



Towards a reflexive, policy-relevant and engaged ocean science for the UN decade: A social science research agenda

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ABSTRACT

The UN Decade of Ocean Science for Sustainable Development (2021–2030) aims to tackle several challenges on the path towards more sustainable ocean futures. Its central objectives are to close knowledge gaps, increase the usability of scientific knowledge on the ocean, strengthen science-policy interfaces, and make oceanography fit for purpose. The quest for a reflexive turn within ocean science itself echoes many claims for more inclusive, diverse, and equitable research practices in the marine realm and provides an entry point for discussing the contribution of the social sciences to the UN Decade. This article examines different social science research avenues and proposes a research agenda detailing different entry points for unpacking the complex web of science-policy interrelations. First, we identify three research themes - reflexive ocean science, policy-relevant ocean science, and engaged ocean science- and nine research avenues where social science expertise is needed to close knowledge gaps. Second, we use the case of marine biodiversity to illustrate how to combine research into different avenues. Finally, the comprehensive study of ocean science's reflexive, political, and societal dimensions is an emerging field within ocean governance scholarship and deserves to receive increased attention from scholars interested in the conditions of transformative change.

1. Introduction: the need for a social science research agenda

The UN Decade of Ocean Science for Sustainable Development (2021–2030) aims to tackle several challenges on the path towards more sustainable ocean futures (Claudet et al., 2020). Scholars consider the UN Decade as an opportunity to close knowledge gaps (Chaffer, 2021; Howell et al., 2020; Polejack, 2021) and argue that increased knowledge on the ocean will support the transformation to ocean sustainability (Claudet et al., 2020; Haas et al., 2021; Nash et al., 2021; Polejack, 2021; Ryabinin et al., 2019; Visbeck, 2018). The objective to foster transformative change associated with the UN Decade (Claudet et al., 2020; Hillebrandt-Andrade et al., 2021; Nash et al., 2021) implies that the natural and social sciences should work together to foster sustainability transformations (Franke et al., 2022; Wisz et al., 2020). In this regard, the UN Decade is considered a “unique, once in a life-time, opportunity to change the way we do things [and] make oceanography fit for purpose” (Ryabinin et al., 2019). This quest for a reflexive turn within ocean

science itself echoes many claims for more inclusive, diverse, and equitable research practices (Harden-Davies et al., 2020; Wisz et al., 2020; Singh et al., 2021; Visbeck 2018) and science-informed policy responses (Ryabinin et al., 2019), reflecting the colonial roots of ocean science (Partelow et al., 2020) and the diverse ontologies of the ocean (Peters and Steinberg, 2019).

We argue that these objectives require a revived debate not merely about ways to study and strengthen science-policy interrelations, but also about the different contributions that social science research can make to understand inequalities, conflicts, trade-offs, competing values and interests that have been shaping the complex web of these relationships and hamper inclusiveness, transparency, and best practices' identification. In this perspective piece, we propose a research agenda detailing the contributions of the social sciences to the following three themes: *reflexive, policy-relevant, and engaged ocean science* (see Fig. 1).

The proposed avenues serve as a structure for synergising already existing, as well as future research in its relevance for more reflexive,

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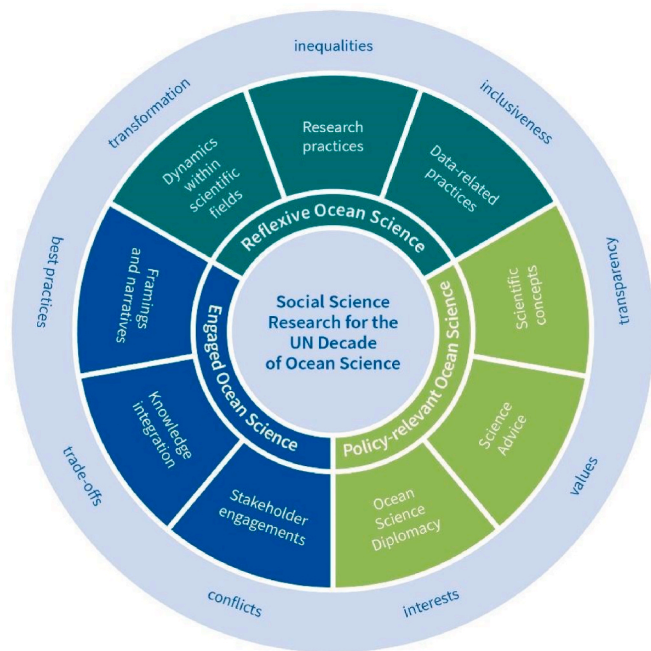


