. Without this certification, one can just lose the equipment's warranty or have the data being trashed out for the lack of quality assurance.

Lastly, the global ocean scientific community moves steadily in determining essential ocean variables, i.e., a minimum requirement of observations to monitor the state of the ocean environment and predict trends which are useful to inform society and policy makers (Lindstrom et al., 2012). It has been acknowledged that complying with such standards will be challenging to the developing world, in particular because of the fragmented ocean international governance framework and the lack of coordination and security in funding schemes (Bax et al., 2018). Capacity development and transfer of marine technology are critical to instrumentalize a coordinated set of data that will allow better forecast and modeling of the marine environment (Miloslavich et al., 2018). Despite some endeavors in the Pacific and Southern Asia (Bax et al., 2018), the overall scenario in ocean observations is still detrimental (Tanhua et al., 2019).

All in all, ocean scientists in the South have limited research budget in local currency with highly fluctuating exchange rates. Much of this budget is then spent in keeping up with international standards, that determine data accuracy, thus allowing replicability and comparison. To make things slightly challenging, the competition for shiptime is intense since there are not many research vessels available. Thus, international cooperation is essential to access and deploy ocean technologies. Governments need to support researchers in negotiating equitable and fair platforms for sharing research infrastructure and co-developing marine technologies.

The Legal Framework That Supports the Transfer of Marine Technology

There is a compelling international legal framework that aims at fostering the transfer of marine technologies, in particular in the context of the United Nations Law of the Sea Convention (LOSC).

The LOSC provides a comprehensive framework regulating the jurisdiction of States Parties and activities taking place at sea, interacting with other instruments, actors and regimes (Trevisanut et al., 2020). Even though scientific evidence is interwoven in many provisions of the Convention, the transfer of marine science and technology is enshrined in part XIII (Marine scientific research), part XIV (Development and transfer of marine technology), and articles 143, and 144. Whereas the link between the framework on marine scientific research, transfer of technology and capacity development has been analyzed elsewhere (Harden-Davies and Snelgrove, 2020), the literature lacks a closer look into the special rules directed to developing countries.

The obligation of transferring marine technology generally covers 1) access to data, information and knowledge; 2) training human resources on science and technology; 3) promoting access to equipment and infrastructure; and 4) promoting international, regional and national scientific and technical cooperation (Harden-Davies and Snelgrove, 2020). In more details, within the framework of scientific cooperation, there is a special obligation for States, alone or in collaboration, to promote the flow of scientific data and information, as well as the transfer of knowledge resulting from MSR and transfer of marine science and technology to developing countries. Additionally, international efforts must focus on increasing the autonomous scientific capability and infrastructure of these countries through capacity development actions as well as the establishment of national and regional research centers aiming at not only increasing skills in pure science, but also to improve the social and economic development of these countries (art. 244 (2), art. 266 (1)(2), art. 268 (d), art. 275, art. 276 LOSC). Aligned with States, International Organizations must endeavor to conclude focused programmes of technical cooperation for transferring all kinds of marine technologies and technical assistance to States that have not been able to establish or promote their own technological capacities in pure or applied marine sciences (art. 269 (a)). Even when not intermediated by international organizations, the TMT between States must consider the needs and interests of developing countries (art. 272, LOSC). Article 267 provides means of interaction with other legal regimes by counterbalancing the obligation to transfer marine technology with the obligation of due regard the rights and duties of holders, suppliers and recipients of marine technology. **Table 1** summarizes the provisions in parts XIII and XIV with rights and obligations for developing countries.

Understanding that technological and scientific developments would require normative adaptation over time, article 271 calls for collaboration through international organizations for enacting criteria and guidelines to facilitate the TMT taking into account the interests and needs of developing countries, including skills and technology regarding activities in the Area, i.e., the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction. Even though no specific organization is mentioned in LOSC, IOC-UNESCO has acted as the focal point for implementing parts XIII and XIV. Other organizations with competences related to ocean sciences are the Food and Agriculture Organization (FAO), the International Seabed Authority (ISA) and the International Maritime Organization (IMO), among others with a more regional focus (Nordquist et al., 1985, pp. 558–560; United

Nations, 2010). The conduct of MSR has increasingly been undertaken by cooperative arrangements, what is fostered by articles 424 and 244 of the Convention. Besides, IOC has been leading initiatives of capacity building in marine scientific research and has assumed a pivotal role in discussions in the BBNJ negotiations, which has transfer of technology and capacity building in the core of the negotiations (Harden-Davies, 2016).

In 1994, a new Implementing Agreement under LOSC was negotiated to implement Part XI regarding activities in the Area (United Nations, 1994). Developed countries were dissatisfied with the regime negotiated in LOSC for the Area, including the obligation of mandatory technology transfer. As part of the compromise to acquire the necessary number of ratifications for the LOSC to come into force, the 1994 Agreement modified article 144 introducing new principles in disfavor of developing countries (Galindo, 2006). First, it has linked the conditions to facilitate the access of technology to the terms of the open market or through joint-ventures, reducing favorable prices to developing countries. Second, it has submitted technology acquisition to the effective protection of property rights, one important limitation for TMT in current times, as we shall discuss below (United Nations, 1994). Despite the setbacks introduced by the 1994 Agreement, the ISA has established an Endowment Fund in 2006 to support the participation of scientists from developing countries in research projects (United Nations, 2010), which, in turn, has been subject to some criticism (Jaeckel et al., 2016).

In spite of the comprehensive legal framework favoring scientific cooperation and marine technology transfer with particular provisions focusing on increasing capacities in developing countries, part XIII and part XIV of the LOSC are under-implemented (Long, 2007) As a result, there is currently a lack of balance between developed and developing countries in producing ocean science (IOC-UNESCO, 2017). These concerns are vivid in many international stages, such as in the BBNJ negotiations, where countries of the Global South are requesting more legal opportunities for accessing marine technologies. As the scope of the Decade is broader than the BBNJ, we claim that it could act more ambitiously as a springboard to foster the implementation of the special rules on marine scientific research and transfer of technology for developing countries, particularly considering the rules on international scientific cooperation aforementioned and the positive outcomes to promote transfer of technology of informal arrangements.

Challenges and Opportunities in Implementing the Transfer of Marine Technology

Implementing the LOSC Rules on Transfer of Marine Technology

Technology transfer can mean a diversity of processes. For example, it can be applied to a dual use of a certain technology being transferred from one field of application to another. It can also represent the factual physical movement of an asset (or even immaterial elements, such as know-how or technical information) or people or a set of capacities between places. Here, we will address technology transfer as the transfer of systematic knowledge for the manufacture of a product, for the

TABLE 1 | Law of the Sea Convention provisions in part XIII and part XIV (Development and transfer of marine technology) specifically dealing with developing countries.

| | | |
|--|-----------|--|
| Special rules for developing States in part XIII | Art 244.2 | States and IO shall transfer scientific data, information and knowledge States and IO shall strengthen the autonomous MSR capabilities of developing countries States and IO shall strengthen human resources of developing countries through education and training |
| | Art 266 | States shall promote the development of MS and technological capacity of States with regards to exploration, conservation and management |
| Special rules for developing States in part XIV | Art 268 | States, IO, ISA shall promote the development of HR through training and education |
| | Art 269 | States, IO, ISA shall endeavour: establish programmes of technical cooperation - own technological capacity |
| | Art 272 | IO shall coordinate Global or regional programmes taking into account interests and needs |
| | Art 273 | States, OI and ISA shall facilitate the transfer of Skills and marine technology with regards to activities in the Area |
| | Art 275.1 | States, IO, ISA shall establish national marine scientific and technologic research centres |
| | Art 276 | States, IO and ISA shall promote the Establishment of regional marine scientific and technological research centres to stimulate and advance the conduct of MSR and foster the TMT |

HR, Human Resources; IO, Intergovernmental Organizations; ISA, International Seabed Authority; TMT, Transfer of Marine Technology; MSR, Marine Scientific Research; MS, Marine Science.

application of a process or for the rendering of a service and does not extend to the mere sale or lease of goods (United Nations Conference on Trade and Development, 2014).

| | |
|---|--|
| Special rules for developing States in part XIII | <p>Art 244.2</p> <ul style="list-style-type: none"> • Autonomous MSR capabilities • Education and training |
| Special rules for developing States in part XIV | <p>Art 266: MS and technological capacity of States with regards to exploration, conservation and management</p> <p>Art 268: States + IO + ISA shall promote the development of HR through training and education</p> <p>Art 269: States + IO + ISA shall endeavour: establish programmes of technical cooperation - own technological capacity</p> <p>Art. 272: Global or regional programmes taking into account interests and needs</p> <p>Art. 273: Skills and marine technology with regards to activities in the Area</p> <p>Art. 275.1 States + IO + ISA shall establish national marine scientific and technologic research centres</p> <p>Art. 276 Establishment of regional marine scientific and technological research centres to stimulate and advance the conduct of MSR and foster the TMT</p> |

Marine technology transfer is generally referred to in the context of the IOC Criteria and Guidelines on the Transfer of Marine Technology, or GTMT, as illustrated in Box 1 (IOC-UNESCO, 2005). GTMT details the need for a clearing-house mechanism, by which interested stakeholders could identify technology-holders and technology needs among the global ocean community. This clearing-house mechanism is not yet established, although IOC has created a Group of Experts on Capacity Development that have produced recommendations on ways to move forward, based in other organizations' models (IOC-UNESCO, 2019). IOC has, however, established a proof-of-concept trial clearing house mechanism in its regional body for the Latin America and the Caribbean through a dedicated website.³ This trial version makes available information on

³<http://portete.invemar.org/cohm>, accessed on January 27, 2021.

some of the region's institutions, experts and research vessels, but a match making feature for those seeking available marine technologies from the North is inexistent. Therefore, after 15 years of the establishment of those criteria and guidelines, the world has yet to see transformational technology transfers that result in a balance between countries in the access and use of marine technologies (IOC-UNESCO, 2017; Salpin et al., 2018).

Diplomacy cannot afford to postpone the debate on the effective transfer of marine technologies. As the world's population grows, there will be a race to explore the ocean natural resources further. Thus, ocean sustainable development based on the best available scientific knowledge is of utmost importance for future generations, in particular for developing countries (Hassanali, 2020). Bearing this in mind, the United Nations proclaimed the next decade as the UN Decade of Ocean Science for Sustainable Development (2021–2030).

The Decade of Ocean Science shall be a good opportunity to foster the debate around effective manners to progress in granting opportunities for developing countries to access marine technology and capacity development (Claudet et al., 2019), by implementing the regimes enshrined in part XIII and XIV of the LOSC. For this to happen, the implementation of the Decade should be centered in searching for equality in the access and use of marine technologies for sustainable development and human and environmental wellbeing. Terms such as co-development of technology instead of transfer, with a more equitable and linear participation of stakeholders, should also be promoted. In this sense, science diplomacy can inform on practices applicable to fostering this balance.

Scientists Leading the Transfer of Marine Technology

In practice, marine technology transfer has relied less in formal intergovernmental diplomatic routes and more in peer-to-peer exchange. Peer-to-peer cooperation is a basic mechanism of the scientific endeavor. It has produced advancements in our common knowledge of the marine realm allowing society to make better informed decisions (Fischhoff and Scheufele, 2013). Research centers, universities and individual researchers have fostered technology transfer for problem-solving, aiming at progressing in scientific



discovery. Agreements signed between research institutions and universities often include the exchange of human capacities and technology transfer at some level (Dolan, 2012). Drivers of such agreements are opportunities presented by the growing internationalization mechanisms adopted by those institutions (Qiang, 2003). Such mechanisms aim at projecting national capacities and competencies abroad to attract human and financial capital for further institutional developments, as a form of investment. In the context of Latin America and the Caribbean, internationalization has also provided the means to access foreign research funding and assets, placing an important opportunity to foster partnerships, but also to overcome national budget constraints.

This practice is more common in the context of technologies developed by publicly funded research, mainly targeting scientific discovery. Privately funded research assets, in particular those aimed at exploring the marine resources such as oil, fisheries and minerals, are less common on those agreements because these technologies raise industry's competitiveness and profit (Ruffini, 2020a). There are, however, a few privately funded organizations that use advanced technologies to promote open access information to society [e.g., Global Fishing Watch (Nugent, 2019)].

It is therefore fundamental that scientific cooperation in informal pathways is continued and promoted so science can profit from the free thinking and foster technology transfer. In fact, diplomacy should acknowledge and promote these informal channels where applicable, supporting actions that have been successful over time, such as cooperation agreements between research institutions. This informality is addressed as a form of Track 2 diplomacy in International Relations scholarship. The term can be understood as a parastatal informal diplomacy in which stakeholders are not necessarily bound to Governments (Jones, 2015). Track 2 diplomacy can use the science international cooperation to progress on

addressing community and common interests in a more flexible way than the official, Government-led track 1 diplomacy. At the end of the day, both forms of negotiations should be interlinked and supportive of one another if we are to see change in the transfer of marine technologies during the Decade of Ocean Science, for example.

Intellectual Property Rights (IPR)

The overarching difficulty for an intergovernmental body such as the IOC to pragmatically propose the transfer of marine technologies lays partially on issues of Intellectual Property Rights (IPR) (Zhou, 2019). Unlike the provisions on TMT, MSR and capacity development, under the scope of the LOSC and the mandate of institutions connected with this regime, IPR in under the mandate of the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO), through the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Indeed, as the LOSC is not a stand-alone treaty, it interacts with other regimes of international law, and has mechanisms to do so (Trevisanut et al., 2020), as for instance the above-mentioned article 267. Nonetheless, the conversation between these regimes has so far only favored private companies detaining patents.

In light of global environmental conundrums, WIPO was challenged to balance “the free transfer of technologies and sustainable innovation”, but without much success (Zhou, 2019). Similar process is undergoing in the WTO, and negotiations on technology transfer under the scope of TRIPS have not been evolving (Zhou, 2019). Therefore, traditional diplomacy has been unable to reach consensus on how to balance IPRs and public interests to advance sustainability (Latif et al., 2011).

Private Sector Involvement

Companies take risks and make investments to profit from technological assets. The private sector alone should not be accountable to make change by opening patents and handling technology blueprints. In addition, countries in Latin America and the Caribbean will benefit little from blueprints if they do not possess the necessary human capacities and physical facilities to develop marine technologies. Therefore, an intergovernmental coordinated effort needs to be developed by finally operationalizing the clearing-house mechanism of IOC to then match technology holders and needs (Harden-Davies, 2016). Second, public diplomacy needs to foster a discussion on the possible trade-offs for the private sector to join in this effort. Companies can profit from opening new markets and investing in capacitating new labor in the region. Third, local governments need to invest in innovation policies and start-up programs to absorb the technology being transferred. Local business might then flourish, and local realities will adapt technologies to their needs, feedbacking the innovation process at a larger scale. At the end of this complex process, countries can begin to negotiate the co-development of technologies, beyond the scope of transferring technology as a passive-active relationship (Chesbrough and Schwartz, 2007). Although there are conflicting views addressing market competition and sustainability, there are also opportunities to leverage this relationship, such as private

research programs on marine ecosystem restoration or pollution (Virdin et al., 2021).

Private companies' interests are considered by diplomacy when defending national positions in international negotiations. Same applies to public interest, as the societal benefit of a healthy and safe ocean environment. Thus, diplomacy needs to balance community/public interest with those interests coming from specific groups or countries. This complex relationship between national interests and global public goods involving science and technology is taken under the scrutiny of science diplomacy research (Ruffini, 2020b). Moreover, a better coordination between international regimes such as LOSC, WIPO, and TRIPS is highly desired. The Decade of Ocean Science should open this dialogue by confronting diplomatic negotiations in both regimes and searching for opportunities. A simple recommendation in this issue would be to align country's representations in both process with the aim of finding common grounds for opening this frank debate on Intellectual Property Rights.

DISCUSSION

The United Nations Law of the Sea Convention and related implementing instruments have set rights and obligations able to reduce worldwide asymmetries in the access to scientific knowledge and marine technology. Nevertheless, in spite of some increase in the participation of Asian countries in scientific publications, mentioned in the latest Global Ocean Science Report, the scientific and technological capabilities remain inequality distributed. Developed countries still concentrate the majority of ocean science human capacity and more incentives for researchers, like the access to international forums and networking (IOC-UNESCO, 2020a). Equally, only five countries in the world, all located in the global north, have full wide range access of technological infrastructure, with only a few others with capacity to conduct open waters and deep-sea research (IOC-UNESCO, 2020a). For instance, none of the Small Island Developing States (SIDS), which includes the Caribbean States, have deep-research vessels.

The origins of many of these difficulties in promoting the right of access to scientific knowledge and technology to developing countries lie in historical processes of colonization (Headrick, 1981). Additionally, from an epistemological perspective, science is a western invention, as so, from the starting point developing countries need to follow theories and methods founded in an alien mindset, still being under dispute how to integrate traditional and indigenous knowledge in the science-making (Weiss, 2005; Mulalap et al., 2020). This topic assesses whether science diplomacy is an appropriate tool to reduce scientific and technological asymmetries without disregarding the compelling reasons for a deeper discussion.

Science Diplomacy Facilitating the Transfer of Marine Technologies in Latin America and the Caribbean

Latin America has experienced a raise in social sciences' research in understanding the role of Science in advising policy, with a

prominent focus on "center-periphery" relations in scientific research and the globalization of the social sciences, or the ownership of knowledge, particularly indigenous knowledge, when compared to the United States and Europe (Echeverria et al., 2020). Historically the theoretical field of International Relations (IR) has dealt with technology in both an optimistic and a skeptical conflict, in particular scholarship around the role of technology in the Cold War. Science and Technology was placed exogenously in theoretical IR and the dynamics and global impacts of Science needed further empirical evidence. Today, IR is seeking ways to incorporate the global politics of science and technology as a distinct subfield, which is by default an interdisciplinary approach that needs to include other fields of social sciences therein (Koh and Jayakumar, 1977). Therefore, science diplomacy can offer a new interdisciplinary approach to study how science and technology, its multiple facets and understandings, can influence international relations (Lidskog, 2014). We frame this discussion around the taxonomy provided by (The Royal Society, 2010) so the organization reflects the general science diplomacy literature.

First, "Diplomacy for science", which stands for diplomacy facilitating international scientific cooperation by leveraging investment and prioritizing research to address uncertainties in decision-making. Here, diplomacy can set official frameworks by which countries can access marine technologies, such as through the IOC. By doing so, diplomatic negotiations can foster the establishment of international cooperation on fair and equitable grounds, in accordance with the Law of the Sea Convention. Moreover, diplomacy needs to integrate debates going on in different fora, in particular among WTO and WIPO, on how to deal with intellectual property rights. In addition, diplomacy can foster an arrangement between the public and private sector regarding the access and application of relevant technology to research global public goods, such as the ocean. Ocean science can only progress in an equitable manner if access to marine technologies is granted on an equitable basis through the diplomatic decision making. Thus, diplomacy for science in this scenario means intergovernmental negotiations to grant access to marine technologies and capacity development.

Second, "science in diplomacy", that deals with the provision of scientific evidence to support international decision-making. Research will be responsible to inform diplomacy on the above mentioned negotiations. Knowledge gaps and trending themes of concern need to be communicated in such a way that diplomacy can discuss institutional and legal arrangements to overcome current obstacles for an effective transfer of marine technologies. Scientists have a pivotal role in clarifying what should be the results in effective marine technology transfer, highlighting the current pathways to acquire technologies and barriers, such as Intellectual Property, maintenance and operating costs. Non-governmental organizations and intergovernmental organizations shall play an important role in this regard (Lidskog, 2014). For example, the organization of public debates among scientists using the networks under NGOs are theme-oriented and independent from States and formal diplomacy, resulting in a flexible approach to discussing the

state-of-the-art research and potential future actions. In ocean affairs, NGOs have provided scientific expertise since the early negotiations of the LOSC (Koh and Jayakumar, 1977). Therefore, science in diplomacy will allow provision of knowledge gaps and current technology needs to properly advance in ocean sustainability to comply with global community interests.

Lastly, “science for diplomacy”, in which international collaboration advances to bridge countries and build a constructive dialogue through joint research projects. The utmost example of such is the adoption of the UN Decade of Ocean Science. The Decade is hoped to be the long-awaited opportunity for research to bridge countries and people around a common goal. Different stakeholders with diverse values and needs shall inform the Decade’s process on achieving societal goals of ocean sustainability (Claudet et al., 2019). The Decade’s *raison d’être* is to put ocean science in service of society, including policy making, despite any possible tension between countries in other international debates. Thus, science for diplomacy will act to allow this dialogue between countries and stakeholders to take place through joint regional/global research efforts, that can be fostered initially by informal pathways, attained to the Track 2 diplomacy practices.

Ultimately, the balance between national political interests and global community interests in transferring marine technologies to foster ocean sustainability is a matter of balancing competition versus cooperation (Ruffini 2020b). There must be an optimal point in which trade-offs are made and commitments are adopted. This point must be achieved by addressing both the issues of national priorities, such as industry development and labor enhancement, with those of global concern, such as marine environmental protection and ecosystem service restoration. In this regard, scientists become yet another social group with intrinsic values and interests (Jasanoff, 1987; McCain, 2016, pp. 253-257). Therefore, progressing in understanding the social dynamics within the group of scientists and between scientists and diplomatic relations becomes essential to better inform global processes based on scientific evidence, such as the UN Decade of Ocean Science (Rose, 2018). Science diplomacy research in this regard, and in particular in the context of Latin America and the Caribbean, the region’s gaps and priorities, will enhance the global discussion to implement the Decade.

Examples of Science Diplomacy Processes Leading the Transfer of Marine Technology

Peer-to-peer cooperation agreements between research institutions and universities generally include the exchange of human capacities and technology transfer at some level (Dolan, 2012). Drivers of such agreements are opportunities presented by the growing internationalization mechanisms adopted by those institutions (Qiang, 2003). Internationalization of universities and research centers is one of the outcomes of the globalization of science.

A good example of such is the cooperation between research institutions from Germany and Cape Verde to create and operate an ocean research center in Cape Verde (Kaehlert et al., 2017). The Ocean Science Center Mindelo results from a formal agreement

between the GEOMAR Helmholtz Center for Ocean Research and Cape Verde’s Instituto do Mar—IMar. The Tropical portion of the Atlantic has a determinant role in the heat exchange between the ocean and the atmosphere, a feature that is central to understand global climate and ocean dynamics (Seidel et al., 2008). German scientists wish to access an island in the middle of the Atlantic to further enlighten how the Tropical Atlantic influences the North. Germany benefits from relevant information and Cape Verde with the access to technologies and capacities to deal with their own waters. Moreover, the center is devoted on building capacities in Cape Verde so their ocean science community can be empowered. Ultimately, the German interest in Cape Verde contributed to the European Commission signing a diplomatic bilateral science and technology agreement on ocean research as a part of a broader ocean science diplomacy arrangement for the whole Atlantic basin (Polejack et al., 2021). This ocean science diplomacy practice has balanced the capacity needs of Cape Verde with the German interests in the region advancing knowledge production that will be fit for the global ocean assessment purpose, fully implementing articles 244, 266 and 275, LOSC.

Another good example of science diplomacy aiding countries to implement their international obligations in the transfer of marine technologies is the global ocean observation network. Ocean observations are highly dependent on technology and, under the auspices of IOC’s Global Ocean Observing System (GOOS) cooperation has been key to deploy equipment worldwide, such as buoys, drifters and other ocean monitoring instruments (Tanhua et al., 2019). In general, this cooperation involves the exchange, maintenance and calibration of equipment from one country to another. The handling of equipment’s blueprints for local development and manufacture is much rarer. Among the practical examples of our knowledge is the development of the Atlas-B buoy in Brazil (Campos et al., 2014). The U.S. National Oceanic and Atmospheric Administration (NOAA) freely handed the blueprints of their Atlas buoy technology for development in Brazil. As a result, Academia and industry partnered to develop an adaptation of this equipment, which was deployed in face of Brazil for testing. In spite of formal Government agreements in this matter, both NOAA and the University of São Paulo together with two Brazilian companies were able to successfully transfer a key technology nonexistent in the country before. Capacities were developed and today Brazil is able to progress in the manufacture of this buoy.

From the above mentioned, science diplomacy as a practice provides different perspectives of implementing the international obligations of transferring marine scientific knowledge and technology, reducing inequalities and empowering developing countries. Practical examples support this perspective, although the Decade will be a more ambitious stage for the science diplomacy interplay.

CONCLUSION

Marine researchers in Latin America and the Caribbean struggle to conduct state-of-the-art research mostly due to the lack of

permanent funding, appropriate scientific capacities and access to marine technologies. Consequently, these countries are challenged to contribute with scientific evidence in current ocean affairs, such as the BBNJ negotiations (Harden-Davies and Snelgrove, 2020). Although the global ocean governance framework provides the legal and institutional support for the transfer of marine technology from developed to developing countries aiming at strengthening local and regional capabilities, after decades of the entry into force of LOSC, part XIII and part XIV are considered among the least implemented of the LOSC (Long, 2007; Long and Chaves, 2015).

The globalized research community has provided informal venues for the transfer of marine technology. However, these peer-to-peer relationships will not be sufficient to achieve the equity that several States have called for to strength national capacity permanently to meet national needs and international standards. Therefore, this paper presents some concrete recommendations on how countries in Latin America and the Caribbean can enhance their national scientific capacities by using science diplomacy as a tool to foster beneficial international deals.

First, according to the requirements of the LOSC and the Resolution on the development of national marine science, technology and ocean service infrastructure (A/CONF.62/120*), developing countries must produce science and technology needs assessments, by which gaps and priorities shall be apparent. Such an effort could be supported by international organizations, the scientific community and research organizations, including from the private sector, together with governments.

Second, efforts must be taken to effectively implement the clearing house mechanism as per the IOC guidelines (IOC-UNESCO, 2005). Major technology holders from the developed world and representatives from organizations with mandate related to intellectual property, such as WTO and WIPO, should be included in discussions on the of such a clearing house mechanism, providing inputs and other perspectives. Issues related to exchange rate, taxation, fees for transportation, and limits to comply with standards for ocean observation should be considered in the clearing house mechanism. Additionally, it is relevant to discuss about incentives to create regional certified laboratories in developing countries to provide maintenance and calibration for equipment, as well as reviewing the standards for accreditation. Latin America and the Caribbean can profit from the trial version of this mechanisms that IOC has initialized in the region.

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Third, a shift in vocabulary may represent a positive change on how developed countries understand their role in promoting scientific and technological equity. Using terminologies such as co-development of technology instead of transfer are able to build more linear relations between stakeholders and reduce perspectives of subservience (center-periphery).

The Decade of Ocean Science shall be a good opportunity to foster the debate around effective manners to progress in granting opportunities for developing countries to access marine technology and capacity development, by implementing the regimes enshrined in part XIII and XIV of the LOSC. Countries in Latin America and the Caribbean have the opportunity during this Decade to push for improvements in the access of marine technologies. The provisions in the LOSC and related instruments give the legal basis for this discussion. Moreover, ocean science diplomacy can provide the necessary insights on possible negotiations based on evidence and favoring fair and just transition pathways.

AUTHOR CONTRIBUTIONS

AP conceived and drafted the first version. Both authors contributed to the writing of the manuscript, co-developed the recommendations and approved the paper's final version.

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The Ocean and Cryosphere in a Changing Climate in Latin America: Knowledge Gaps and the Urgency to Translate Science Into Action

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Climate Change hazards to social-ecological systems are well-documented and the time to act is now. The IPCC-SROCC used the best available scientific knowledge to identify paths for effective adaptation and mitigation of climate change impacts on the ocean and cryosphere. Despite all the evidence highlighted by SROCC and the key role of the ocean and cryosphere for climate change at all levels, Latin America (LA) faces challenges to take effective action mostly due to socio-economic vulnerability, political instability and overall technical capacities. Countries have adopted diverse actions as the information needed by policy makers has been made available, not necessarily in accessible and inclusive ways. Regional imbalance in economic development, technological level, capacity development, societal involvement, and governmental oversight have contributed to skewed geographical and technological gaps of knowledge on key ecosystems and specific areas preventing effective climate actions/solutions. We analyze the Nationally Determined Contributions (NDCs) from the region as proxies to the incorporation of IPCC recommendations. The gaps and opportunities for the uptake of ocean and climate science to political decision making is discussed as five key aspects: (i) climate assessment information and regional policies, (ii) knowledge production, (iii) knowledge accessibility, (iv) knowledge impact to policy, and (v) long term monitoring for decision making. We advocate that the uptake of SROCC findings in LA policies can be enhanced by: (a) embracing local realities and incorporating local, traditional and indigenous knowledge; (b) empowering locals to convey local knowledge to global assessments and adapt findings to local realities; (c) enhancing regional research capabilities; and (d) securing long-term sustainable ocean observations. Local and regional participation in knowledge production and provision enhances communication pathways, climate literacy and engagement which are key for effective action to be reflected in governance. Currently, the lack of accessible and inclusive information at

the local level hampers the overall understanding, integration and engagement of the society to mitigate climate effects, perpetuates regional heterogeneity and threatens the efforts to reverse the course of climate change in LA. Local researchers should be empowered, encouraged, rewarded and better included in global climate-ocean scientific assessments.

Keywords: climate change, SROCC, local knowledge, policy makers, Latin America

INTRODUCTION

The critical importance of the ocean and the cryosphere to the climate system (Reid et al., 2009), hydrological cycles (Schanze et al., 2010; Liu et al., 2020) and the consequences to society (Nicholls, 2010) stimulated the IPCC to commission a Special Report on the Ocean and Cryosphere in a Changing Climate (hereafter SROCC) (IPCC, 2019a), which assessed climate change impacts on marine and coastal ecosystems. The combined effects of ocean warming, ocean acidification, and deoxygenation are reducing primary production and marine biodiversity, and impacting associated ecosystem services such as nutrient cycling, carbon sequestration and fisheries (Bindoff et al., 2019). Sea level rise and ocean extreme events are causing coastal damage, with natural and capital losses, and many associated socio-economic impacts (Nicholls, 1995; Leatherman, 2001). People dependent on or living in close connection with coastal, polar and mountain environments are especially vulnerable to the hazards of ocean and cryosphere change (Oppenheimer et al., 2019).

Climate change is a global phenomenon, but the scale to act is local, primarily influenced by a country's policies, geography, socio economic development, and vulnerability to climate-risks. Consequently, climate coastal adaptation policies have been developed, with substantial variations between countries, and across developmental status (Klein et al., 1999, 2001). Investigating how scientific knowledge and international recommendations based on science are being taken at national level is not simple, due to the time-lag between implementation, monitoring, evaluation and reporting. In addition, climate change adaptation actions generally lack scientific uptake and on-the-ground change, with most focus being on assessing vulnerability, compared to developing plans and actions (Gibbs, 2015).

Latin America and the Caribbean¹ (hereafter LAC) represents a high contrast region where wealth and prosperity coexist with vulnerability and extreme poverty, explained by low growth (Fernández-Arias and Fernández-Arias, 2021). The region hosts 1/3 of the world's most biodiverse countries and highly urbanized regions (UNEP, 2011). It comprises 46 countries, dependent territories and overseas departments on the edge of the Atlantic and Pacific oceans and the Caribbean Sea and is limited to the south by the Southern Ocean. Altogether, LAC has more than 30,000 km of coastline, ranging from the tropical region—dominated by mangroves, seagrass meadows and coral

reefs—to subtropical and temperate areas, dominated by salt marshes, rocky shores and macroalgal beds all the way to the Drake passage, where the influence of the Southern Ocean and Antarctica is well-documented (Sijp and England, 2004; Scher and Martin, 2006; Livermore et al., 2007; Yang et al., 2014; Viebahn et al., 2016; England et al., 2017). This continent-wide latitudinal range reflects diverse oceanic domains and climate influences, responsible for the high diversity of marine habitats and ecosystems (Miloslavich et al., 2011; Turra et al., 2013; Spalding et al., 2017) where hotspots of “exceptional marine biodiversity” and fisheries coincide with areas most severely affected by global warming (Ramírez et al., 2017). Coastal areas surrounding the Mesoamerican reef and nearby islands are low-lying and extremely vulnerable to sea level rise. Extreme hydrometeorological events are frequent and coastal erosion is a widespread threat (particularly severe in Northern and Northeast Brazil—Silva et al., 2014), associated with human interventions, poor coastal planning and management but also influenced by the morphodynamic nature of the coast (Silva et al., 2014), as most coastal areas in the region. The diversity of this region is also reflected by a wealth of peoples, languages, social-political systems, cultures, traditions and origins that constitute a unique mosaic of diversities with 780 indigenous peoples and 560 different languages (Freire et al., 2015) that heightens regional imbalance and skewed geographical and technological gaps.

Despite the alarming magnitude and extent of climate change effects shown by SROCC, Latin America (hereafter LA) is challenged to take effective action due to socio-economic vulnerability. Extreme poverty in LA reached unprecedented levels in 2020 (ECLAC, 2021), and social inequality indices, like unemployment and labor participation rates, have worsened particularly among women, despite the recent emergency social protection measures adopted in the COVID-19 pandemic. The recently published Regional Human Development Report² for LAC (UNDP, 2021) highlights that concentration of power, violence in all its forms and failed social protection of policies and frameworks cause the contrasts found in the region. These promote high inequality and low growth, challenging the intake of the recommendations from SROCC even though the region plays a key part in the global green recovery (UNDP, 2021).

This paper analyzes the adopted Nationally Determined Contributions (NDCs) in LAC as a reflection of the incorporation

¹The acronyms LAC and LA are not used interchangeably: LAC refers solely for evidence from Latin America and Caribbean while LA is used when evidence refers to Latin America.

²Regional Human Development Report for Latin America and the Caribbean in https://www.latinamerica.undp.org/content/rblac/en/home/library/human_development/regional-human-development-report-2021.html.

of IPCC recommendations. We briefly discuss gaps and opportunities in the region for the uptake of ocean and climate science to political decision making, organized in five key categories: (i) climate assessment information and regional policies, (ii) knowledge production, (iii) knowledge accessibility, (iv) knowledge impact to policy, and (v) long term monitoring for decision-making. We finally present some conclusions and propose future actions.

NATIONALLY DETERMINED CONTRIBUTIONS (NDCS) AS SCIENCE UPTAKE INDICATORS

Nationally Determined Contributions (NDCs) are official Government commitments to comply with UNFCCC's targets. NDCs may also reflect how IPCC findings are perceived and incorporated into policy documents that go beyond current national climate plans and bring us closer to the Paris Agreement goals of decarbonizing economies and improving resilience. We reviewed the NDC reports submitted by 31 Latin American and Caribbean countries to the NDC registry³ and searched for expressions such as “oceans and coasts,” “fisheries,” “risk management,” “gender,” “UN 2030 Agenda,” “interculturality,” “community-based solutions,” “ecosystem-based adaptations,” and “cryosphere.” In addition, we incorporated Socio Economic indicators such as Gross Domestic Product (GDP) per capita, Human Development Index (HDI), and specific GDPs for 2017 and 2019, relative to the overall values of GDP estimates for the whole world, extracted from the World Bank Database⁴. Results are shown in **Table 1**.

Risk management was the most common feature, addressed by 29 countries, followed by Ocean and coastal activities ($n = 27$). Fisheries actions were reported for 19 countries, while ecosystem-based adaptation appeared in 18, such as Mexico's Blue Carbon action. Gender equity/balance issues were a concern for 17 countries and frequently mentioned by most countries, although not included by Guatemala and Uruguay. Community based adaptation is of particular interest in 16 countries, while Agenda 2030 has been considered by 15 countries in their NDCs. Interculturality, the existence and equitable interaction of diverse cultures and the possibility of generating shared cultural expressions through dialogue and mutual respect⁵ was important for 13 countries. The least frequent concern was with the Cryosphere, only included in the NDCs of Argentina, Chile and Peru (**Figure S1**).

NDCs in the LAC region have been developed according to local context and capacities. Commitments to climate change mitigation and adaptation are frequent, but specific targets to “oceans and cryosphere” have not been prioritized. For example, SROCC reports coral reefs as amongst the most susceptible ecosystems and yet the Mesoamerican Arrecifal Barrier has not been included among local NDCs. The same

rationale goes for “Ocean and Coasts” in the NDCs from Brazil, Guyana, Nicaragua, and Peru which seems invisible to national commitments despite the proportion of coastal and marine areas in these countries. NDCs in the region have not yet been impacted by SROCC findings as reflected by the first (and now the second more recent) round of NDC submissions. Unless the climate and ocean communities recognize LAC's socio-economic contexts and associated environmental and social vulnerabilities to consider uniting to act, this scenario might not change significantly over time.