Fig. 1. Research themes and social science research avenues for the UN Decade (Source: own illustration).

policy-relevant, and engaged ocean science. Using the case of marine biodiversity, we illustrate how research into different avenues can be combined to gain a more nuanced understanding of the practices that constitute science-policy interrelations. Being explicit about social science research avenues is essential to avoid that social science researchers are considered as “silent partners whose job it is to care for science” (Viseu, 2015, p. 291). With the proposed avenues, we seek to clarify the conditions under which social sciences can respond to epistemological, ontological, and axiological dilemmas over science-policy interrelations and therefore support the production of scientific knowledge that is useful, policy-driven, engaged, and directed toward a safe and sustainable ocean.

2. Reflexive ocean science

Many ocean scientists consider the Ocean Decade an opportunity to reflect and change the way oceanographers “do things” (Ryabinin et al., 2019). Our first argument is that social sciences can contribute to our understanding of what such reflections should focus on, in specific consideration of the social and political dynamics that come to matter in this regard. We propose the theme of ‘reflexive ocean science’ to draw attention to these dynamics within scientific fields, the context of research practices in scientific laboratories, vessels, marine stations, automated vehicles, and the variety of ocean-related data practices. These research avenues facilitate an understanding of the social inequalities shaping the production of scientific knowledge and highlight the role of scientists as important ‘agents’ that are not external to what the oceans become.

2.1. Dynamics within scientific fields

Understanding the dynamics within scientific fields offers insights into the structure of ocean science and enables us to examine the social and political dynamics that shape scientific knowledge production and the relationship between knowledge and power (Jasanoff, 1996; Jasanoff and Martello, 2004). Scientific knowledge is embedded within a specific institutional, historical, social, and political context. Historians of science and oceanography have studied the connections

between marine scientific development and its social context (Mills, 1993), arguing that oceanography “has taken shape within particular conceptions of place, interests, and sovereignty—not least because the ocean sciences are involved with the practical and epistemological control of the earth’s resources and are therefore intimately connected with the realities of the nation-state and its institutions, on the one hand, and a globalised economy, on the other hand” (Rozwadowski, 2014, p. 336).

The concentration of ocean science in a few industrialised nations, including the USA, Australia, Japan, and several European countries (e. g., Germany, France, and the UK), is a challenging issue; addressing it involves negotiating the conditions for scientific capacity building and marine technology transfer (Tolochko and Vadrot, 2021a,b). A key factor here is the technologically complex and expensive character of ocean science; rapid innovation in data management, artificial intelligence, and remote sensing techniques perpetuate imbalances between world regions, most notably the global North and South, and between public and private endeavours (Partelow et al., 2020). For social science research, this implies that we need to understand how indicators, evaluation schemes, political priorities, and incentives have shaped the field of ocean science, and how policies involving international collaboration, capacity building, or technology transfer shape the development of the field in different regions and potentially reduce global inequalities. This entails the critical examination of what is considered excellent ocean science, and how scientific interests converge with economic, political, industrial, and military goals (Oreskes, 2003).