GAPS AND OPPORTUNITIES IN LATIN AMERICA

Climate Assessment Information and Regional Policies

National Adaptation Plans (NAPs) are policy driven commitments that translate the NDCs into local and sectoral actions. Technology Needs Assessments (TNAs) are rights of States to claim the necessary technology to comply with IPCC recommendations. NDCs, NAPs and TNAs are three different, but complementary, instruments that countries in LAC seek to implement. While NDCs are designed to fulfill international commitments, NAPs and TNAs reflect national capacities and local vulnerabilities, yet to be targeted in IPCC assessments.

IPCC assessments are geographically and disciplinarily skewed, strongly based on the most influential science produced by developed countries (Vasileiadou et al., 2011), with a disproportionate influence of formally educated and economically advantaged groups (Castree et al., 2014). Thus, as LAC contributions to SROCC have been limited (nine authors from seven countries), the resulting recommendations also lead to limited local application. Moreover, political leadership in the region favors socio-economic policies over environmental protection (e.g., Custer et al., 2018, in relation to the UN 2030 Agenda). Yet NAPs generally show two main pathways: while developed countries focus on economic risks and opportunities, developing countries prioritize natural resources and conservation (Alves et al., 2020). A clearer connection between environmental threats and socio-economic concerns must be established so regional leaders feel safer and supported to make decisions. Local researchers should be encouraged to work closely with communities and aid in bridging knowledge gaps.

The IPCC epistemic community defines knowledge as information published in peer-reviewed papers, generally neglecting publications in other languages and other sources of knowledge (traditional, indigenous, and local knowledge—ILK). SROCC has made an effort to include ILK (Abram et al., 2019) and yet LA-ILK's representation was slim. One can argue that SROCC has favored traditional, formally educated, and economically advantaged groups as most scientific assessments do (Castree et al., 2014) perpetuating cultural and geographical imbalance. Representation matters and the participation of Lead Authors from LAC in SROCC was also low. Ten out of 103 SROCC authors were self-identified as belonging to 8 LAC

³<https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>

⁴<https://data.worldbank.org/indicator>

⁵As expressed by the Convention on the Protection and Promotion of the Diversity of Cultural Expressions (Art. 4.8).

TABLE 1 | Specific categories listed as targets to meet either UNFCCC's climate targets or specific SDGs from 31 countries from Latin American and the Caribbean region (LAC) according to the NDC Registry*. Countries are alphabetically listed. Economic indicators, *i.e.*, Gross Domestic Product (GDP) per capita, Human Development Index (HDI), and specific GDPs for 2017 and 2019 relative to overall world GDP estimates for these specific years were world extracted from World Development Indicators**, at the World Bank website.

| Categories Countries | Risk management | Gender | Ocean and coasts | Agenda 2030 | Ecosystem based adaptation | Fisheries | Interculturality | Community based adaptation | Cryosphere | GDP 2017 | HDI 2017 | R_GDP 2017 | R_GDP 2019 |
|-------------------------------|--------------------|--------|------------------------|----------------|----------------------------------|-----------|------------------|----------------------------------|------------|-------------|-------------|---------------|---------------|
| Antigua & Barbuda | 1 | 1 | 1 | 1 | | | | | | 2.17 | 0.78 | 1.02 | 3.00 |
| Argentina | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.76 | 0.83 | 0.82 | -2.44 |
| Bahamas | 1 | 1 | 1 | 1 | | 1 | | | | 2.08 | 0.81 | 0.98 | 0.17 |
| Barbados | 1 | 1 | 1 | | 1 | | | | | 0.32 | 0.80 | 0.15 | -0.18 |
| Belize | 1 | 1 | 1 | 1 | | | | | | -0.13 | | -0.06 | -1.27 |
| Brazil | 1 | | | 1 | 1 | | 1 | | | 0.51 | 0.76 | 0.24 | 0.30 |
| Chile | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | -0.24 | 0.84 | -0.11 | -0.11 |
| Colombia | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | -0.16 | 0.75 | -0.08 | 1.49 |
| Costa Rica | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 2.80 | 0.79 | 1.31 | 0.89 |
| Cuba | 1 | 1 | | 1 | | | | | | 1.77 | 0.78 | 0.83 | 0.00 |
| Dominica | 1 | 1 | 1 | | | 1 | | | | -7.00 | 0.72 | -3.28 | 2.62 |
| Dominican Republic | 1 | 1 | 1 | 1 | 1 | | | | | 3.52 | 0.74 | 1.65 | 3.16 |
| Ecuador | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 0.57 | 0.75 | 0.27 | -1.29 |
| El Salvador | 1 | 1 | | | | 1 | | | | 1.74 | 0.67 | 0.82 | 1.48 |
| Grenada | 1 | 1 | 1 | | 1 | | | 1 | | 3.87 | 0.77 | 1.81 | 1.13 |
| Guatemala | 1 | 1 | | | | 1 | 1 | 1 | | 1.36 | 0.65 | 0.64 | 1.78 |
| Guyana | 1 | | | | | 1 | | | | 3.22 | 0.65 | 1.51 | 3.86 |
| Haiti | 1 | 1 | 1 | 1 | | | | | | 0.96 | 0.50 | 0.45 | -2.31 |
| Honduras | 1 | 1 | | | 1 | | | | | 3.08 | 0.62 | 1.45 | 0.78 |
| Jamaica | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 0.50 | 0.73 | 0.23 | 0.19 |
| Mexico | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 0.93 | 0.77 | 0.44 | -0.91 |
| Nicaragua | 1 | | | 1 | 1 | 1 | 1 | 1 | | 3.31 | 0.66 | 1.55 | -4.03 |
| Panamá | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 3.81 | 0.79 | 1.79 | 1.05 |
| Perú | 1 | | 1 | | 1 | | 1 | 1 | 1 | 0.83 | 0.75 | 0.39 | 0.41 |
| Saint Kitts and Nevis | | 1 | 1 | | | | | | | -2.74 | 0.78 | -1.29 | 1.65 |
| Saint Lucia | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 2.96 | 0.75 | 1.39 | 0.98 |
| St Vincent and the Grenadines | 1 | 1 | 1 | | | 1 | | | | 0.66 | 0.72 | 0.31 | 0.12 |
| Suriname | 1 | 1 | | | 1 | 1 | 1 | 1 | | 0.76 | 0.72 | 0.36 | -0.53 |
| Trinidad & Tobago | | 1 | | | | | | | | -2.77 | 0.78 | -1.30 | -0.29 |
| Venezuela | 1 | 1 | | | | 1 | | 1 | | | 0.76 | 0.00 | 0.00 |

Note that negative scores are shown in red.

*<https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>.

**<https://ourworldindata.org/human-development-index> and <http://wdi.worldbank.org/>.

countries⁶ (97% of the total authoring contribution). The USA alone had 15 authors, in contrast with other LAC countries such as Cuba and Trinidad and Tobago—the only SIDS regionally represented—as well as Mexico and Brazil—two of the largest and most populated countries in LA—which accounted for one participant each. Apart from language and representation,

⁶These countries are: Argentina, Brazil, Costa Rica, Cuba, Ecuador, Mexico, Peru, and Trinidad and Tobago.

technical and scientific capacity deficiencies refrained researchers in the region from contributing more (Polejack and Coelho, 2021).

Knowledge Production

Knowledge production of the ocean-climate nexus in LA insofar as the uptake of such knowledge to national advisory exercises is still incipient, possibly due to limited technical capacities in the region combined with a deficient access to marine

technologies and research platforms. International cooperation aids local researchers to overcome such bottlenecks (Soler, 2021). Argentina, for example, has developed a national strategy to strengthen marine research capabilities, allowing for better coordination and optimization of resources, the “Pampa Azul” initiative. However, seven years after its launching, economic instability jeopardized investments, despite international commitments. One current opportunity is the All-Atlantic Ocean Research Alliance, a South to North multilateral scientific cooperation open to countries in the region (Polejack et al., 2021). It aligns research priorities, infrastructure, and budget, to overcome the knowledge gaps in the Atlantic, informing decisions for improved societal benefit. As a result, the Alliance fosters marine technology transfer and balanced knowledge co-production.

Use of regional knowledge is hindered in world assessments for several reasons. Despite budget constraints, political and economic instability, LAC researchers produce a wealth of knowledge that often faces intra-academic barriers, such as language (Angulo et al., 2021). Knowledge relevant to local systems are often published in languages other than English or outside of mainstream Journals receiving less attention by peers and thus becoming invisible to global assessments like SROCC. Therefore, local researchers are again critical to make such knowledge visible to global reporting processes. Regional ILK needs to permeate more effectively into global assessments like IPCC and IPBES reports to complement classic scientific information. At the same time, the results/findings from such reports must return to local communities in a language that both society and policymakers understand and relate to, so that the uptake of such knowledge is enhanced. Science cannot be detached from local realities, even if the final message pertains to global effects. Translation of scientific knowledge to local languages is certainly essential to allow for a more equitable extraction of the information from these assessments making calibrated language and the whole process more palatable to the general public since its information is designed to provide evidence, agreement and communicate uncertainties (Mastrandrea et al., 2010) based on peer-reviewed research. By adjusting the language, it allows the information and its flow to be more inclusive and receptive to diversity, particularly when interculturality is taken into account. Although many perceive the region as sharing similar languages, geographies and cultures, reality shows a huge diversity of languages and cultures but also values and beliefs. Latin America and the Caribbean are as diverse and wide as the geographic breadth and ecosystems/biomes described in-between. Thus, climate change perception of threats needs to account for local realities and require larger representation of specific groups, knowledge and traditions at different assessment processes.

Climate knowledge production is also dependent on multiscale observing systems to produce accurate scenarios and long-term predictions. Nevertheless, despite existing initiatives, there are still considerable capacity and data gaps (Malone et al., 2010; Foltz et al., 2019; Smith et al., 2019; Speich et al., 2019; IOC-UNESCO, 2020) due to insufficient observations. These gaps are particularly critical in coastal Africa, South America,

the Caribbean, Southeast Asia, and Small Island Developing States, where development pressure and high social vulnerability hamper ocean and climate sustained observations. These areas should represent high monitoring priorities and efforts.

Knowledge Accessibility

Societal engagement is influential in science uptake to inform decisions by pressing governments to act, as well as by using scientific information to transform behavioral patterns and foster climate and ocean literacy, and social innovation. Consequently, inclusion and equity require accessible language and capacity development. In socio-ecological systems, where scientific uncertainty and societal stakes are high, values tend to be in dispute and decisions are urgent. The Post-Normal Science framework (PNS, Funtowicz and Ravetz, 1993) proposes a multi-stakeholder engagement in the decision making, jointly considering the risks and opportunities to act. We need to address social vulnerabilities at the local level to enhance and sustain the engagement of LA in the green/blue economy. Thus, PNS could be an adequate framework for developing SROCC’s recommendations further.

Scientific knowledge used to be restricted to academic groups and publications and discussed within invisible schools (Sieber, 1991). Recently, the Open Science Movement has attempted to make this knowledge available to all (Aspesi and Brand, 2020). Open Science is about making scientific research and data freely accessible, but should also mean dialoguing with society, while embracing ILK in support of better-informed decision making (Oliver and Cairney, 2019; Safford and Brown, 2019).

Broad stakeholder engagement (affected communities, indigenous peoples, local and regional representatives, policy makers, managers, interest groups and organizations) has the potential to combine and use relevant knowledge (Obermeister, 2017) and balance the disproportionate influence that economically advantaged groups have in most scientific assessments (Castree et al., 2014). The formal process of IPCC assessments follows predetermined formats and standards^{7,8}, uses specific calibrated language and approaches unfamiliar to many scientists and policy makers in LA. Locally, there is little interaction and support by IPCC focal points to promote learning-oriented methodologies, familiarity with the language and experience to address the IPCC process, hampering regional/local participation. Although the recognition and use of ILK is expanding in peer-reviewed research (Savo et al., 2016; Abram et al., 2019) thus providing information and responses to guide and inform policy with different perspectives (Huntington, 2011; Nakashima et al., 2012; Lavrillier and Gabyshev, 2018), most global assessments have not yet incorporated ILK information (Obermeister, 2017) thus limiting the potential of local adaptation response (Ford et al., 2016).

Science diplomacy, the interrelation between research and international relations, can reduce inequalities and bridge communities by aiding in the implementation of international

⁷<https://www.ipcc.ch/documentation/procedures/>

⁸<https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-principles-appendix-a-final.pdf>

provisions aimed at leveraging scientific capabilities in LAC (Ruffini, 2018; Salpin et al., 2018; Polejack and Coelho, 2021). By incorporating scientific literature in other languages, other sources of knowledge, and regional input, global assessments like SROCC reduce most of its imbalance. The opportunity presented by the UN Decade of Ocean Science (Ryabinin et al., 2019; Polejack, 2021), particularly through the Ocean Literacy movement seek creative ways to bridge science, policy, diplomacy and society (Santoro et al., 2017; Borja et al., 2020).

Knowledge Impact to Policy Change

Climate change adaptation and mitigation requires coherence of global, national, and local levels of governance, a challenge to the integration of political and administrative systems. There is a void between international treaties, national regulations, and local implementation due to the lack of broad stakeholder participation in the formulation of these policies, undermining their adequacy (Keskitalo et al., 2016). The development of effective responses involves societal adjustment and modification of current behavior provoking such changes.

Scientific advice is playing an increasing role in policy and decision-making (Gluckman, 2016a). Governments require scientific evidence in a wide range of situations (e.g., Gluckman, 2016b), but there is still the need to respect the different imperatives in science and in policy, so better-informed decisions are made, and research is promoted and sustained in the long-term (Parkhurst, 2016).

Interculturality matters to LAC (UNDP, 2021) and has been recognized as an important regional aspect that defines local identity as reflected in a few NDCs. Thus, as scientists, we must incorporate the local social, cultural, and political forces to seek mutual understanding and cooperation to also find solutions to climate change adaptation. Local institutional and policymaking landscapes are determinant of how scientific evidence is perceived and used in the decision-making process, mostly because these decisions consider a wide range of factors that are grounded on local realities, including social values and beliefs (Cairney, 2016) and traditional and local knowledge, reflected in the interculturality aspects brought by a few NDCs. Latin America has a diversity of political systems that produce and apply scientific evidence in a variety of ways, deriving from national and subnational realities that often challenge the Western-democratic perspective of the use of evidence, so dominant in global reporting exercises (Parkhurst, 2016). Thus, standard global solutions can become locally irrelevant and there is a need to consider these realities when co-designing fit-for-purpose local solutions. In this sense, local actors (scientists, the public and stakeholders) are better equipped to act as knowledge brokers within their local social-political contexts.

Importance of Long-Term Monitoring for Decision-Making

Long-term observations inform society about change rates in ocean warming, sea-level rise, acidification, and deoxygenation (Breitburg et al., 2018; Bourlès et al., 2019; Turk et al., 2019), including coastal areas where the effects on ecosystems and ecosystem services are often associated with social vulnerability,

highly affecting society (IPCC, 2019b). Detection of climate change in coastal regions is difficult because of their natural variability, requesting long-term ocean observing systems (Duarte et al., 2013; Turk et al., 2019). Globally coordinated ocean observing systems provide the information needed to support climate prediction on different timescales (e.g., Sloyan et al., 2019). However, many existing records are still short to detect anthropogenic change, and some regions remain undersampled (e.g., deep-sea, shelves). Southern Hemisphere temperate, subpolar and polar latitudes are among the least studied areas of the planet, which represents a serious gap to decrease the uncertainty of global models predicting future climate scenarios (Meredith et al., 2019). Long-term data is essential to measure changes to ecological and environmental conditions, but also the outcome of policies and human behavioral changes (Pecl et al., 2017). Thus, long-term ocean observatories in LAC, combining environmental data (such as Essential Ocean Variables-EOVs) with social sciences and traditional knowledge need to be developed and implemented (Abram et al., 2019; Fennel et al., 2019).

At the heart of climate change research is the requirement of sustained observations with time series frequent and long enough to develop baselines and climatologies. Baselines are compared with anomalies, changes in phenology, trends or changes in populations, and spatial distribution. Time series enables us to characterize variability, reduce uncertainty, and increase forecast and prediction which can guide the outcome of policies and human behavioral and environmental change. Bio-Environmental baselines and time series represent global trends and local pressures that can be evaluated against natural variation for policy and decision-making at many levels (Muelbert et al., 2019). Integrative scenarios, combining environmental, socioeconomic and health sciences, such as the Nexus method (Howells et al., 2013), has been successfully applied to climate and fisheries in the Humboldt Current System (Garteizgogea et al., 2020), in the assessment of climate vulnerability in Brazil (Araujo et al., 2019), and in the International Long-Term Ecological Research (ILTER) programs described in Muelbert et al. (2019) and detailed for LAC in **Table S2**.

Consequently, better government climate-related decisions are likely to occur when decision-makers are exposed to climate scenarios and environmental indicators with dynamic outputs, even in face of models' limitations and potential risks of being misused to support biased political statements (Saltelli et al., 2020). According to Haasnoot et al. (2015), scenarios lead to increased awareness of when and which adaptation policies should be applied.