2.2. Research practices

Oceanography is ‘situated knowledge’ produced on research vessels, in laboratories, and with sensors on the seafloor or satellites in space (Lehman, 2018). It is produced thanks to collective efforts and technological advances that have changed human ability to interact with the ocean and transformed oceanic imaginary through technological (re) mediation of spaces (Ratte, 2019). Societal factors matter in the day-to-day production of marine scientific knowledge and “may at time affect the content of science and its evaluation of scientists” (Mills, 1993, p. 14). As a product of social work, science depends on mediated rules, norms, paradigms, and specific modes of organisation (Kuhn, 1977). However, ocean science is criticised for being dominated by “Western countries and men” (Ahmadia et al., 2021, p. 2; Gissi et al., 2018; Shellock et al., 2022). Even in cases of fruitful cross-regional cooperation, capacity building, and active involvement of researchers from developing countries, imbalances between scientists from northern and global South institutions persist (Partelow et al., 2020) to the extent that “discrimination, bullying, harassment, and assault occur” and “perpetuate the fundamental inequities that should be addressed” (Amon et al., 2022).

In order to analyse related practices, STS scholars have sensitised us to the need to study the production of scientific knowledge at different sites, for example, in the laboratory (Latour, 1987), marine stations (De Bont, 2009) or in an ocean-going research vessel, which brings together large structured human groups (Bernard and Killworth, 1973). A diverse set of research practices and related ideas, values, paradigms, and beliefs constitute ocean science and need to be understood if oceanography, as practiced in the past, ought to be transformed for the future. However, scientists do not only take part in the construction and endorsement of ideas of excellence, (in)equality, and inclusiveness but also experience and embody political and legal conditions of ocean science that were set in place to regulate specific aspects of marine scientific research. While scientists are undoubtedly affected in their daily work by international agreements, such as the Nagoya Protocol of the Convention on Biological Diversity (CBD), they also wield some power in the sense that they may influence policymaking and agenda-setting, control information flows, data access (Dedeurwaerdere et al., 2016), set new norms for transparency (Blasiak et al., 2019), or by reflecting their own biases

(Shellock et al., 2022).

2.3. Data-related practices

Creating and sharing data and questions around monitoring, digitalisation, infrastructures, and the interoperability of existing databases have become central issues to ocean science and governance (Morgera, 2018). Although open-access databases, such as the Ocean Biogeographic Information System (OBIS) (Klein et al., 2019), the Global Ocean Observing System (GOOS) (Tanhua et al., 2019), the Deep Ocean Observing Strategy (DOOS) (Levin et al., 2019), and repositories of genetic information (e.g., GenBank) have proliferated in the past decade, many habitable ecosystems lack baseline data and systematic monitoring for their management (Sagi et al., 2020; Snowden et al., 2019). Moreover, digital technology, modelling, automation, and artificial intelligence, increasingly supporting data collection, management, and analysis, create particular visions of data-driven policy-making (Bakker and Bridge, 2006) and can lead to “algorithmic injustices” and discrimination (Crawford, 2016).

Thus, studying data-related practices is crucial for understanding biases and inequalities regarding access to and use of ocean data, typically produced, owned, managed, and used by diverse actors, including government agencies, universities, research labs, oil and biotech companies, the fishery sector, international organisations, and museums (Drakopoulos et al., 2022). Different actors engage in diverse data practices, which lead them to “encounter many of the typical barriers to data sharing and integration” (Neang et al., 2021, p. 256:7). Additionally, the capacity to access and use ocean data is limited, leading to information asymmetries and disparities between actors’ ability to influence policy (De Santo et al., 2019). According to the Global Ocean Science Report 2020 “countries are inadequately equipped to manage their ocean data and information, which hampers open access and data sharing” (Isensee, 2020, p. 25). Efforts to improve ocean data use require social sciences’ support to analyse user needs and how different actors with different data practices can best collaborate, integrate their knowledge, and avoid injustices and discrimination. Qualitative research with scientists or database managers can be crucial to assessing underlying needs, values, and norms that shape data-related practices. These qualitative insights may be fruitfully aligned with insights from quantitative analyses of data usages and information flow patterns at larger scales (see Blasiak et al., 2018; Rohden et al., 2020; Scholz et al., 2021).

3. Policy-relevant ocean science

Strengthening the interrelations between ocean science and policy is an essential objective of the UN Decade and can facilitate the production of policy-relevant ocean science (Lubchenco, 1995, p. 8; Lubchenco et al., 2019, p. 107). We argue that social sciences can contribute to unpacking the conditions under which ocean science may become policy-relevant and how ‘epistemic communities’ generate authoritative knowledge claims and form environmental regimes (Haas, 1992). Concepts such as co-production (Jasanoff, 1990), uncertainty (Oreskes and Conway, 2010), scientific ignorance (Wynne, 1992), and boundary work (Gieryn, 1983) have proved useful to sensitise scholars to the mutual influence of science and policy. We propose the theme of ‘policy-relevant ocean science’ to draw attention to the sites, processes, practices, and bodies operating at the interface between scientific knowledge production and policy-making.

3.1. Science advice

Social sciences are well equipped to examine the governance structures of global knowledge institutions, scientific and technical bodies, and committees, the making of global assessments, such as the first and second World Ocean Assessments (Inniss and Simcock, 2017; United Nations, 2021), their authority within societal and political circles, and

their mechanisms for inclusiveness and participation (e.g., Beck, 2011; Vadrot 2014; Hughes and Vadrot 2019; Díaz-Reviriego et al., 2019). The establishment of a Scientific Committee can shift state interests and foster consensus based on the idea that states being confronted with new information may learn to perceive the policy problem from a different angle (Haas, 2017), such as in the case of the Scientific Committee of the Commission for the Conservation of Southern Bluefin Tuna, which oversees the assessment of the status and trends regarding the Southern Bluefin Tuna population (Gonçalves, 2021).

Science advice can also be studied as a set of practices that materialise in less formalised settings and situations. Scientists may make their voice heard individually - for instance, as advisors in diplomatic delegations - and collectively through forming alliances at international negotiations, where they can speak on behalf of a specific scientific community. During negotiations, scientific actors such as the Deep Ocean Stewardship Initiative or International Union for Conservation of Nature (IUCN) can make statements, circulate policy briefs, organise side events, and reach out to government representatives on an informal basis. Hence, scientists also possess agency and act as ‘honest brokers’ or ‘issue advocates’ (Pielke, 2004). Thus, social sciences can help understand how non-state scientific actors can exert significant influence, but also sensitises us to the need to consider that science-policy arenas are shaped by “specific regional complex relationships, influenced by organizational culture and environments” as the case of the Wider Caribbean Region illustrates (Mahon and Fanning, 2021).

3.2. Scientific concepts

Science and expertise can be used in different political settings and for different purposes: legitimising political action or non-action and as policy instruments. Policy-makers may also selectively refer to expert knowledge related to their priorities and strategically select scientific terms or concepts resonating with their interests, which may lead to ‘epistemic selectivity’ and a narrow understanding of the policy issue at hand (Vadrot, 2014). We consider that scientific concepts -including related facts, numbers, indicators, or thresholds travelling to different sites of policy-making- occupy a special place in policy-relevant ocean science because they can translate complex scientific findings into simple messages that may be taken up by state and non-state actors seeking to influence policy-making. One example is the concept of ecological connectivity, which is used in different ocean-related negotiations conveying the message that the status quo of marine protection needs to be changed in favour of more holistic approaches (Tessnow-von Wysocki and Vadrot, 2022).