CONCLUSIONS

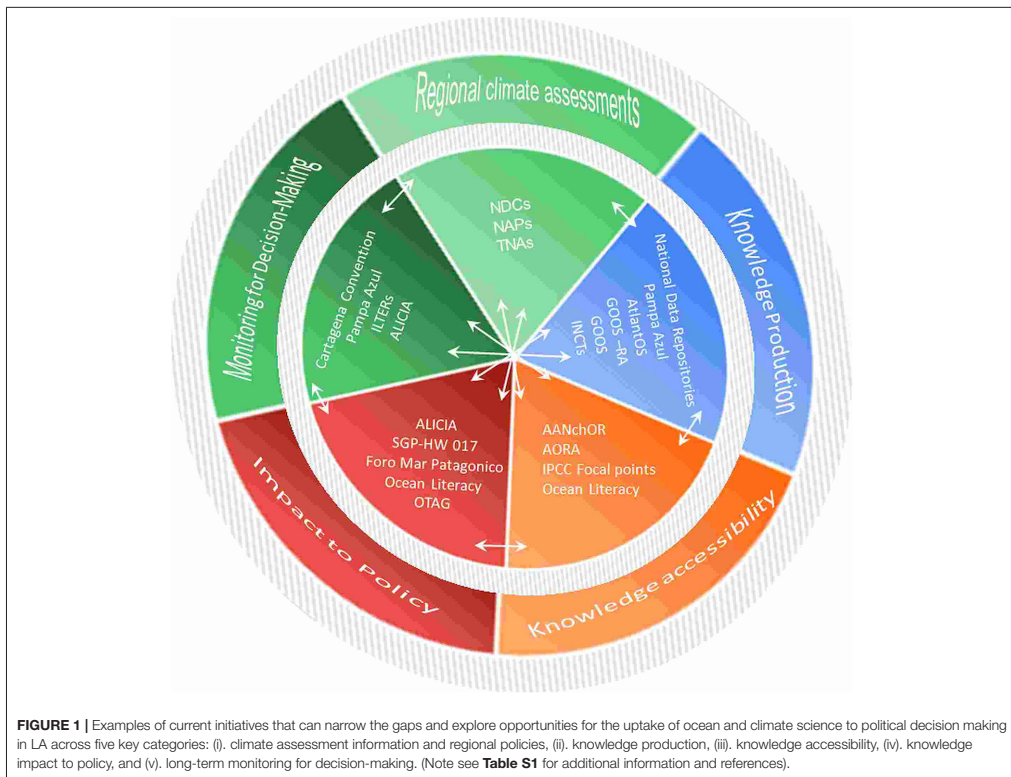
Despite the efforts to disseminate, warn and engage as many nations as possible in a global effort to reverse the course of climate change, high inequality and low economic growth in several regions are hampering the overall understanding, integration, and engagement to mitigate climate effects, thus

perpetuating regional heterogeneity (UNDP, 2021). The goals and specific objectives of climate change strategies around the world tend to reflect a global agenda that, at least for LA, are often detached from national/regional vulnerabilities and contexts which in part respond to delayed actions. It needs to change.

In order to reduce knowledge gaps in LA, there is a need to secure investment in long-term observations and to promote capacities, which will also raise the accuracy of models and predictions. Sustainable research funding shall provide local and regionally oriented information and advice. Moreover, successful initiatives like Pampa Azul, AtlantOS, the All-Atlantic Ocean Research Alliance, Rede Clima, Acceso Libre a la Información Científica—ALICIA, the National Repository in Mexico and the Cartagena Convention (Table S1) reflect State policies trying to overcome bottlenecks in LA. The interruption of such policies jeopardizes future investments and continuity of climate action mitigation.

How would Latin America engage in climate action globally while maintaining its identity and structure of interconnected social, economic, and ecological systems? It is imperative to develop specific national-institutional capacities and public awareness to support and advance a long-term process

with a more diverse and multi knowledgeable approach embracing local cultures, language, and broader participation of local communities (Figure 1). Despite political and economic limitations, the region must be integrated not only from a commercial perspective of goods and services (i.e., Mercosur) but also from an environmental standpoint to implement its strategies against irreversible climate change. A few organizations in the region could facilitate this coordination and strengthen the participation of LAC representatives in global reporting assessments such as SROCC. The InterAmerican Institute for Global Change (IAI—Instituto InterAmericano para la Investigación del Cambio Global) is a regional intergovernmental organization that promotes interdisciplinary scientific research and capacity building, informing local and regional decision-makers about important issues of global change. Although the IAI has mechanisms in place to provide scientific evidence for the improvement of its Parties' public policies, it is essentially intergovernmental, i.e., triggered by diplomatic negotiations that depend upon national mechanisms of integration with other stakeholders. The Economic Commission for Latin America and the Caribbean (ECLAC) is also another important intergovernmental organization in the region that could enhance the coordination in climate change responses, significantly



contributing to regional knowledge production and public policies, while promoting the transition to environmentally sustainable and low carbon economies (UNDP, 2021). However, both IAI and ECLAC apply similar diplomatic processes as the IPCC and the UNFCCC, with little synergy with local stakeholders. Moreover, neither have a climate (not to mention ocean) focus and not all countries in the region are Parties to those organizations. Therefore, while we recognize that regional organizations can aid in bridging global, regional and national perspectives based in science, we advocate that local researchers can act as knowledge brokers and should be empowered, encouraged, rewarded and better included in global climate-ocean scientific assessments.

Addressing climate change entails modifying the status quo facing resistance from influential groups in society that interfere with the development of local climate change policies (Meadowcroft, 2009). In this perspective, we advocate that the uptake of SROCC findings in LA policies can be enhanced by: (a) embracing local realities and knowledge purveyors; (b) empowering locals to both inform local knowledge to global assessments and adapt those findings to local realities; (c) enhancing regional research capabilities; and (d) securing ocean observations for the long run. The adoption and incorporation of SROCC's recommendations into NDCs depend strongly on the local reality which is dictated by the relationship between adaptation-related processes (social vulnerability, low growth, as well as high contrasts and inequalities) and political pressures.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MMCM led the process with all co-authors (MC, LCC, MNL, AP, ACP-P, and ER-A) who have substantially contributed

to the document, its revision, reading and approving the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fclim.2021.748344/full#supplementary-material>

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What does Integrated Ecosystem Assessment mean to research and policy stakeholders working in the Atlantic? Implications for science diplomacy

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ABSTRACT

Integrated Ecosystem Assessment (IEA) is designed to be an inclusive, evidence-based process to engage stakeholders, in the support of ecosystem-based management. IEA is resource intensive, requiring the engagement of personnel, experts from many disciplines, public and private institutions, and including issues of technology, infrastructure, capacity building, etc. Stakeholders such as policy decision makers and scientists in influential decision making roles often determine the level of investment when committing to an IEA. It is thus critical to understand how these specific stakeholders understand and perceive IEA, as well as their motivations for engagement. We interviewed government officials, science managers and researchers whose decisions are critical for mobilizing resources (time, expertise and funding) in support of ecosystem based management (and potentially IEA) in the Atlantic Ocean. The interviews aimed at documenting their perceptions of IEA, and their motivations to engage in the process. Our results show that most of these research and policy stakeholders are generally unaware of, or have misconceptions about IEA concepts. Moreover, many seem to perceive IEAs as still unfit to address most policy and managerial goals. We discuss our results in light of Postcolonial theory, and suggest ways to improve transboundary collaboration on

marine IEAs that meet the needs of a broader range of stakeholders. We suggest how improving inclusivity and applying ocean science diplomacy can help to support IEA through negotiating, strengthening and diversifying the involvement of international stakeholders, and can likewise bolster the salience, legitimacy and credibility of IEA among stakeholders. This article is part of the Mission Atlantic Project (Horizon 2020) which is designed to conduct IEAs in the Atlantic Ocean.

KEYWORDS

Ecosystem-based management, All-Atlantic Ocean Research Alliance, decision making, science-policy interface, science diplomacy

INTRODUCTION

Ecosystem based management and the governance of human activities requires inclusive approaches that engage stakeholders from across disciplines, geographies, sectors, cultures, genders, and generations (Wisz *et al.*, 2020). Integrated Ecosystem Assessment (hereafter IEA) is an interdisciplinary and participatory process that engages stakeholders to support ecosystem-based management. IEA has been adopted by the UN Environment Program (UNEP, 2022), the International Council for the Exploration of the Seas (ICES) (Walther & Möllmann, 2014) and the US National Oceanic and Atmospheric Administration (NOAA) (Harvey, Kelble, & Schwing, 2017). IEA has been promoted as an effective evidence and ecosystem-based approach to develop policy-relevant recommendations about the state of the environment and its interaction with human activities (Harvey *et al.*, 2017; Walther & Möllmann, 2014). Participants of an IEA process seek to combine, interpret, and communicate knowledge in order to define courses of action in a given environmental management challenge (Levin *et al.*, 2009; ICES, 2012a; Dickey-Collas, 2014; Levin *et al.*, 2014; Samhuri *et al.*, 2014; Harvey *et al.*, 2017). Moreover, those engaged in an IEA process seek to evaluate management strategies together with the possible outcomes (via trade-offs) derived from the agreed managerial measures (Levin *et al.*, 2009; ICES, 2012a; Dickey-Collas, 2014; Levin *et al.*, 2014; Samhuri *et al.*, 2014; Harvey *et al.*, 2017).

Engagement in the IEA process

IEA is a stepwise process that includes: 1. a scoping phase to identify the goals of ecosystem-based management and threats to achieving these goals, 2. the development of ecosystem indicators and targets, 3. a risk analysis, 4. an assessment

of scenarios relative to ecosystem-based management goals, and 5. the monitoring of indicators (Figure 1).

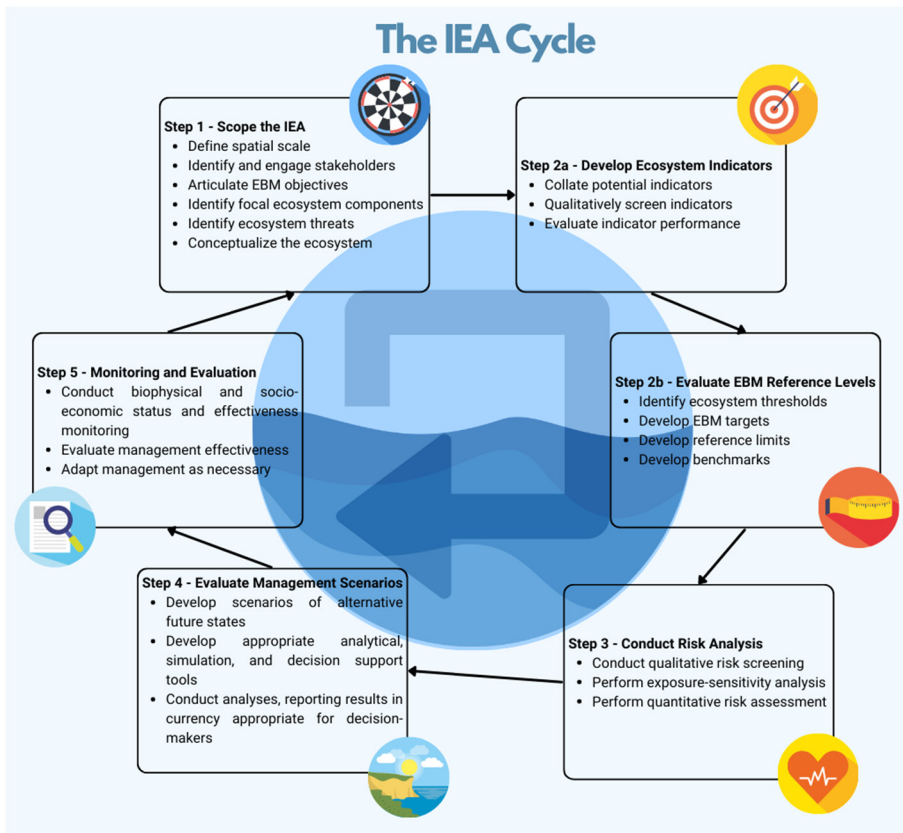


Figure 1: The Integrated Ecosystem Assessment cycle adapted from Levin *et al.* (2014).

The first phase of the IEA process is the scoping phase, and is the part of the IEA process where relevant stakeholders are identified and engaged to negotiate and formulate the IEA objectives, along with the necessary knowledge to be provided (Levin *et al.*, 2014). During the IEA process, stakeholders are requested to identify the appropriate scale to define management objectives (Samhoury *et al.*, 2014), and the strategies to exchange the IEA information with decision-making processes (Harvey *et al.*, 2017).

Failure to engage in the IEA process potentially weakens the inclusivity and the effectiveness of the scoping phase, which is the foundation of the entire IEA process (Levin *et al.*, 2014). Stakeholders who do not engage in the IEA will lack the evidence base needed to inform decisions that could support their own interests.

Moreover, failure of some stakeholders to engage in IEA could undermine the potential for IEA to help achieve shared ecosystem based management objectives in a region (and beyond) (deReynier, Levin, & Shoji, 2010). A lack of clarity on the purpose and need of IEA can be detrimental to the process (Harvey *et al.*, 2017), in particular, due to its relevance for operationalizing ecosystem-based management principles (Dickey-Collas, 2014; Levin *et al.*, 2009). Unveiling individuals' perception of and the need for IEAs is critical to understanding the values they place in engaging in the process. Thus, it is useful to assess how policy decision-makers and scientists empowered to deploy resources for cross-border science collaboration understand and value the IEA process. It is likewise useful to understand what factors motivate them to commit resources to IEA activities.

IEA and science diplomacy

Ocean natural processes do not adhere to national jurisdictions (Ranganathan, 2020), and for this reason, international science is needed to support the objectives of many marine IEA initiatives (Polejack, 2021). IEA objectives are rooted in societal challenges that require an ecosystem-based management solution, advised by scientific evidence and traditional knowledge (Rudd *et al.*, 2018). In the cases where an IEA occurs across jurisdictions or in international spaces, such objectives require international engagement and action.

Because of the transboundary and international nature of many marine IEAs, ocean science diplomacy, can potentially play an important role in facilitating such initiatives. Ocean science diplomacy refers to the interaction between marine research and international relations. Ocean science diplomacy can involve issues of evidence provision, the balance of national versus international interests, and/or power dynamics involving scientific matters between countries (Polejack, 2021). First, evidence provision to international decision-making is perhaps the most commonly known feature of ocean science diplomacy, e.g. data on fish populations to determine fishing quotas. Second (and less visible), less commonly considered is the research regarding the balancing of national interests (e.g. exploitation of marine resources for economic profit), with more global interests (e.g. ocean conservation). In cases where these interests clash, power conflicts may emerge. For example, the fishing industry of a given country will most probably show interest to engage in the diplomatic negotiation concerning the establishment of no-take zones or marine protected areas, seeking to avoid an overlap with lucrative fishing sites. This specific industry's interest may then become a national interest to be supported and defended by diplomacy. Alternatively, that specific ocean site may become the subject of global interest due to its strategic provision of other ecosystem services, such as biodiversity conservation or climate change mitigation. Finally, power dynamics involving scientific matters between countries can come into play whereby ocean

science diplomacy can become a soft form of power (Nye, 2017). For example, better scientifically equipped countries can use their national science assets to seduce other countries and attract investment and talents to empower domestic science systems and raise competitiveness (Fedoroff, 2009; Nye & Welch, 2017). IEA is a relatively new concept, and there are so far no clear examples where political tensions have hampered specific IEA efforts. However, power disputes can critically influence area-based management exercises, such as Marine Spatial Planning (Ramírez-Monsalve & van Tatenhove, 2020).

The Atlantic Ocean presents a useful opportunity to examine how research and policy stakeholders perceive international IEAs. The Atlantic is the second largest ocean basin and has the world's longest running history of international IEA, mostly done in the North (Levin *et al.*, 2014). For example, NOAA has been a strong advocate for applying IEAs to fisheries management (Harvey *et al.*, 2017; Muffley *et al.*, 2021; NOAA, 2022), while ICES is seeking to expand IEAs to sectors beyond fisheries (Dickey-Collas, 2014; ICES, 2019; Walther & Möllmann, 2014). The alignment of Canada, the European Union, and the United States of America through the Galway Statement has reinforced the importance of IEAs in support of better ocean management and cross-disciplinary research (Link *et al.*, 2019; Rudd *et al.*, 2018; Wisz *et al.*, 2020). In the South, the work jointly done by Angola, Namibia and South Africa in managing marine resources through the Benguela Current Convention has shown how delicate an ecosystem assessment can become when dealing with economical assets in face of the consequences of climate change (de Barros Neto *et al.*, 2016).

The Belem statement is an agreement that aims to support scientific collaboration in the South and North Atlantic by establishing the All-Atlantic Ocean Research Alliance, a cooperative international arrangement with the aim of enhancing citizens' wellbeing, grounded in joint marine research efforts (Polejack, Gruber, & Wisz, 2021). The European Commission, in support of the Alliance, has also contributed major funding to support the development of Atlantic-scale IEA, as by the Mission Atlantic project¹. It is however poorly understood how policy decision makers and leading scientists in the Atlantic understand and prioritize the IEA process.

This paper investigates the diversity of perceptions of IEA among a sample of research and policy stakeholders across the Atlantic, and the inherent implications that these perceptions might pose to the development of IEAs. This paper analyses the perceptions of a particular set of research and policy stakeholders, which include research leaders and high-level decision-makers. These stakeholders' values can potentially influence the level of commitment directed toward the IEA process, and

¹ <https://missionatlantic.eu/> accessed on June 15, 2022

its success. This study is part of the Mission Atlantic project, which aims to operationalize IEAs through case studies from the North and South Atlantic, in support of ecosystem-based management in the Atlantic and the All-Atlantic Ocean Research Alliance.

METHODS

Our goal was to understand how individuals with positions of power and influence in the Atlantic Ocean perceive IEAs. We selected individuals engaged in negotiating and implementing the All-Atlantic Ocean Research Alliance among government officials and researchers. We conducted twenty semi-structured interviews with government officials (13 interviewees) and researchers (07 interviewees) from Argentina, Brazil, Canada, Germany, Portugal, Spain, South Africa, the United States of America, and the European Commission. We focused on government officials who hold decision-making roles important to the allocation of resources for IEAs (human and financial). We also focused on research leaders, as those leading research projects, groups or institutions working on the science-policy interface in the Atlantic Ocean. We expect that their perceptions of IEA matter in terms of committing time, resources and personnel to the process.

The general profile of the interviewed government officials were decision makers who occupy high-level positions in national ocean-related science systems, including Science and Technology State Secretaries and Ministers, directors, science managers and diplomats. These government officials are budget owners, agenda setters, and report to the high levels of governments (e.g., Head of State or Ministers). Unlike “mid-level technocrats” (Jasanoff, 1998) who would be personally participating in an IEA process, our interviewees are not expected to take a seat at the IEA table, but rather be fed by the results of IEAs and capable of determining further engagement. The general profile of the interviewed researcher is that of a person who has gained extensive, and high profile experience in international scientific cooperation by coordinating cross-boundary research projects and scientific programs, and engages across large international marine research institutes in the Atlantic.

The first author of this publication was personally involved in negotiating the All-Atlantic Ocean Research Alliance. His positionality has facilitated the identification and engagement with interviewees. The first author also conducted the interviews, and it is believed that this pre-existing level of trust and acquaintance facilitated access to the interviewees, and their openness and sincerity when answering the interview questions. The first author also analyzed the results. The first author

positionality can thus place him as an insider researcher (as per Merriam *et al.*, 2001).