Scientific concepts can be studied as ‘boundary objects’ (Star and Griesemer, 1989), facilitating dialogue and agreement between actors with different interests, values, and beliefs. Boundary objects are flexible and robust at the same time, can accommodate the needs and constraints of actors, and are “common enough to more than one world to make them recognizable, a means of translation” (Star and Griesemer, 1989, p. 393). The concept of “Ecologically or Biologically Significant Marine Areas” (EBSAs) of the CBD, for instance, was plastic enough to accommodate top-down conservation and local bottom-up approaches advocated by Small Island Developing States (Gray et al., 2014). However, scientific concepts can also become contested and “weighted” (Hughes and Vadrot, 2019), turn into objects of struggle, where controversies about scientific contents or facts develop into conflicts about competing values, interests, and beliefs (Vadrot, 2014; Borie and Hulme, 2015). We need to bear in mind that “contestations over knowledge are entwined with contestations over the potential political and societal implications of that knowledge” (Turnhout and Gieryn, 2019, p.70; Peterson 2019).

3.3. Ocean science diplomacy

We understand ‘ocean science diplomacy’ (Polejack, 2021) as a two-coined phenomenon. A pragmatic foreign policy approach for

“building constructive international partnerships” (Federoff, 2009, p. 9) and an analytical lens to study interrelations between ocean science and policy, i.e., “relations [that] are maintained through practices that are firmly scientific in purpose, process or objective (or all) while diplomatic in their quality and/or effects” (Kaltofen and Acuto, 2018, p. 8). As such, the term sensitises us to the recognition and distinction of “typical patterns of interaction of science [...] and international affairs” (Weiss, 2005, p. 297). For example, the International Oceanographic Commission of UNESCO was supported by major powers to showcase oceanography as an “internationalist and peaceful open science” (Robinson, 2021, p. 157). Due to such initiatives, cooperation has been the norm in oceanography since the 1960s (Robinson, 2021) and is especially important regarding high seas governance (Harden-Davies, 2018).

Ocean science and diplomacy have become inextricably interlinked, which is why the UN Decade should also be considered under the angle of science diplomacy and its diverse meaning and effects. Social sciences can contribute to identifying and measuring the social benefit of ocean science diplomacy (Polejack et al., 2021; Claudet et al., 2020) and can identify the needs and priorities of publicly funded science diplomatic initiatives and assess their impact and outcomes. Social sciences can also contribute to the study of ocean science diplomacy by exploring its enabling structural conditions and those practices within the context of bilateral and multilateral scientific cooperation that perpetuate global imbalances by adopting a postcolonial perspective (Polejack, 2021).

4. Engaged ocean science

The UN Decade seeks to strengthen scientific collaboration by addressing global imbalances and considering both the full range of knowledge holders, including scientific communities, different stakeholder groups, and Indigenous Peoples and Local Communities. Concepts such as ‘co-design’, ‘co-production’, and ‘co-creation’ are increasingly used to articulate the need to rethink practices of knowledge production and use by making them more inclusive and participatory. We propose the theme of ‘engaged ocean science’ to draw attention to these dynamics and argue that social sciences can contribute to unpacking what co-creation or co-design means in practice by paying attention to the different interests, values, and conflicts involved in attempts to engage stakeholders, integrate knowledge, and frame ocean policy.

4.1. Stakeholder engagements

Participation of diverse stakeholder groups in the creation of scientific knowledge is perceived to increase its legitimacy (Mitchell et al., 2006), understood as “the perception that the production of information and technology has been respectful of stakeholders’ divergent values and beliefs, unbiased in its conduct, and fair in its treatment of opposing views and interests” (Cash et al., 2003, p. 8086). Scientific knowledge created without considering the needs and views of stakeholders faces the risk of being objected to by the public (Cash et al., 2003; Collins and Evans, 2002; Mitchell et al., 2006). Therefore, it is fundamental for the UN Ocean Decade to support the creation of knowledge that is perceived to be legitimate by stakeholders who are directly affected by that knowledge. For instance, it would increase the legitimacy of temporal closures for fisheries if fishers had a participatory role in making knowledge that supports the closing of the marine area.

Legitimacy could also be enhanced by providing spaces for dialogue and debate among experts, counter-experts, and other civil society sectors. By including different stakeholders in deliberative processes, legitimate science can offer trade-offs and make participants reconsider their interests and most suitable solutions. For instance, the development of wind farms spurs controversies ranging from seabed environmental impacts to social gaps explained by “not in my backyard” reactions (Bell et al., 2005, p. 460). Stakeholder engagements do not always avoid these controversies, such as the struggle of fishers in

sharing the sea. However, they increase the value of science by giving societal outputs to scientific knowledge production, which may avoid some controversies. This avenue fosters anti-boundary work that “aims at reaffirming the social influence of science, designing a new role for global environmental research and expanding the number of its legitimate contributors” (De Pryck and Wanneau, 2017, p. 205).

4.2. Knowledge integration

Beyond stakeholder engagement, the participation of right-holders, such as Indigenous Peoples (CBD, 2016), would enable an ethical use of Indigenous, local and traditional knowledge (TK) in the framework of the UN Ocean Decade. Integrating different knowledge systems - namely science and TK - would “provide a better foundation for understanding complex biological and ecological questions” (CBD, 2016, p. 20). TK supplements scientific knowledge on marine biodiversity (Huntington, 2000; Johnson et al., 2018) and advises on conservation practices and sustainable use practices (Harden-Davies et al., 2020; Mulalap et al., 2020; Vierros et al., 2020). Current efforts to integrate both knowledge systems in the context of biodiversity protection include the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Regional Workshops to identify EBSAs. IPBES pursues improving the links of both science and TK with policy- and decision-making and has a conceptual framework that points to similarities and differences between concepts of both knowledge systems (Borie and Hulme, 2015; Vadrot, 2020). The EBSA Workshops, in turn, are a scientific and technical exercise of the CBD in which scientists and TK holders meet to identify marine areas in need of protection by using both science and TK (Dunn et al., 2014; Johnson et al., 2018).

As TK is embedded in an oral tradition (Mulalap et al., 2020), social science research methods, such as ethnography and interviews, are particularly suitable to document it in conformity with ethical practices (CBD, 2016). Furthermore, social scientists could contribute integrating scientists and TK holders by identifying the needs of both groups (Lidskog and Sundqvist, 2002; Star and Griesemer, 1989) and performing knowledge-brokering activities (Orsini et al., 2017) for the making of knowledge that responds to the demands of each group.

4.3. Framings and narratives

Science contributes to the framing of policy issues and environmental discourse (Litfin, 1994; Hajer, 1995). A social science research agenda for the UN Decade for Ocean Science can also shed light on the framings and narratives through which scientists often communicate their findings to the public and policy-makers. This is important because “scientists’ ideas, beliefs, and discourses form the frames that shape their choices about which research to pursue, their approaches to collaboration and communicating results, and how they evaluate research outputs and outcomes” (Rudd, 2015, p. 44). On the one hand, voices within the scientific community calling for “a consensus-based narrative that the scientific community needs to be ready and able to promote”, which will be harder to ignore by policy-makers, are becoming louder (De Santo et al., 2019, p. 3). While speaking with many voices compromises their ability to have a societal and political impact (Azevedo-Santos et al., 2017), ocean scientists show remarkable uniformity in the rank order of top research priorities (Rudd, 2015).

At the same time, it remains vital to preserve and maintain the diversity of scientific expertise and framings because sustainably governing oceans requires diverse expertise due to the multi-sectoral nature and interconnectivity of problems. Also, ocean scientists expressed “major differences of opinion [...] as to the appropriate scope of their involvement in knowledge co-production and mobilization, and with regards to the relative epistemic authority of science versus politics for ocean policy-making” (Rudd, 2015, p. 56). These findings call for an increased exchange and possibly streamlining among social and natural scientists and practitioners on how and what knowledge shall be

provided to policy-makers at different levels of policy-making.