The first author carried out twelve face-to-face interviews during the All-Atlantic Forum² (Brussels, February 2020), before COVID-19 travel restrictions were in force. After that, from April to October 2020, the remaining eight interviews could only be carried out online (via the Zoom platform). Interviews consisted of a set of nine questions, from which six were common to all subjects and the remaining three were specific to each category of interviewee (government officials and researchers). These questions were aimed at investigating the overall perception of science diplomacy and the specific issue of IEA was explored by two questions: 1) In your opinion, what is international IEA? and 2) how should the success of IEA be measured? These interviews were performed in the context of collecting perceptions about ocean science diplomacy. IEAs were dealt with within this context. Results pertaining broader perceptions on ocean science diplomacy are the focus of a different paper.

The interviews were conducted both in English and in Portuguese and were fully transcribed in their original language. Translation from Portuguese to English was only done to present extracts in this paper. To preserve the anonymity of the interviewees, the names of the interviewees were replaced with numbers, shown in brackets after each quote, along with their functional role (researcher or government official).

The data were approached by grounded theory (Bryman, 2012, pp. 567–570) and MAXQDA Plus 2020 (Release 20.4.1) software was used to support our analysis. Codes identified in the data were revised multiple times and clustered in themes, which were again revised and used to guide our analysis, as per thematic analysis (Braun & Clarke, 2006). We present the resulting themes as subsections of the Results section below and in Table 1.

RESULTS

In general, interviewees expressed being unfamiliar with the IEA concepts and how the process is conducted. Neither government officials, nor the researchers interviewed claimed to have actively participated in an IEA process. Some interviewees stated being entirely unaware of IEAs. Thus, the perceptions we collected come from the moment of the interviews, where many government officials and researchers were introduced to IEA for the first time. However, this lack of clarity and experience on the IEA framework did not impede these

² <https://allatlanticocean.org/view/atlanticforums/2020-brussels>, accessed in Nov.18, 2021

individuals to share their beliefs of what an IEA should or not entail. The data presented here do not represent the view of experienced research and policy stakeholders who were personally involved in an IEA. Moreover, the results do not attempt to suggest a generalization of our findings. Rather, results should be viewed as a point in time and reporting from non-experienced individuals' perceptions of IEAs. These specific individuals are, however, influential in the context of the All-Atlantic Ocean Research Alliance and their perceptions can facilitate the engagement and investment in IEAs in the region.

The codes derived from the interviews were clustered around seven themes, summarized and presented in Table 1.

Table 1: Summarized results showing the main themes identified, key results emerging from those themes, an exemplary quote and whether the result was more frequent amongst government officials, researchers or both.

| Theme | Key result | Exemplary quote |
|---|---|---|
| Uncertainty about the IEA concept | The lack of clear understanding of the IEA process, its limitations, and benefits | <i>"I'm certain there's a good definition of it and a good description, but I suppose that's about as far as my conceptualization of it goes"</i> |
| IEA as a resource management tool | IEA seen more as a tool to manage marine resources rather than unveiling ecosystems' complexities | <i>"So for me, it's looking at this resource multi-dimensionally, not just looking at it through one lens"</i> |
| IEA as a way to understand and manage nature's complexity | Recognition of the human limitations to assess the complexity of ecosystems | <i>"Ecosystems don't know no boundaries. The boundaries are put up in there by our knowledge paradigms. (...) the world itself in the nature in which it's working, it's already integrated. So we need to find a rubric, a methodology that helps us to understand this holistic part of it"</i> |
| Managing human as part of the ecosystem | IEA is about managing human activities rather than managing nature | <i>"Fisheries management is mostly about managing fishermen, harvesters, not about managing the fish at all. Fish are just the kind of the outcome. They're part of the story"</i> |
| Managing resources that have economic value | Results arising from IEAs should be tailored to address resource management and governance decisions | <i>"Eventually, there will be a value placed on (...) looking at the economic and monetary aspects of systemic views of ecological ecosystem"</i> |
| Integrating knowledge | A call for breaking boundaries and working across disciplines and sectors while assessing marine ecosystems | <i>"It requires really different sectors, different disciplines to work together, which then translates as well into... when you operationalize it, that you need different policymakers, you need different funding agencies"</i> |
| The challenges of an ecosystem-based approach | IEA does not offer a one-size-fits-all solution | <i>"there's sometimes too much enthusiasm for the idea that there's an optimal solution to what is ultimately not a tractable problem that can go back to having the solution. That there isn't an activity that you could set a target level that will guarantee some particular outcome"</i> |

1. Uncertainty about the IEA concept

Most interviewees premised their answers to IEA questions with the caveat that they lacked a clear understanding of IEA concepts and methods. This was the case for both government officials and researchers we interviewed. Often, interviewees explained that IEA was not their expertise, nor part of their routine work. One official stated:

“I’m certain there’s a good definition of it and a good description, but I suppose that’s about as far as my conceptualization of it goes” (Respondent 18, government official).

“It’s a term that often confuses me when people use it. And there’s a whole lot of other information in that, that is not my expertise. And I can’t even begin to comprehend what you would need to actually measure the success of something like that.” (Respondent 19, researcher)

2. IEA as a resource management tool

In spite of a lack of clarity on the IEA concepts and process, interviewees showed preconceived beliefs on what IEA would entail and what it was meant to achieve. To these individuals, IEA is mainly perceived as a marine resource management tool. For example:

“So for me, it’s looking at this resource multi-dimensionally, not just looking at it through one lens” (Respondent 12, government official)

“it’s fundamentally just about recognizing the complexity of the environment that we are managing. Fisheries management is more than just about managing fish. But our point would be that fisheries management is mostly about managing fishermen, harvesters, not about managing the fish at all. Fish are just the kind of the outcome. They’re part of the story” (Respondent 9, researcher)

Another perception brought by interviewees was about IEA being an area-based managerial tool. In this sense, one of the roles of the IEA is to assess specific geographical areas to be applied in area-based management processes, such as Marine Spatial Planning and coastal zoning.

“So we have to be more flexible on what we call this animal but I think at the end of the day it is about zoning, thinking about the entrusted real estate that you have in the ocean and how you really want to manage or interact with it in a sustainable way” (Respondent 10, researcher).

“You sit down and look at an area, see what the activities are, and you try to decide for that country, for that community, without purely lobbying and economic

influences, which makes sense, right? So, where is each area, what each area is going to be intended for. What is best to do, what is best not to do, right, so that the fauna and flora can recover, and everything else.” (Respondent 13, government official).

3. IEA as a way to understand and manage nature’s complexity

Interviewees communicated a belief that IEAs are designed to assess and report on the complex connectivity found in nature. Researchers were more inclined to express the complex linkages between ecosystem components, and the role that IEA can play in understanding and managing these complexities. For example, a researcher stated:

“IEA is complex because it tries to see all the possible impacts of an action, not just one or two aspects, but really all the aspects that can affect an ecosystem, a landscape, etc...” (Respondent 7, researcher).

Government officials expressed a certain degree of confusion and skepticism when addressing the complexity of nature. For example:

“(...) ecosystems are integrated anyway, so I'm not sure that makes immediate sense to me” (Respondent 18, government official).

“I've never heard or read about integrated ecosystem, but all ecosystems need to be integrated.” (Respondent 15, government official)

According to one government official, IEA is:

“a flexible way of beginning to vision (sic) how the wild itself operates. Ecosystems don't know no (sic) boundaries. The boundaries are put up in there by our knowledge paradigms. We like classifying these kinds of things and so to that extent we create the need for an integrated but the world itself in the nature in which it's working, it's already integrated” (Respondent 16, government official).

The belief that IEAs are designed to assess and report on the natural interconnectedness of nature seems to be related to the adoption of concepts that are artificially created by humans. As suggested by respondent 16 above, this can be a paradigm created by humans in an attempt to frame the complexity of nature so we are capable of understanding it. Another official challenged the dominant conceptualization of ecosystem:

“[ecosystem] is one dimension of a much bigger set of integrated systems where what we understand an ecosystem to mean is going to change (...) as having a value in itself or having a function on production supplies (...) in terms of the basic processing

that ecosystems achieve as part of the services that it provides to us” (Respondent 4, government official).

4. Managing humans as part of the ecosystem

While the interviewed government officials tended to understand the IEA as a tool to report on the state of the marine environment, in particular from the perspective of providing services to humans, researchers brought forward the notion that humans are an intrinsic part of those ecosystems. Therefore, assessing ecosystems would mean also assessing human dimensions found within them as part. Consequently, to the interviewed researchers, IEA would be a tool to understand the impacts of human activities on the environment, and to manage them. For example:

“it's a struggle because the word ecosystem means a lot of different things to people (...) and what was (...) most useful in what we brought to the Minister, was to recognize that humans are included in the ecosystem and that most environmental management is about managing human behavior” (Respondent 9, researcher).

5. Managing resources that have economic value

Interviewed officials seemed more likely than researchers to attach the goals of an IEA to the economic value of marine resources. This concern was also translated when linking IEAs to political objectives. To those officials, results arising from IEAs should be fit-for-purpose in aiding decision making mainly about resource management.

“Eventually, there will be a value placed on that and (...) [we] need to be looking at the economic and monetary aspects of systemic views of ecological ecosystem” (Respondent 4, government official).

“We have to understand the value of what the condition at that ecosystem is.” (Respondent 6, government official)

Researchers rarely brought political and economic issues upfront when explaining their views of IEAs, but one in particular stressed the need for governments to take more responsibility in managing marine resources, stating:

“The government has to establish some kind of rules. And of course, the government has to control what is happening there. So you have to have a complete monitoring of the area in order to control what is happening there. They have to have much more responsibility” (Respondent 11, researcher).

6. Integrating other knowledge

Both Government officials and researchers have expressed the need to brake boundaries and work across different disciplines and sectors when assessing marine ecosystems:

“It requires really different sectors, different disciplines to work together, which then translates as well into... when you operationalize it, that you need different policymakers, you need different funding agencies, and that is the complexity” (Respondent 2, government official).

“so, I come in from the physics. I think it's really important to start connecting. So we are doing a lot of that, like, doing more multidisciplinary analysis and to try to understand how the environment... In the end, the variability of the physical components are providing for the environment, for the ecosystems.” (Respondent 20, researcher)

According to some government officials, transdisciplinarity in the IEAs should go beyond knowledge disciplines, but also incorporate other frameworks. In their perspective, these other frameworks would include the United Nations (UN) 2030 Agenda (Sustainable Development Goals (SDGs)), the World Ocean Assessment (United Nations, 2021), and also the IPCC reports (e.g., IPCC, 2019):

“I think the national level is quite important, but in the international level you would also have maybe the use of the sustainable development goals and reports to the UN that possibly could be used with the various indicators. Each of the goals would have a set of indicators and reporting against those indicators could provide some sense of how that integrated ecosystem approach implementation is going on, whether it's been achieved or not” (Respondent 12, government official).

“First of all, if you take the general assessment, the UN assessment of the ocean status, you have an established methodology. The other one is the IPCC. You take the SDGs and the different indicators. Then, you might have different key performance indicators related to performance required at national level, so you have again a whole series of descriptors there. So, we have enough, we have all these existing frameworks. What is always missing is: how is this actually implemented?” (Respondent 2, government official).

7. The challenges of an ecosystem-based approach

To most of the interviewees, IEA should be a beneficial tool for decision-making. However, on several occasions, interviewees made reference to the challenges associated with using IEA for managerial decisions. For example, a government official stated:

“When I see in my own country our fisheries folks who are leading integrated ecosystem assessments and I see how slow it is to get people to migrate from a fisheries-based ecosystem to a totality of the ecosystem, it's frustrating. It takes a long time for that level of focus to change its direction” (Respondent 3, government official).

Another official illustrated the inefficiencies of the current management system:

“as an RFMO (Regional Fisheries Management Organization manager) said: we closed the fisheries for this species, it's been 10 years. And the species doesn't recover. Why doesn't it recover? Because it's not fishing, it's climate change, it's oil, it's shipping... so this stock will never recover, because it's not impacted by how much we're fishing. So, it's no use” (Respondent 13, government official).

One researcher shares this frustration:

“I think there's sometimes too much enthusiasm for the idea that there's an optimal solution to what is ultimately not a tractable problem. That there isn't an activity that you could set a target level that will guarantee some particular outcome. That's just not possible because there are too many movable pieces in the system, but I think it's much better to talk about ecosystems approaches than it is to talk about single species or even multi-species approaches” (Respondent 9, researcher).

DISCUSSION

The researchers and government officials we interviewed have a lack of familiarity with the IEA framework. They also stated not having participated in an IEA before. In spite of their lack of familiarity with IEA, interviewees expressed preconceived concepts on what an IEA should entail. These individual's perceptions expose their understanding and values placed to IEAs as a non-experienced public. Their perceptions matter because of their influence in the Atlantic Ocean community. These stakeholders are agenda-setters, budget holders, science managers and influential researchers with the capacity to influence the allocation of resources for IEA. Therefore, our results do not represent a generalization of any population, but rather individual insights that compose their truths and understandings of IEAs. This is the framework by which we discuss the results.

The importance of understanding the IEA

Although IEA is considered among the scientific community as a well understood concept, and features prominently in the discourse of organizations such as ICES, UN Environment, and NOAA (Levin *et al.*, 2014), interviewees declared being

unfamiliar with the IEA concept. This highlights the need to discuss and harmonize all participants of the IEA process in defining central concepts before all else.

Although these individuals state being unfamiliar with IEA techniques, their perception aligns with current descriptions of a process by which fit-for-purpose research is delivered to decision making, mainly regarding marine resource management (Long, Charles, & Stephenson, 2015). This view produces an expectation that science will deliver the necessary answers to a more sustainable ocean management in the Atlantic. Researchers we interviewed expressed concern over the inherent complexity of nature, which challenges science when presenting possible managerial paths. Government officials who we assessed seek solutions from science to enhance sustainable economic development, despite the uncertainties that science seeks to unveil. Our results provide evidence of this clash in the expectations that these government officials and scientists have of the outcomes of IEAs.

Expectations of an IEA

In general, interviewees were skeptical about the capacity of IEA to deliver a silver bullet solution to design relevant actions towards marine sustainability. Government officials expressed concerns over IEAs being isolated from political ends, including economic development. Researchers seemed to be concerned about possible misinterpretations about the limits of IEAs by decision makers and wider society.

Although both government officials and researchers advocated for the adherence of IEA to broader societal benefit, they seem to conceptualize this societal benefit differently. To interviewed researchers, this benefit would accrue from safeguarding the ecological environment. To officials, social benefit would come from the economic, yet sustainable, exploitation of marine resources. Both perceptions are complementary in an IEA process, but our results reinforce the importance of harmonizing concepts, goals and expectations from all actors involved.

The meaning given to IEA

To our interviewees, which all participate in the All-Atlantic Ocean Research Alliance, IEAs tend to be seen more as Integrated Assessments of Human Threats. Consequently, interviewees reflected a utilitarian view of the ocean, whereby humans act as engineers of nature, with the power to both disturb and manage it. This finding aligns with the ideas of human dominance and ownership over nature, with a resulting responsibility over our actions (Ludwig *et al.*, 2021). The improved understanding of the natural events of the marine environment come as a second goal, as a means to identify a feasible level of human exploitation of the marine

environment. According to this perspective, the IEA process would prioritize the assessment of ecosystem components linked to service provision to humans.

Throughout the interviews, these individuals have challenged presupposed concepts, such as “ecosystem”, stating that these mean different things to different stakeholders. To the interviewed government officials, IEA seeks to find sustainable, but also profitable ways of leveraging ecosystem services for societal benefit. In this case, ecosystems are manageable. To researchers, what is manageable in fact is human activity, not ecosystems and their services. Thus, these conflicting perceptions will probably impact communication throughout the IEA process when bridging communities that have different understandings of ecosystems and IEA. There is a need to make sure that all participants engaged in an IEA have a common understanding of the adopted IEA concepts and what is reasonable to achieve from the IEA.

The importance of the scoping phase

As our interviews have indicated, combining government officials and scientists is not a usual, easy task. Both communities value IEAs differently and communication needs to be secured in order to properly address each groups’ concerns. For this dialogue to occur, all relevant stakeholders need to be engaged and participating in the IEA process, otherwise the whole IEA process runs the risk of resulting in an exclusively academic activity. In the IEA process (Figure 1), the scoping phase is a determinant step to properly identify and engage the most relevant actors. In this phase, participants engage in negotiations about the scope, the target, the scale and all necessary steps to be done in an IEA. Similar to most negotiations, stakeholders’ interests and expectations can clash and create conflicts that can put in risk the whole IEA process (Furnham & Boo, 2011). It is therefore essential to identify these conflicts and make sure that relevant evidence is generated by the IEA and expectations are equally shared amongst those involved.

Best practices for cross disciplinary stakeholder inclusion (e.g., Land *et al.*, 2017; Oates & Dodds, 2017; Ostrom, 2014) should be applied during the scoping phase of the IEA process. Although these best practices for stakeholder inclusion are well established (e.g. Ostrom et al 2014) many stakeholders expressed frustration concerning the lack of inclusivity in the scoping phase of IEA.

The scoping phase of the IEA needs thus to be a safe, open and committed space by which the inherent limits of the proposed assessment are disclaimed and dealt with, transparently. We advocate that neutral, professional mediators should be involved in the scoping phase of any IEA, using exercises for enhanced trust-building and dialogue, so participants would feel safe in sharing perspectives.

Transdisciplinarity as a principle for IEA

Many interviewees highlighted the importance of transdisciplinary science (as described in Jahn, Bergmann, & Keil, 2012) to the success of IEAs. Many transdisciplinary research efforts fail to secure the sufficiently balanced participation from the various disciplines and stakeholders (Kelly *et al.*, 2019). This weakens the potential for research to address the social, environmental and economic aspects of sustainability challenges that must be addressed by IEAs. In addition, navigating transdisciplinarity across scientific disciplines is not enough to a few interviewees. In their view, integration in IEA should embed all available knowledge sources, including the outcomes of international reports such as the Sustainable Development Goals and the World Ocean Assessment (United Nations, 2021). Transdisciplinarity in IEA should not be constructed as an exclusive endeavor of scientists and government officials, but rather welcome other ways of knowing. Such inclusivity is supported by scholarship (e.g., Fischer *et al.*, 2022; Wisz *et al.*, 2020).