5. Combining avenues to unpack science-policy interrelations

In the previous sections, we have introduced nine avenues for social sciences research. In the following, we will illustrate how these avenues can be combined. Based on the ongoing research project MAR-IPOOLDATA, which aims to develop a new methodological approach to study science-policy interrelations empirically, we propose a multi-sited research approach consisting of: 1) ethnographic research at international negotiation sites and 2) research into the dynamics of scientific fields and research practices (see Table 1). This parallel approach enables us to develop a more nuanced understanding of the interrelations between marine biodiversity research and governance and to unpack the power dynamics that shape both the uptake of science advice and scientific concepts in international negotiations and the development of scientific fields and research practices in different world regions.

To address the first pillar of our research approach, we use the case of the ongoing negotiations towards a new legal instrument for the conservation and sustainable use of marine biodiversity beyond national jurisdiction (BBNJ). We use the BBNJ negotiations as field site for the conduct of collaborative event ethnography (CEE, 2014) (Büscher, 2014; Hughes et al., 2021) and digital critical policy ethnography (Vadrot and Ruiz Rodríguez, 2022) to keep track of emerging conflict lines, contestation instances related to marine biodiversity research, and the role of scientists and scientific concepts (Vadrot 2020). Treating the negotiation sites as organized social spaces, we combine CEE and digital critical policy ethnography with social network analysis to gain insights into the interplay of involved actors such as states, IGOs, and NGOs and the location of agency and expert authority. In short, we aim to understand how science shapes these negotiations, which is insofar important as “the politicization of science”, and “scientific uncertainty” are critical concerns in the ongoing BBNJ talks (De Santo et al., 2019 p. 2).

However, in order to situate the science that matters in the BBNJ negotiation within the scientific field itself, we propose to combine our ethnographic data with the second pillar of our approach: research into the complex dynamics and (emerging) practices that constitute the marine biodiversity field. To this end, we surveyed the dynamics of the field based on scientific publications and text (Tolochko and Vadrot, 2021a,b). According to Callon et al. (1986, p. 9), scientific texts play a particular role in science and scientists’ attempts to ‘build a structured world’ out of their daily practices, including the acquisition of funding, the management of laboratories, staff, and equipment, collaboration, and the division of labour. We analysed global inequalities, where Europe, the US, and Australia do not only publish more and receive more citations but allocate a significant proportion of collaboration capital from all regions (see Fig. 2). However, our research also shows that different regions focus on different research topics at different moments

in time. We identified regional differences regarding environmental management and conservation research, which is dominated by research institutions in the Global North and classical taxonomy, which is prevalent in Latin America, but decreasing in the USA and Australia (Tolochko and Vadrot, 2021a).

In order to complement this quantitative representation of the marine biodiversity field with the subjective experiences of individual scientists, we conduct oral history interviews with key marine biodiversity scientists; these encapsulate a unique part of the evolution and shifts of the field. Oral histories provide “a unique perspective into how ‘who we are matters’ to the way that science is done, in what we choose to study, how we understand it, and what we tend to ignore” (Olson and Pinto da Silva, 2019, p. 371). Interviews yield insights not easily found in printed and published sources and a clearer understanding of the subjective interpretation of facts and help record events and trends about a scientific field’s development (Weiner, 1988; Doel, 2003). The data we collect will allow us to produce a shared story about the evolution of the marine biodiversity field, explain in greater depth how new technological developments are transforming the ways we study and govern the ocean, and reveal the (geo-)political, social, and material implications of these transformations.

The third site we propose to study is where marine biodiversity data is collected, analysed, and used to map, monitor, and govern marine biodiversity. Because research funding, equipment, structures, and cultures differ across regions, we argue that ethnographic research in laboratories (Stephens and Lewis, 2017) located in different countries and on research vessels with different capacities is needed to complement our understanding of the complexity of marine biodiversity research. According to Latour and Woolgar (1986), the laboratory produces scientific facts while the local and national research levels determine the knowledge based on which interests and policies will be formulated. Using three cases (the United States, the European Union, and Brazil), this research compares regional and national policies and practices of monitoring marine biodiversity.