What “Integrated” means in the IEA

This feature was highlighted several times, in particular among the interviewed government officials. In these official’s perspectives, IEA should go beyond integrating knowledge of the marine environment. To them, IEAs would be one component of a much broader system that includes production, distribution and other economic value chains of marine resources. Such a “system of systems” would enhance economic profit at the lowest environmental cost. According to this perspective, IEAs should provide sufficient information about the environmental components affecting resource exploitation, so this information could be integrated to other assessments, such as those that are more economic-oriented. Following this line of thought, IEAs would serve the market, that is, contradictory to the view that IEA findings are intended to lead the market to adapt to ocean thresholds (Rockström *et al.*, 2009). Therefore, among the Atlantic stakeholders we interviewed, IEA may be perceived as tool for finding solutions that maximize profit, while minimizing loss to environmental health. The question remains on how to define which level of loss of environmental health would be acceptable, or how to refrain economic activities to allow ecosystem recovery in the IEA process (Martin, Maris, & Simberloff, 2016; UNEP, 2021).

Decolonizing IEAs

Post-colonial theory is an interesting perspective to discuss these results. Post-colonialism assumes a western dominance in shaping a value system by which we make sense of reality (Césaire, 1955; Harding, 2011; Said, 1978). Post-colonialism

explains, for example, how we came to perceive natural resources as inexhaustible. This perception of nature as a cornucopia partially derives from the notion that colonies were abundant in resources and were to be explored in exhaustion without much consequences since the environment would be resilient enough to serve the crown (Fanon, 1965). Thus, Post-colonial theory provides an interesting approach to unveil the basis of the western value system when it comes to face the challenges of developing a sustainable future and to redesign our very own relationship with nature, core to IEA.

When we position nature as a separate entity to humans, we adopt a binary logic that triggers issues of superiority and dominance. Humans, in this view, are superior to nature since we are capable of managing it, as our interviewees, particularly government officials, seemed to perceive. According to our interviews, IEA is perceived as a tool to assess how humans can leverage the provision of services and goods from the ocean while keeping it in a sufficiently good environmental status. Decolonizing IEAs would require that stakeholders see themselves as just another part of the natural world, and not a steward separate from it.

IEA depends on successful participatory approaches, and must be decolonized to have legitimacy. Principles of environment justice and equity should be front and center in international IEAs (Bennett, 2022). This should include the identification, engagement and empowerment of minorities and disadvantaged groups among the stakeholders to be voiced and equitably represented when designing IEAs.

International IEAs and Ocean Science Diplomacy

Interviewees did not explicitly refer to international IEAs in their responses. However, the broader interview was conducted in such a context and international elements seem to be important in the case of IEAs in the Atlantic. Interviewees expressed the ambition of promoting dialogue among communities and engaging these voices in the IEA process. In addition, the interests of the private sector, of social actors and other stakeholders not focused by this study can trigger conflicts with negative impacts to the IEA process. Therefore, we find the framework provided by science diplomacy to be relevant to discuss international IEAs.

Transboundary marine IEAs, as those conducted under the Mission Atlantic project, are complex due to the potential for conflict between different national interests at play, generally dealt with by diplomacy. Diplomatic environmental negotiations are highly supported by scientific findings as science provides information on the state of the marine environment, on the human threats and on options to manage such threats (Holford & Nichols, 2017).

As suggested by interviewees, IEAs should be integrated with other marine management frameworks, such as area-based management initiatives like Marine

Spatial Planning and coastal zoning. The IEA process holds similarities with these area-based management tools, particularly regarding participation and collective decision-making. Power struggles have been reported to be critical to marine spatial planning (Ramírez-Monsalve & van Tatenhove, 2020). Therefore, one could expect a similar context in an IEA where acknowledging and managing power conflicts become paramount.

Ocean science diplomacy (Polejack, 2021) can provide a framework to study the multi-actor dynamics of those engaged in international IEAs. It provides a new perspective on the power play underlying the negotiations of international IEAs. Through ocean science diplomacy, regulatory frameworks, such as international legal regimes or States' practices, can be better addressed in an IEA. Apart from producing the relevant scientific evidence in an IEA, there is also the issue of communicating this evidence so it impacts the policy formulation. Once again, ocean science diplomacy adheres to the objectives of transboundary IEAs by combining elements of international relations scholarship with political sciences and science and technology studies. Lastly, international IEAs could be enhanced by including the training and expertise of diplomats, in particular negotiation and mediation techniques, which also falls into the scope of ocean science diplomacy.

CONCLUSIONS

This paper analyzes the perceptions of government officials and scientists on the meaning of Integrated Ecosystem Assessments (IEA) in the context of the All-Atlantic Ocean Research Alliance. Most of the interviewees stated not having had previous experience with IEAs, and being generally unaware of IEAs concepts and process. However, this lack of understanding of IEA was no obstacle to them to elaborate on what IEA is and how it should proceed. According to their perceptions, the main goal of IEA is to co-produce knowledge about the management of human threats to the marine environment. According to this view, humans are separate from the marine environment, with the power to both disturb and manage it. The scientists and government officials we interviewed had distinct views of IEAs. Scientists reflected on the complexities of assessing integrated ecosystems and rarely placed economic benefit as a priority. Officials perceived IEA as the environmental component of a broader system that aimed to maximize economic profit while minimizing environmental risk. We question who can determine what an acceptable level of environmental risk would be in the Atlantic. From our research, we can make the following recommendations, in particular for transboundary marine IEAs. We advocate that the scoping phase of an IEA is of critical importance. It is during the scoping phase that stakeholders are identified and engaged. With their involvement, there is a need to make their interests visible and respected. During

the scoping phase, a safe and open space needs to be secured, so these interests can be negotiated and mutual understanding on concepts, roles in the process and the possible outcomes are achieved. We acknowledge the limitations of this study, particularly regarding the profile of our interviewees, most of which are not IEA experts. Nonetheless, the government officials and researchers we interviewed showed preconceived assumptions of the IEA process that highlight the importance of communicating and agreeing upon IEA concepts between all participants as a top priority.

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DISCLAIMER

This paper reflects only the authors' views. The Ministry of Science, Technology, and Innovations is not responsible for any use that may be made of the information it contains.

AUTHOR CONTRIBUTION

Conception: AP. Design: all authors. Data collection, analysis, and first draft: AP. All authors contributed equally to the development of the manuscript and agreed with its submission.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Coloniality in Science Diplomacy – evidence from the Atlantic Ocean

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ABSTRACT

Ocean science diplomacy stands for the social phenomena resulting from the interaction of science and diplomacy in ocean affairs. It includes, inter alia, the provision of scientific evidence in support of international decision-making, the building of alliances through scientific cooperation and the enhancement of international collaborative research about the ocean. Despite this general conceptualization, there is a need to understand what sense practitioners in the field make of ocean science diplomacy. This paper reports on perceptions of ocean science diplomacy collected through twenty in-depth interviews with government officials and researchers active in the setup and implementation of the All-Atlantic Ocean Research Alliance, both from the South and North Atlantic. Interviewees overall perception is that ocean science diplomacy is a positive and critically important phenomenon that combines the best of science and diplomacy. However, results show that these practitioners perceive ocean science diplomacy differently, resulting in a polarization of power in two ways: between science and policy, and between South and North Atlantic realities. Scientists have reported feeling suspicious of the policy making processes, while officials portray science as

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unaccountable and segregated from policy. South Atlantic interviewees have expressed concern over their limited access to research, but at the same time seem more welcoming to the scientific evidence presented by scientists. Northern interviewees, with reported enhanced research capabilities, seem more inclined to search for the scientific evidence that supports national political goals. The South-North Atlantic relationships seems to be based on preconceived perceptions of the other. Northern subjects make sense of their Southern peers as those in need of assistance, while Southern interviewees claimed being unheard and victim of tokenism. I discuss these findings in light of postcolonial and decolonial theories, advocating for the need to decolonize ocean science diplomacy in the Atlantic Ocean if we are to achieve its alluded benefits.

KEYWORDS

Coloniality of power, decolonialism, postcolonialism, international relations, political sciences

INTRODUCTION

Science diplomacy analyses the interplay between knowledge development and political contexts in which research and international affairs interrelate, from international evidence-based negotiations to building uncontentious partnerships (Davis & Patman 2015). Science diplomacy has been recognized as a long-lasting practice in bridging countries even in face of conflicts elsewhere (Turekian *et al.*, 2015), although overlooked by orthodox International Relations scholarship (Kaltofen & Acuto 2018). Finding its grounds on the universality of science and its progressive influence over diplomatic negotiations (Skolnikoff 1993), science diplomacy is particularly mainstreamed by the policy world as a practice to our collective benefit (Ruffini, 2020b; Rungius & Flink, 2020). In turn, academia is interested in understanding what are the drivers of science diplomacy practices, including foreign policy interests, industrial competition, and the use of science as a form of power between countries (e.g, Flink, 2020, 2021; Ruffini, 2020a; Rungius & Flink, 2020). Despite these attempts to unveil the policy push over science, some academics still ascertain science diplomacy to be grounded in the neutrality of science as a benefit to diplomacy (Domingues & Ribeiro Neto, 2018; Turekian, 2018). Empirical evidence on the drivers and interests that fuel science diplomacy is needed (Flink 2021), and even more so on South-North science diplomacy phenomena (Soler 2021), where the colonial historical bounds cannot be neglected. The Atlantic Ocean plays a key role in this regard, centrally connecting countries from South and North while being the main stage for historical colonization (Games

2006). In face of the call for further empirical evidence on science diplomacy, this inductive research assessed the meanings and values that Northern and Southern practitioners use to engage in ocean science diplomacy. As this research analyzed agent's perceptions as they were presented, postcolonial and decolonial theories were considered appropriate to discuss findings.

This article makes reference to South and North Atlantic as given geographies which are separated by the Equator, with each reaching both polar seas: the Southern Ocean in the South and the Arctic Ocean in the North (Talley *et al.* 2011). At times, this paper also makes reference to the dichotomy Global North - Global South. In the context of the Atlantic Ocean, Global North refers to the wealthier countries of North America and Europe and Global South the less privileged countries in Latin America, in Africa and in the Caribbean. It is acknowledged that Global North and South are contested terms that suggest an oversimplification of a group of very distinct countries (Tripathi 2021). However, I opt to use them in detriment to other grouping terms that denote a sense of subalternity, such as developing and Third World countries (Haug *et al.* 2021; Khan *et al.* 2022). What the terms Global North and Global South capture is the core-periphery relations that sustain most of the inequalities in terms of science and diplomacy capabilities of countries in the Atlantic. It is also acknowledged that this binary logic invites a sense of opposition and conflict (Chimakonam 2019), but my goal in using such terms is to highlight the structural differences that do exist between these groups of countries, which can result from the historical colonization and subsequent Western dominance over Southern epistemes (Kloß 2017; Santos 2019), that still today benefits the privileged countries in Europe and North America (Carchedi & Roberts 2021).

Ocean Science Diplomacy

The ocean, as a life-supporting system under serious environmental threats, is subject to international law and governance, where conflict is the rule and not the exception (Ranganathan 2020; Robinson 2020a). The ocean, more specifically the high seas and the seabed, is considered a global commons. Global commons are spaces and resources that lie beyond the sovereignty of countries, whose management becomes a matter of global public interest, greatly informed by science (Vogler 2012). Large ocean areas (particularly in the South Atlantic and South Pacific) are still deficient of scientific knowledge that would allow better informed international decision making (IOC-UNESCO 2020). Consequently, international scientific cooperation, facilitated by diplomacy, is deemed necessary to overcome the existing bottlenecks in our knowledge about the ocean. As science and technology become important drivers in ocean diplomatic negotiations (Robinson 2020b), science diplomacy stands out as a structural phenomenon in global ocean affairs (Polejack 2021). Distinct to a land-based science diplomacy, ocean science

diplomacy is fluid and complex. It is constantly challenged by the very fragmented and yet unresolved international ocean regime where science has ever been critical (Ranganathan 2020; Robinson 2020b). Moreover, the discrepancies between countries, particularly regarding technological capabilities, imposes questions of which countries are able to explore and manage the ocean as a global commons, possibly reflecting colonial dimensions in ocean diplomacy (Ranganathan 2016).

Colonialism and the Atlantic Ocean

The Atlantic Ocean stands out as an interesting case to study ocean science diplomacy. Historically, the Atlantic has been the main stage for colonization and imperial expansion (Games 2006). Colonialism was responsible for the wealth that European empires enjoyed from exploring Atlantic colonies (Mignolo 1995). In this work, ‘colonialism’ stands for the historical European political project to invade, settle, explore and control non-European geographies for the benefit of the empires (Kohn & Reddy 2022). Colonialism was possible due to the technological advancements in navigation, intensified in the sixteenth century with the Atlantic Ocean at the heart of the matter (Kohn & Reddy 2022). Apart from exploring natural resources, colonialism systematically selected what was considered beneficial to the wealth of the crown, expropriating local knowledge, specially about the local natural environment, and repressing those that were considered unfit (Quijano 2007). Consequently, colonialism established a relationship between the settlers and the colony based on dominance. Scholars argue that the colonialization of what today is termed as Latin America facilitated the creation of Europe as a socially and politically constructed identity, where the European would be the civilized and superior to the colonized, who were perceived as the savage deprived of civility and enlightenment (Quijano 2007). The differences in the physical traits of the colonized and the settler have possibly nurtured the notion of race as a social classification, placing non-Europeans as the inferior other (Harding 2008; Said 1978). As a result, these relations of superiority and inferiority legitimized dominance and permitted the Eurocentric perspective to be the standard of civility and scientific epistemology (Quijano 2000). The historical and political colonialism (and its subsequent Eurocentrism) is relevant to understand the modern international relations between former colonies and empires in the Atlantic (Alejandro 2018), and hence composes the backstage of this research.

Coloniality

It could be said that colonialism saw its epilogue with the political independency of colonies. However, this Eurocentrism has continued to rank and segregate humanity in terms of class, gender and race (Mignolo 2009). Postcolonial theory postulates

that the modern social fabric cannot be understood without acknowledging this ‘colonial wound’ (Losurdo 2020; de Sousa Santos 2009; Spivak 2010). Decolonial scholars attribute this persistent legacy of colonialism to be a redesign of power relations and dominance in modern international relations, termed as coloniality of power (Mignolo 2007; Quijano 2000). Coloniality then represents the new colonial project, referring to the social, economical and political consequences of historical colonialism that gives the backbone for the core-periphery relationships today (Mignolo 2009). Coloniality can also provide an explanation to how resources still flow from peripheric (and semi-peripheric) countries to enrich core countries, as addressed by dependency theorists (Furtado 2020). In this sense, colonialism would be a social formation, while coloniality a “political and symbolic condition” (Lissovoy & Bailón 2019).

Coloniality and science

Science and technology are intrinsic parts of historical colonialism and current coloniality. During colonization, the access to biodiversity, minerals and also cultural heritage was of interest to European empires. This exploitation and expropriation accounted for the enhancement of science, with Europe as the detainer of scientific knowledge and wisdom (Collyer *et al.* 2019 p. 8). Far from being only a historical fact, still today the consequences of colonialism impacts science. For example, historical colonialism allied to current coloniality produce and maintain an imbalanced paleontology, due to the concentration of fossil data in Northern countries (Raja *et al.* 2021). Humanity’s ignorance about the marine biodiversity that occurs in areas beyond jurisdictions is impacted by coloniality, with diplomacy maneuvering legal principles (such as the common heritage of (hu)mankind) to defend economic interests that profit from inequalities (Vadrot *et al.* 2021). Coloniality also prevents Southern researchers to access science infrastructure (Polejack & Coelho 2021), which makes them invisible to their Northern peers (Gomez *et al.* 2022) and subject to what has been referred to as “parachute science” (Vos & Schwartz 2022). Coloniality can also explain certain trends in science cooperation between core and periphery, where historical colonial bounds and subsequent language similarities could promote biased research networks, with South-South cooperation being still incipient (Leydesdorff *et al.* 2013). Therefore, in order to understand how ocean science diplomacy takes form in the Atlantic region, it is necessary to comprehend the historical colonial ties together with the modern international relations that exist between Northern and Southern countries. North-South relationships have persisted over time, with science playing an important role in advancing geopolitical claims in the Atlantic (Blair 2019).

Case study: the All-Atlantic Ocean Research Alliance

This study focuses on a specific science diplomacy arrangement in the Atlantic Ocean: the All-Atlantic Ocean Research Alliance, a North-South ocean science diplomacy framework (Polejack *et al.* 2021).

The All-Atlantic Ocean Research Alliance (hereafter the Alliance) was created through a set of successive international ocean science cooperative arrangements bridging countries from the North (Canada, United States and the European Union) and the South Atlantic (Argentina, Brazil, Cape Verde, Morocco and South Africa). The countries involved in the creation of the Alliance agreed upon research priorities and the alignment of resources, much of which attained national interests, becoming a petri dish case study for exploring the realpolitik of ocean science diplomacy in action (Polejack *et al.* 2021). This research drew from this Alliance to engage with practitioners of science diplomacy in the Atlantic, as to collect their perceptions of ocean science diplomacy. By establishing what ocean science diplomacy means, these science diplomats (as the practitioners of science diplomacy, according to Melchor 2020) define the values of engaging in such practices, influencing the agenda-setting, the allocation of funds and the overall meaning of science diplomacy in the Atlantic Ocean region, driving foreign policies and research efforts in one direction or another.

Results suggest the existence of a polarization of power in the Atlantic Ocean science diplomacy framework in two ways: 1. a clash between science and policy, and 2. Differentiated meanings and engagement between North and South Atlantic. Since calm waters do not make a good sailor, it is time to acknowledge this power play among stakeholders and countries in the region if we are to achieve, in ten-years time, the “Science We Need for the Ocean We Want”, as predicted by the UN Decade of Ocean Science for Sustainable Development (Ryabinin *et al.* 2019).