6. Concluding remarks

We started by pointing to the need for a social science research agenda to support the implementation of the UN Decade of Ocean Science and its specific objective to increase the policy relevance and usability of ocean science. Then, we introduced nine avenues of social science research structured around three themes (reflexive, policy-relevant, and engaged ocean science), which provide different entry points for the empirical study of science-policy interrelations. We conclude that the UN Decade is very well situated to provide intensified coordination between science and policy; however, we should also treat it as an object of social science research situated somewhere between ocean science diplomacy, stakeholder engagement, and research and data-related practices. This implies that social science researchers should study the UN Decade and critically assess how it may reproduce or change the practices and narratives of knowing and governing the ocean, especially in relation to colonial patterns and inherent inequalities embedded in everyday relations. The UN Decade is not only about increasing the uptake of ocean science but is situated within a specific political, social, legal, and historical context, where the ocean and its resources are subject to overexploitation and geopolitical struggle. In this respect, the UN Decade itself should adopt a reflexive approach and be aware of its own practices’ power in re-shaping global inequalities and hegemonic practices. Strengthening existing formal and informal partnerships, drawing on marine social science networks, and including review mechanisms and critical friends may be options to increase the up-take of existing social science expertise into the UN Decade. Finally, the comprehensive study of ocean science’s reflexive, political, and societal dimensions is an emerging field within ocean governance scholarship and deserves to receive increased attention among marine social scientists. When studying and designing science-

Table 1
Combining research themes for the empirical study of science-policy interrelations

Research theme	Research question	Research site	Method
Policy-relevant ocean science	How does science shape the BBNJ negotiations?	BBNJ negotiations	Collaborative Event Ethnography, Digital Critical Policy Ethnography, Social Network Analysis
	What is the science that shapes these negotiations?	Field of marine biodiversity research	Bibliographic analysis, Social Network Analysis, Oral History Interviews
Reflexive ocean science	How does scientific capability shape negotiating positions?	Sites of marine biodiversity monitoring and research	Laboratory ethnography

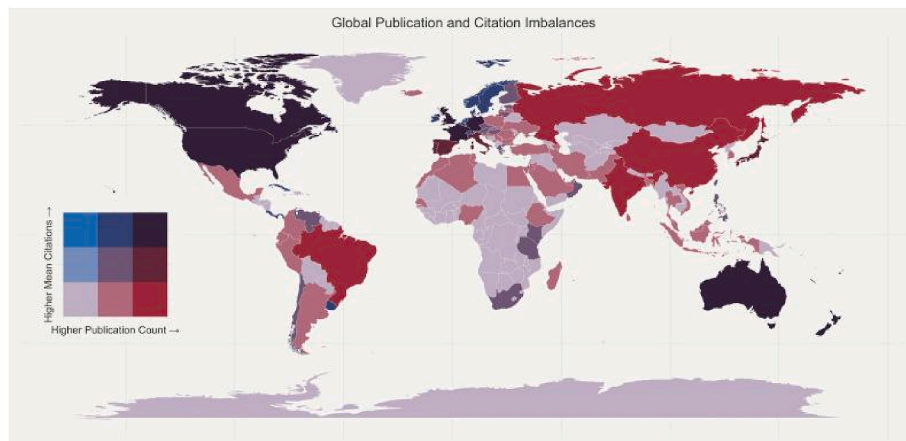


Fig. 2. Geographic distribution of the total amount of articles and average citation count by country, 1990–2018 (Source: Tolochko and Vadrot, 2021b, p. 6).

policy interrelations in the context of ocean sustainability, we need to consider that this landscape is rapidly changing. New sites, such as the BBNJ instrument and aspirations to create digital oceans, emerge and provide possibilities “to change the way we do things, [and] make oceanography fit for purpose” (Ryabinin et al., 2019).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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