METHODS

This research assessed individual perceptions of ocean science diplomacy from South and North Atlantic government officials and researchers, active in the setup and implementation of the All-Atlantic Ocean Research Alliance. Perception is a sensorial information process which, determined by past experiences, enables an individual to create a lens in which to view and signify the world through a filter of sociocultural influences (McDonald 2011). In assessing these individuals’ perceptions, the meaning each of them make of ocean science diplomacy is being revealed, and at the same time their positionality is being exposed. Positionality “describes how an individual’s perspective is shaped by their social position, including class, gender and sexuality, racial identity, and other determinants of

social privilege” (Polk & Diver 2020). The sample was composed of high-level decision-makers (13 individuals) and research leaders (07 individuals) coming from Argentina, Brazil, Canada, France, Germany, Portugal, Spain, South Africa, the USA, and the European Commission. High-level decision-makers are government officials who occupy high hierarchical positions in national ocean-related science systems, including Science and Technology State Secretaries and Minister, directors, head of departments, science managers, and diplomats. Research leaders are those who have extensive experience in international scientific cooperation by coordinating large-scale research projects and scientific programs but are also involved in the provision of scientific information to political decision-making.

The identification and selection of these interviewees was done on the basis of their professional positions, but also leveraging from the author’s prior engagement with them as a former negotiator of the Alliance on behalf of Brazil. All interviews were done by the author. On one hand, the previous interaction between the author and the interviewees might have improved trust-building and consequently facilitated openness and sincerity when answering the questions. On the other, it also exposes the author’s positionality. The author is self-identified as a Southern male with a background in natural science and proactively engaged with the All-Atlantic Ocean Research Alliance and other international fora (generally related to ocean sciences). With over 20 years of activity in the field, mainly as a government official in Brazil and a practitioner of ocean science diplomacy, the author can be considered as an insider researcher (Merriam *et al.* 2001). Consequently, the author’s positionality matters for it exposes the background through which this analysis was done.

Semi-structured interviews (Bryman 2012) were done in presence (12 interviews), during the All-Atlantic Forum² (Brussels, February 2020), as well as online (08 interviews), due to the COVID-19 travel restrictions, from April to October 2020. Interviews were composed of a set of six questions, from which three were common to all interviewees, while the remaining were specific to researchers or to government officials (Table 1).

² <https://allatlanticocean.org/view/atlanticforums/2020-brussels>, accessed in Nov.18, 2021

Table 1: Interview questions.

| GENERAL SET OF QUESTIONS | |
|--|--|
| 1. Can you tell me a bit about yourself? Background, age, experience...? | |
| 2. Tell me about Science Diplomacy, what is it to you? | |
| 3. In this context, please let me know how useful Science Diplomacy could be? | |
| QUESTIONS TO SCIENTISTS ONLY | QUESTIONS TO GOVERNMENT OFFICIALS ONLY |
| 4. Let's say you hold an important result that could help authorities to deal with a problem, what would you do? | 4. Please share how you use scientific information in your work. How to access, apply? |
| 5. Tell me how you feel about your participation in negotiations (national or international). | 5. Tell me your perception of how negotiations take scientific information (first nationally, then internationally). |
| 6. Would you have any insights on how this picture could look better? | 6. Any final recommendations on how to improve this? |

Interviews were conducted both in English and in Portuguese and were fully transcribed in their original language. Translation from Portuguese to English was only done when presenting extracts in this paper, which are shown between brackets and in italic. Interviewees are anonymized and their names replaced by corresponding gendered names inspired by the Orixas (Rosario 2014), a mythological pantheon of African gods which illustrates one of the many African cultural heritage introduced by cross-Atlantic colonial slavery in South America.

Transcripts were analyzed with the software MAXQDA Plus 2020 (Release 20.4.1) and codes were assigned to text extracts. Codes were generated by the author in accordance with grounded theory (Bryman 2012), meaning that no pre-established codes were used. Coding was revised multiple times. These revisions included reassessing transcripts and the audio of the interviews in full, assigning codes relevant to capture the main ideas expressed by interviewees. The same text (or parts of it) could have been assigned to multiple codes. Revisions were considered fulfilled when coded segments did not require further reassignments. The full list of generated codes can be found as supplementary material³. Codes were clustered in themes, as per a thematic analysis (Braun & Clarke 2006). Themes were also revised multiple times. Revision of themes was carried out by clustering all the coded segments under each thematic category (irrespective of the interviewee or the order in which the element was transmitted) until no further rearrangement was necessary and the placement of codes under each theme was considered exhausted.

Thematic analysis was chosen (Braun & Clarke 2006) because it allows the identification and organization of patterns of meaning, suitable to identify these individual's perceptions and values in engaging in ocean science diplomacy

³ For reviewing purposes, the list of codes is included in this file as an appendix, as requested by one reviewer.

practices, irrespective of the sample size. Thematic analysis, however, is limited to collect *what* was said, rather than *how* interviewees say it, which also limits the scope of the discussed results. Moreover, positionality is very influential in thematic analysis for it is the researcher who assigns codes and organize themes, which naturally denote her/his standpoint, grounded on issues of gender, class, race, and social realities (Braun & Clarke 2013 pp. 174–83). In spite of such limitations, this method was suited to collect the necessary understanding of what agents in the Atlantic context mean by engaging in science diplomacy practices. Therefore, the themes generated by this research are presented as subheadings of the Results section below and include: 1. Ocean science diplomacy perceived as beneficial, 2. Perceptions about the role of science and diplomacy, 3. How scientists feel about diplomacy and policy, 4. How policy-makers feel about science, 5. Different science diplomacies in North and South Atlantic, and 6. Perceptions of coloniality.

RESULTS

Figure 1 illustrates a dive into the ocean, showing exemplary quotes from the interviews that reflect the themes addressed in this section. This dive starts at the surface, where the best of science meets the best of diplomacy, for our collective benefit. In shallow waters, conflicting issues between the principles of science and policy start to become evident. Diving deeper, individual positionalities in terms of those from the Global South and those from the Global North diverge, particularly on the motivations to engage in practices of science diplomacy. At this stage, issues related to differences in scientific capabilities and advisory schemes are frequent. At the bottom, the different meanings and values attributed to ocean science diplomacy by this particular set of individuals seem to point to matters of coloniality.



Figure 1: Visual graphic on the results shown in this paper ranging from a beneficial ocean science diplomacy in the surface to matters of coloniality in the bottom. Quotes represent exact extracts of interviews conducted in this research.

1. Ocean science diplomacy perceived as positive

In general, individuals expressed unfamiliarity with the current academic conceptualization of science diplomacy (e.g. Gluckman *et al.*, 2018; The Royal Society & AAAS, 2010). In spite of this alleged unawareness, interviewees have expressed perceptions of science diplomacy that goes in line with the general common sense frequently found in the academic literature (e.g. Fedoroff 2009; Turekian *et al.* 2015). This common sense of science diplomacy includes the benefits accruing from using science to peacefully bridge countries and communities around shared goals, achieved by exercises of trust-building and generally based on the goodwill of those engaged to overcome global challenges (Skolnikoff 1993).

“Science diplomacy is about building the relationships. It's building the trust but it's also building the sense that we are all working towards a common good” (Omin, South, Government official).

To interviewees, ocean science diplomacy is an unavoidable reality.

“It's not because it's beautiful, it's because we actually achieve a greater impact through international cooperation than individually” (Xango, South, Government official).

“Science diplomacy is moving from being a very welcome and easy optional extra to becoming a critical part of how we are collectively going to solve problems” (Oxossi, North, Government official).

“Science diplomacy is really central to a lot of politics around the world” (Exu, South, Government official)

Science diplomacy would have the power to overcome existing political constraints between countries.

“Commitments were made to say, okay fine, we have to be able to utilize the ocean for common needs. So that create issues... Currently science is pushing towards [the motto of] forget our differences” (Exu, South, Government official).

“Science diplomacy seems to be that continuous steady point of engagement that surrounds so many different subjects, but it's a core of goodwill between countries that may be choosing to disagree about matters elsewhere” (Ere, North, Government official).

2. Perceptions about the role of science and diplomacy

Frequently, the general perception of science diplomacy as a powerful tool to build alliances and overcome political sensibilities was based on assumed characteristics of the practice of science. For example, one Southern government official believes that the internationalization of science gives the foundations of this dialogue between science and diplomacy.

“You cannot practice science without doing it in an international context and therefore diplomacy automatically becomes part of it. It's an unavoidable consequence” (Ibeji, South, Government official).

In addition, science has been attributed as a source of truth, a safe port to be called.

“When you enter the policy debate, it's really easy to go down a slippery slope of being seen as an advocate for a particular position because of some reason other than the science. Whereas if you stay solid as a science voice, I think then the science community can routinely be that repository of truths that people can go to” (Ere, North, Government official).

Science has also been portrayed as a driver of political decision-making.

“Politics don't matter if the science is important. Sometimes you can get a lot done if the scientists go first, and the politics will follow. Not always, but...” (Odoya, North, researcher).

These views seem to translate a feeling of trustworthiness in science, of a science that is naturally open, uncontested, apolitical, and internationally cooperative. Ocean science diplomacy would then profit from these perceived characteristics of science to influence diplomatic decisions. As pointed out by one government official, science can be an inescapable force in diplomatic negotiations that are informed by scientific evidence:

“in international negotiations, I would presume it's very difficult to avoid the scientific evidence without having to walk away from that negotiation process, in the way that we know has happened in the climate change negotiations, for example” (Ibeji, South, Government official).

One Northern government official portrayed science as also determinant for economic development and social wellbeing.

“Our assumptions in terms of how we build our economy, how we ensure the people have the security and prosperity that they need and the values that they can pursue.... We are now bound to what science has produced for the first time” (Oxossi, North, Government official).

Traditional diplomacy has been portrayed as limited and in need of the help of science.

“Diplomacy can effectively solve problems. There are other issues where diplomacy is not enough, the intervention of knowledge is necessary. And especially when diplomatic relations, for many social, economic, political reasons, are complicated and serious, it must be scientists who help” (Kao, North, Government official).

3. How scientists feel about diplomacy and policy

Although interviewees attributed to science a power of influence in diplomacy, scientists have expressed multiple feelings when engaging with diplomacy and general decision-making processes. Such feelings included:

Pride:

“How did I feel about my participation? I feel great. And I think that we helped move the needle but, as you know, it's a pretty slow process. It takes a lot of perseverance” (Yemanja, North, researcher).

Frustration:

“[I feel] sometimes a little frustrated, especially in the CBD, I was really frustrated because it was an ordinance that had no justification and it fell. This is sometimes very demotivating.” (Oya, North, researcher).

Limited agency:

“I feel the ball is on the other side, on the people that take the decisions at a different level, completely different to what I do. I'm a scientist, just a scientist” (Eparrei, South, researcher).

Suspicion:

“You just happen to be a good case to get something through that you wouldn't even subscribe if you knew what it was, right? So I feel we shouldn't be seen as being part of that particular process, but we should be ready to inform those who are in that game” (Iorimar, North, researcher).

Misuse:

“Often it's not that obvious that something is scientific. Sometimes it's really about urgency, about politics. But you always have to justify it in a scientific way...” (Oya, North, researcher).

Precaution:

“I always personally felt a real sense of responsibility. I felt like I had to be really careful about what I was saying and doing. I tried to make it clear there was a whole bunch we didn't know, so that they weren't somehow confused and think that I knew, that we knew, as scientists, everything” (Oxala, North, researcher).

Estrangement:

“I always wondered why the hell are scientists there because you sort of get in the way of the diplomats trying to do the job that they're supposed to be doing” (Iorimar, North, researcher).

“for me, that was very impressive because I was never really close to that world and then you can see how it is so dynamic and you have to get adjusted and accustomed to that truth, to be able to do the best of your help” (Eparrei, South, researcher).

4. How policy-makers feel about science

The relationship of science with society was frequently raised by officials. Officials tended to perceive science to be apart from socio-political realities and closed in itself.

“We’re not doing science for science's sake. We are trying to bring scientists, who only think about science excellence, to go beyond that. (...) How do we bring in the users of the science who are affected by these challenges right at the beginning of defining what needs to be done? And in so doing we are beginning to create a new paradigm that it's not just scientists influencing science diplomacy” (Alafim, South, Government official).

Another interesting perception of science was highlighted by one official who seemed to call for a more socially engaging science, but recognizing boundaries to the agency of scientists in the “big political games”:

“Even though scientists very often stay in their labs, they give an example in the universities, they give an example to their students, to the PHD candidates, they give an example to society. (...) Of course, we cannot enter into the big political games, which are of a totally different nature.” (Saluba, North, Government official).

According to another official, science is not accountable in the policy sphere and scientists need to build a consciousness of their expanded role in delivering answers to society, as potential leaders of future transitions:

“Science is not a very accountable area. It's accountable to the scientific community, but not to the rest in the same way. But in this context is quite different because now science actually has to lead and science has to be very conscious of the fact that the community of practice involved in science diplomacy is no longer the scientists. Is the people who need science to deliver answers, solutions, directions, transitions” (Oxossi, North, Government official).

One issue of importance in the relationship of science and other sectors was communication.

“This is also a scientist's duty, a diplomat's duty, to always explain what scientific findings are, what are the impacts of it, to make it into an easy language for the population to understand” (Xango, South, Government official).

“Public opinion-making, storytelling is very often also linked to how can we manage to couple that with the scientific evidence, so that it catches really the attention of the opinion-makers, slash, of the politicians” (Saluba, North, Government official).

Hitherto, perceptions have positioned science as a powerful influence over diplomacy, but with limited participation in decision-making processes. Both

officials and scientists recognize a need for better coordination. On one hand, interviewed scientists not always feel comfortable when engaging with policy-making. On the other, government interviewees tend to perceive science as a source of truth, but apart from socio-political realities. As yet, perceptions seem to position science as a key element to lead social transformation and aid diplomacy, but concurrently challenge it on becoming more accessible and accountable.

5. Different science diplomacies in North and South Atlantic

Southern and Northern interviewees have expressed different departing points when engaging in ocean science diplomacy frameworks. To Southern interviewees, issues of research funding and scientific capabilities were central.

“We have different challenges, where quite a number of countries do not even have research vessels. So, how can they contribute? How can they participate in such a venture? Some of them are lined on European vessels and come along but then they are unable to design their own agenda” (Exu, South, Government official).

“I think it goes back to the point that we don't have the resources to do things alone, to address these various issues. So collaboration, whether it's in the area of oceans, or a very good example right now is the issue of COVID, where we're seeing science diplomacy being used to leverage various countries' expertise, experiences” (Omin, South, Government official).

Not only the capacity to develop research was brought upfront. The fashion by which government officials access science to inform decision making also differed. For example, while one Northern official states:

“I have technically limitless access to the available science information in that we are an organization that has very sophisticated technocratic processes to extract knowledge from projects, convene scientific experts to pre-digest results and give us some pre-digested analysis” (Oxossi, North, Government official)

A similar official in the South recognizes the challenges they face in providing scientific evidence to decision making:

“[country A] is probably in a fortunate position where we do have science advisors at different levels. That may not be the case for many other countries” (Omin, South, Government official).

With the expressed differences in the capacity to foster research and to access research findings to inform diplomacy, differences on the use of the available scientific evidence were also noted. Northern officials seem to search for the scientific evidence that can support political claims:

“We just recently, for example, reframed our [document] and that means that we will not simply pursue that and all the policies around us including science within [country B], but we will support and pursue and imbue all of our diplomacy around the world with a view to working with other countries also to attain that goal because it is a global goal, but it's also now.... it is a geopolitical interest of the [country B] to do that. So the diplomacy will use Science to attain that end.” (Oxossi, North, Government official).

“As we prepare a policy statement or a position, does the science back this up? What's the science behind it that would lead us to be able to comfortably say that's our position and this is why” (Ogum, North, Government official).

Southern officials tend to listen to scientists before formulating a political statement:

“The [National] Academy [of Science] actually has a series of experts that are members in different areas and also work closely with the government. Well, not as in we'll provide you with what you want to hear but using the science that's out there in terms of reports, in terms of what is happening globally, where the science is going” (Omin, South, Government official).

One Southern government official voiced concerns on the political use of the scientific evidence in diplomatic negotiations:

“This thing of science being neutral is bullshit. Of course, it's less political, but it is political. If you have more people, who go to meetings, who finance studies, how is this financing done... We are not silly. When you don't have your own people on a scientific committee, you don't trust in it. But you start to get lost too” (Oxum, South, Government official).

This same official provided an example on how impactful this influence of science can be to Global South foreign policies:

“It's like the tuna quotas, right? If you divide the high seas today and say: so for now, whoever has the technology to do this will start, then you can never play again. And turns into this awful quota, that if you didn't fish 70 years ago, you don't get a quota for anything today” (Oxum, South, Government official).

And ends with this strong quote:

“I, from a developing country, am very afraid of what this might mean for our ambitions for the future” (Oxum, South, Government official).

6. Perceptions of coloniality

Although the term “coloniality” was not used by interviewees, issues related to the differences between North and South were frequent, denoting how instrumental coloniality seems to be to the North-South science diplomacy. According to one Northern researcher, North-South differences can be explained on the basis of how the world operates:

“I think we have too much structure, old structure and too much naivety and particularly when you consider how we need to pull this outside of the Northern Hemisphere kind of top down approach, which still is quite present in the way in which science operates, the way in which the world operates. I'm giving a talk next week, and I'm showing different maps of the world to try to illustrate the idea that even just mapping the world influences how we think about it. And you have the different projections, and then a globe itself. If you just take whatever projection you like and flip it upside down and put the North Pole in the bottom of the map, it looks completely different. It doesn't look like our planet at all to me when I look at that and the oceans look very different, the way in which they connect. And so, we're all of us trapped in these old ways of seeing the planet itself and our various woos and, you know, I always look at the globe and I think yeah [Country C] is on top” (Oxala, North, researcher).

Away from the generic initial statement of producing a “*common global purpose*” (Jetrue, North, researcher), the structural inequalities in the Atlantic produce distinct realities to those doing and managing ocean science. For example, a Northern researcher expressed:

“we are all about -we need to understand the ocean, so we get better decisions-because we are coming from a perspective of excellent capacity” (Iorimar, North, researcher).

In the South, another researcher recognizes:

“Setting up international agreements to do ocean research is perhaps not as high on the agenda as reducing poverty, most of which is not dependent on the ocean environment” (Nana, South, researcher).

In consequence, achieving the expressed desire of applying ocean science diplomacy to build a new world ambition based on the power of influence of science becomes virtually impossible without addressing the impacts of such structural differences in the Atlantic. And, of course, the meaning they create.

This same researcher testified on tokenistic scientific practices:

“I've noticed a tendency for the involvement of third world countries and their scientists to be sort of... from a token perspective. So with some projects and

programs the international consortia around those and involved in those is already all worked out. The proposals are essentially written and then there's a realization oh, by the way, we need to include a Brazilian or we need to include a South African. And it almost comes as an afterthought. So, you know, you're not really... and I've seen the same thing with programs that focus on the tropical systems where there's really token involvement of the Angolans in the whole thing, but they're not really leading anything and they're not allowed to change anything within the proposal itself. So, that for me is a bit of an issue and I've seen it in the past and it's kind of continuing to happen today. So I think that's a huge limitation.” (Nana, South, researcher)

Similar thoughts were shared by one Southern government official:

“Of course you do have the problems of this being an unequal share, of being a share that often gives unequal possibilities to countries, and we suffer this from countries in the North” (Oxum, South, Government official)

These perceptions of unequal opportunities were also recognized by individuals from the Global North:

“The traditional methods of doing ocean research are very expensive and it is necessary to evolve towards lower cost systems. You have to have information on top and this is the best way to combat the inequalities that persist between the South and the North” (Kao, North, Government official).

These perceptions of structural differences in capacities seem to also produce a meaning of the South as those in need of assistance, a feature risen by both government officials and researchers in the North:

“The leveling, the increasing arrival of countries to get to a point where they actually can take some action rather than be so poor that they can just crush under the whoa with what their circumstances might be. As a small kid, I dreamed about being in a certain place in a science community on a marine environment and I think those countries had similar aspirations, individuals there, but they get to realize it now (...) they're part of our community” (Ere, North, Government official).

“When I talk to countries which are in the middle of the road, for them the Ocean Decade is all about capabilities and capacities. It's about being able to join the dialogue, being able to assess, also in a quantitative way what the ocean means in their development agenda” (Iorimar, North, researcher).

One Northern official voiced the value of knowing Southern realities and the significance that this has in science diplomacy.

“I'm interested to know what does the world look like to them [the South], what they consider to be important. And in diplomacy, science diplomacy in particular, your selection of what is important or not important, what should you know, knowing what

you should know is the single biggest problem in all of this” (Oxossi, North, Government official).

However, a Northern researcher pointed out to the strategic importance of knowing, of profiting from this knowledge about your peers:

“At the end, we are always going to have some kind of asymmetry because companies, persons, institutions and countries or allies or whatever, they use the asymmetry in the information, they know something... If I know something that you don't know I have an advantage” (Jetrue, North, researcher).

The role of the Global North as holders of capabilities was expressed by this government official, who also seemed to align such position to a power in making decisions about viable scientific cooperation:

“So [Institution] being a major distributor of the ocean observations in the world, needs to see value in changing the way in which they do business. Doesn't mean we're trying to be bullies here, but if we're contributing we'd better be part of the conversation” (Ogum, North, Government official).

Meanwhile, this Southern official expressed concern over the sustainable future of the Atlantic:

“My perception is that either we do something with a broad regime in the South Atlantic or the South Atlantic is going to die, because the Chinese, the Spanish and so many others are fishing like there is no tomorrow. They do what they want, right?” (Oxum, South, Government official).

One Southern official articulated on the existing differences between North and South and how they seem to produce distinct meanings of engagement to each community. He alludes to science diplomacy the power of change and provides a few recommendations:

“Between the South, we must increase our visibility in the discussions. I think that bit is lacking. We must also build more cooperation between ourselves. In science diplomacy, we are not carrying to the negotiations an empty bowl, and then the others must donate into that bowl. We are taking our geographical advantage areas because of our geopolitical positioning, our science systems and infrastructure. We are playing as equal partners to negotiate on a future of the Atlantic because we all are stakeholders. So to me, it is important that even when we bring in other partners, they must not be looking as if the [North] will provide everything. We have contributions to bring along. And we must articulate that, so that the others can see that without us they cannot achieve the purposes of that [Alliance]. Just as much as we must also acknowledge that without the partnership with the North, we will not have an All-Atlantic. So, we need to find those kind of spaces where we move away from the

development assistance philosophy. Science diplomacy must lead to that kind of work, of creating this kind of interaction”. (Alafim, South, Government official)

DISCUSSION

Interviewees seem to perceive the influence of ocean science in international relations as inevitable, even critical. In their perception of ocean science diplomacy, the scientific component, rather than the diplomatic, is identified as the main factor of science diplomacy. This perception goes in line with what The Royal Society & AAAS (2010) term as Science for Diplomacy, where science is assumed to serve diplomacy in fostering dialogue, building alliances and alleviating political tensions. According to the interviewees’ perceptions, science is portrayed as value-free, apolitical and a source of truth. Science diplomacy would be a strong influence in international relationships and a driver of change, primarily supported by the perceived values of universality and neutrality of science. This initial perception of a benevolent and inevitable ocean science diplomacy is further challenged as the interviews went in more details. Issues such as the search of scientific evidence to support political claims, the influence of science funding and research infrastructure in North-South relationships, and competition amongst peers became more evident.

Science is commonly promoted as paradigmatic (Khun 1962), universal (Merton 1973), and the source of objective truths (Popper 1963). Hence, public perception of science tends to reinforce such a view (Jasanoff 2012 p. 247). However, science, as any other social phenomena, is embedded in the political, economic and social drivers that signify its meaning and conduct (Latour 1993). Such a turnover is apparent in the interviews. When interviewees were given a chance to elaborate further on their perceptions of science diplomacy, they usually expressed many of the political and social drivers that seem to influence the practice of science in the region. Questions about the accountability of science, the segregation of science from policy, accessibility to scientific evidence and unbalanced research capabilities seem to point to at least two layers of power disputes composing the meaning of ocean science diplomacy in the Atlantic. These power disputes are: a) a dispositional power between researchers and government officials in international negotiations, and b) a relational power fueling a South-North divide and producing different meanings for ocean science diplomacy practices in the region.

A. Dispositional power

One would assume the term science diplomacy to reflect a cross-boundary phenomenon where (at least) scientists and diplomats would coordinate and work together. However, the collected results point to the existence of limitations to such

joint work. One of the limitations refers to the positionality in which the interviewed researchers place themselves in international negotiations and how that positionality place government officials in an advance position of power in relation to the researchers. The interviewed scientists reported to be confused about the political decision-making process and not wishing to fully engage with it, suspicious of the processes and values of the policy world. Apparently, scientists seem to feel more comfortable acting as providers of scientific evidence and leaving the room for the diplomats to take over negotiations in what was called “big political games”, where scientists seem not to belong to. The position of actors in relation to each other will determine what they might be able to achieve in terms of outcomes from a decision-making process, constituting what is termed as ‘dispositional power’ (Ramírez-Monsalve & van Tatenhove 2020). In this case, the influence of science (and the agency of scientists) is limited in the process of international decision-making, and government officials are placed in a position of superiority in relation to the researchers. The predominance of policy actors mainstreaming and conceptualizing science diplomacy has been reported by previous publications which raise the concern on the driving interests in using science as a source of power to fuel diplomatic relations (see Ruffini 2020a). The establishment of trust between science and policy was presented by the interviewees as one element that would facilitate the cooperation between researchers and government officials, an element which could also address the power imbalance. However, trust-building is a complex process that takes time and is context-dependent, sometimes limiting the legitimacy of the decision-making process by promoting specific stakeholders’ views (perceived as trusted sources) to be more influential than others (Cvitanovic *et al.*, 2021; Lacey *et al.*, 2018).

It would be interesting to investigate this feature further. If such agreement proves to be a common practice, it would challenge scholarship that alludes much power to the diplomacy that happens away from the State-led setting, generally termed as public or track two diplomacy (Jones 2015; Nye 2008), where non-State actors progress with international negotiations in spite of traditional diplomacy.

B. Relational power

The availability and use of resources will influence the ability of actors to interrelate and achieve certain outcomes from a decision making process, constituting what is termed as ‘relational power’ (Arts & Tatenhove 2004). In this case, the privileged position of countries in the North Atlantic, with reported better technical capacities and more structured advisory schemes, seem to facilitate the uptake of scientific evidence to diplomacy. Some of the interviewed Northern government officials

expressed alleged unlimited access to scientific evidence⁴, evidence which they are capable of selecting to support political positions⁵. Meanwhile, interviewed Southern individuals reported on their limited agency in setting ocean research priorities⁶, with limited advisory systems⁷, falling victim to tokenism⁸ and afraid to what these limitations might mean to their countries' future⁹. These results indicate that the technical divide between the North and South Atlantic motivate distinct engagements in ocean science diplomacy. It would seem that Northern officials seek to use science to support foreign policy goals and raise influence over other countries, whereas the South seems to desire an improvement of their capabilities, enhancing opportunities for research and enjoying similar levels of evidence-informed decision-making. Thus, the inequalities between North and South is pivotal in ocean science diplomacy frameworks in the Atlantic, requiring those studying the region to consider structural unbalances both in science and in diplomacy to play a considerable part in the dynamics between science and diplomacy. One way of analyzing such discrepancies is through the lenses of postcolonial and decolonial theories, explained in broader terms in the introduction and explored further in the next sub-section.

Coloniality of power in ocean science diplomacy

Briefly, postcolonialism argues that today's social fabric cannot be understood without acknowledging the historic political project of European colonization, resulting in a classification of colonies and people therein as inferiors (Fanon 1965; Harding 2008). Decolonial theoreticians defend that modernity is a concept built from colonialism (Mignolo 2007) and coloniality of power a term to designate the current project to maintain colonial values of dominance and classification of the 'other' (Quijano 2000). It has been observed that interviewees from the North Atlantic often refer to their Southern partners of the All-Atlantic Alliance as those

⁴ *"I have technically limitless access to the available science"* (Oxossi, North, Government official)

⁵ *"As we prepare a policy statement or a position, does the science back this up?"* (Ogum, North, Government official)

⁶ *"quite a number of countries do not even have research vessels. Some of them are lined on European vessels but then they are unable to design their own agenda"* (Exu, South, Government official).

⁷ *"[country A] is probably in a fortunate position where we do have science advisors at different levels. That may not be the case for many other countries"* (Omin, South, Government official).

⁸ *"I've noticed a tendency for the involvement of third world countries and their scientists to be sort of... from a token perspective."* (Nana, South, researcher)

⁹ *"I, from a developing country, am very afraid of what this might mean for our ambitions for the future"* (Oxum, South, Government official).

seeking assistance, which naturally results in the North as the assistance provider, somehow superior. Southern subjects, in turn, voiced the deleterious consequences of this assistance philosophy and tokenism, both in research as in diplomacy. This feature is not exclusive to this Alliance, but rather a common practice in international aid, particularly on issues of health, as recently discussed by Khan *et al.* (2022). Thus, coloniality of power would advise on South-North relationships in ocean science diplomacy. From the manner by which Northern individuals make sense of their Southern peers to issues of equity in the access to funding, research infrastructure and human capital, all could be rooted in a project of coloniality. This project would seek to maintain countries in the Global North as the holders of scientific capabilities, culminating in more influential roles in the international agenda setting on ocean affairs, which seems to happen with regard to the negotiations on the conservation and sustainable use of the biodiversity that occurs out of national jurisdictions, for instance (Tolochko & Vadrot 2021; Vadrot *et al.* 2021). Examples of this coloniality in science diplomacy could include the incipient participation of Southern scientists in developing critical scientific reports to influence diplomatic negotiations (Muelbert *et al.* 2021).

As part of the colonial wound, Southern scientists are bound to Western criteria of excellence, even if these criteria are largely unfit to the reality in which they exist (Kraemer-Mbula *et al.* 2020). This criteria of excellence not only affect scientists, but also traditional and indigenous knowledge, the millennium survival kit for individual decision making in every Southern colony. Western science determines which epistemes are fit and valuable to the eyes of the modern, widely accepted and, of course, Western scientific method (Hesselmann 2019; Sharma 2021; Smith 2012). This epistemicide, or the murder of knowledge (De Sousa Santos 2016), translates how ineffective coloniality has been on *de facto* producing knowledge that is fit-for-purpose, questioning if science has ever been either universal or apolitical (Latour 1993). In addition, this epistemic injustice has shown how detrimental epistemicide is to build any possibility of a better planet (Koskinen & Rolin 2021).

Unless there is an effort to decolonize science diplomacy, ocean science diplomacy will reproduce outdated habits by reinforcing coloniality and failing in achieving its perceived main goal of building alliances around science to tackle global challenges. At this point in time, it seems inevitable to also question whether the very concept of science diplomacy makes sense to Southern communities as it seems to do for those in the North. As a concept developed in the USA with further debates in Europe, science diplomacy may be yet another manifestation of coloniality of power. According to these interviews, diplomacy is distinctively influenced by science in the North and South, turning the definition of what would be a Southern-centered science diplomacy a matter of interest, if indeed this definition is desired by the South. Noteworthy, the search of what a Southern science diplomacy would

look like can greatly differ between epistemic communities and countries, reinforcing the artificiality of the term South as including many different realities. However, science diplomacy has been reported as a tool for the globalized advancement of humanity as a single entity (Berkman 2019; Gluckman *et al.* 2018), but caution is necessary with the Northern approach to using science as a source of power to chase political interests abroad, what could reinforce relationships of dominance and coloniality of power with the South, all considered (Flink 2020; Ruffini 2020b; Rungius & Flink 2020). It is time for the many countries and communities in the Global South to signify science diplomacy to local realities and build meaningful international engagements for these communities benefits (Mencía-Ripley *et al.* 2021).

On this regard, globalization has produced a worldview centered on people rather than nations, as if humanity was one single entity (Chilcote 2002). As discussed before, coloniality ranks humanity from those fully humans, in general the normative white Northern men, to those less humans. It is virtually impossible to correctly address any global challenges, wicked problems and so on without breaking this paradigm and recognizing privileges (Ludwig *et al.* 2021). Therefore, ocean science diplomacy will probably fail extensively in the ambition to tackle global common interests. Nonetheless, understanding these forces in action on the interrelation of ocean science and diplomacy will boost our collective knowledge towards seeking shared interests that can be explored conjointly.

On a final discussion note, this research being inductive means that the identification of postcolonial and decolonial theories as the adequate lenses through which to analyze these results occurred after these individuals' perceptions were exposed. However, my own positionality might have influenced this criteria, as much as it have impacted the selection of coding categories and themes. As highlighted by one of the reviewers of this article, a reflexive discourse analysis was done in order to ascertain that this text was not reproducing coloniality itself (Alejandro 2021). To this end, I used my interpretation of coloniality as a compass discourse. Thus, after reflexively reanalyzing this text, I attempted inasmuch as possible to undress myself of Eurocentrism and oppressive lines of argumentation. This has proven to be harder than expected and I do apologize to the reader in case colonial praxis are still present. Decolonization starts with self and reflexive analysis is an endless process, thus this paper's evidence should be looked at with these limitations in mind.

CONCLUSIONS

Science has extensively informed on the ocean thresholds (Rockström *et al.* 2009), supporting diplomatic negotiations with enough empirical evidence, which are largely failing in producing the required changes (Ruffini, 2018; Tessnow-von Wysocki & Vadrot, 2020). It seems very naïve to believe that science alone holds such a power in moving the current directions of humanity. Unless we acknowledge the need for a bridging of communities of practice and move towards greater ocean equity between regions, leaving behind outdated habits, we will probably fail again in envisioning a new order, as expected for the UN Decade of Ocean Science (Claudet *et al.* 2019).

Although we are caught between the devil and the deep blue sea, with the data presented and discussed in this paper showing signs of how coloniality refrains us from building this imagined ocean science diplomacy, I want to conclude with a beam of hope, expressed by the interviewees themselves. When asked how we could do better, these knowledgeable individuals presented a few possibilities to progress with change. First, enhancing South-South cooperation may improve greatly the decolonization of ocean science diplomacy by creating alliances based on similar challenges and socio-economic realities. Second, recognizing matters of coloniality in ocean science diplomacy, many of these individuals showed signs of goodwill in pursuing a new worldview, one in which epistemic justice and more balanced capacities are nurtured as an incremental part of doing ocean science diplomacy. Lastly, dialogue. Listening to the other inasmuch as taking their views into consideration was highlighted as the oil to grease the engine of ocean science diplomacy in the Atlantic. I end with a quote that envisions the future of science diplomacy:

“So science is moving from being an observer to an actor, and diplomacy has to move from being a polite way of bringing scientists together to talk about interesting things to a mandate to deliver for people they may never see or meet. We need a new area of international relations, which will likely describe the specificities of science diplomacy in an age where diplomacy will depend on science in a way it never has done before” (Oxossi, North, Government official).

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DISCLAIMER

This paper reflects only the authors' views. The Ministry of Science, Technology, and Innovations is not responsible for any use that may be made of the information it contains.

AUTHOR CONTRIBUTION

The author declares to be the sole author of this work.

CONFLICT OF INTEREST

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary Material – coding system

The Table below shows the code categories identified from all interviews. Codes are presented in alphabetical order along with their frequency (in terms of absolute number of coded segments).

| Code System | Frequency |
|--|------------------|
| Accessibility to data | 14 |
| Broader participation | 33 |
| Capacities | 18 |
| Collaboration | 35 |
| Communicating Science Diplomacy | 27 |
| Competition | 6 |
| Cross-border interests | 23 |
| Diplomacy for Science | 17 |
| Equity | 18 |
| Funding for research | 22 |
| Global interests | 34 |
| Intergenerational aspects | 10 |
| Limitations to advice | 35 |
| Linking national to international | 8 |
| National Interests | 47 |
| National Science Advice schemes | 30 |
| Northern perspectives | 22 |
| Operability of Science Diplomacy | 23 |
| Other advice/values beyond science | 11 |
| Researchers pushed to societal issues | 15 |
| Risk in decision making | 5 |
| Role of institutions | 23 |
| science as a soft power | 11 |
| Science closed in itself | 33 |
| Science denial | 6 |
| Science Diplomacy examples | 24 |
| Science for Diplomacy | 49 |
| Science in Diplomacy | 24 |
| Science-policy conflict | 94 |
| Science-society clashes | 40 |
| Skepticism | 35 |
| Southern perspectives | 53 |
| Trans/interdisciplinarity | 27 |
| Unawareness of doing science diplomacy | 18 |
| Unseen ocean | 23 |
| Values of science diplomacy | 78 |
| What science diplomacy should be | 42 |



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