



Envisioning ocean governability transformations through network-based marine spatial planning

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Abstract

The globally accelerating environmental crisis calls for radical changes in the governance of ocean resources towards a more sustainable and socially equitable world. Transdisciplinary sustainability research and networked knowledge-to-action approaches are critical parts of this change. The effective application of such approaches still puzzles social actors (individuals and networks) willing to act in more transformative ways. We conducted twelve participatory network mapping activities to assess the perception of high-level federal government institutional entrepreneurs on the structure and dynamics of an emerging socio-political arena for marine spatial planning (MSP) in Brazil. Our informants, mostly cognizant of their own intra-governmental structures, anticipate the MSP arena to remain self-enclosed, with changes only occurring within the federal government structures in the coming years. Their perceptions were largely conservative, narrow, and unambitious and therefore unfit to generate regime transformations. The limited awareness of response capacities beyond the federal government potentially leads to the endurance of the low performance already present in the MSP arena. Results from the participatory network mapping informed a five-step functional ocean governability analysis pointing to key potential contributions to support a critical turn in MSP: 1. envision situated interactional narratives to leverage regime shifts; 2. build a shared understanding of and anticipating transformative coevolutionary dynamics; 3. build awareness of the potential synergies among disparate but innovative area-based responses; 4. specify inter-network-based limitations and the necessary changes underpinning potential leaps in performance levels of ocean governance orders; 5. make power asymmetries explicit to stir structurally tailored strategic action by less influential groups. We discuss the potential role of inter-network strategies and actions and how they may confront the symptoms of depoliticized MSP pathways and the risks of it becoming an instrument of further marginalisation and power asymmetry in Brazil.

Keywords Net-map · Social network analysis · Ocean governance · Ecosystem-based management · Knowledge-networks

Introduction

The crescent extent, intensity, and diversity of human uses of the ocean rely on accelerating spatial access to resources (Jouffray et al., 2020). Humankind is urged to rapidly change how we govern the ocean across interdependent local and global scales (Zondervan et al. 2013). Research on and practise of ecosystem-based management (EBM) approaches has been advanced to address predominantly sectoral and fragmented ocean governance systems (Langlet and Rayfuse 2019). To enable shifts towards EBM regimes and to promote governance transformations at multiple levels, it is essential to embrace the complexity of coastal and marine social-ecological dynamics (Long et al. 2015). EBM can possibly be built-in across an array of integrated area-based

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policy options, e.g. marine protected areas (MPA; see ‘Aichi Biodiversity Target 11 in Marine and Coastal Areas’) and marine spatial planning (MSP; see Unesco’s recent ‘Joint Roadmap to accelerate Maritime/Marine Spatial Planning processes worldwide’), among other instruments to manage oceanscapes (see Convention on Biological Diversity, 2018; UN Environment 2018).

While several nations are in the process of implementing integrated area-based solutions, most countries are still struggling with cumulative impacts generated by the interaction of antagonistic interests (Korpinen and Andersen 2016; Borja et al. 2016). The struggles of ocean actors in pursuing policy innovations to manage ocean resources are exemplified by the persistent challenges for implementing integrated approaches and by the disparities between how those approaches are conceptualised and practised (Kirkfeldt 2019). The complexity social innovators face partly derives from the wickedness of incumbent regimes, their path dependencies and policy layering (Kelly et al. 2018). The outcomes of ocean management attempts are typically unclear and often driven by organisations with competing and/or overlapping attributions and legal competencies over marine areas (Kelly et al. 2018). Moreover, research has pointed out that many countries (e.g. England) adopt depoliticized (or post-political) area-based ocean planning strategies in which engagement and meaningful debates with stakeholders are minimised, resistance to transforming the status quo remains, and contestation is replaced by elite and technocratic-managerial governance (Clarke and Flannery 2019). These ocean governability challenges require novel marine social science research approaches that are better capable of diagnosing ocean governance regimes and identifying ways to improve their functioning.

Transdisciplinary research can function as a wildcard in the establishment of marine governance ‘transition arenas’ (Kelly et al. 2018)—an idea resonating with proponents of somewhat related concepts and applications in the ocean governance realm such as ‘policy-experimentation’ (Fox et al. 2013), the formation of ‘learning-networks’ (Christie et al. 2016; Dalton et al. 2020), ‘knowledge-networks’ (Cvitanovic 2017), and a range of other networked-knowledge to action approach aiming to facilitate interaction, knowledge-exchange and learning by and between social innovators (Bayliss-Brown et al. 2020). However, while frameworks and tools have been developed to assess and support change in ocean governance, Kelly et al. (2018) reviewed the most cited academic papers in the field to find out that much of the research is still naively impotent to deal with fragmentation in ocean governance systems. These authors call for a more realistic understanding of the context in which transformative change in ocean governance systems takes place.

Promoting actionable knowledge, informing social innovation, and shedding light on the complex structures of

ocean governance arenas is crucial to revealing transformative pathways connected to decision-making in ocean affairs. Social network analysis (SNA) is a helpful analytical tool with the potential to provide recommendations on how to improve policy responses to explicit contextual complexities. By creating and analysing maps of social connections between actors (and the lack thereof), SNA examines the social structures and dynamics of a variety of governance systems. Its application encompasses conceptual studies and empirical analyses of specific contexts from specific sectors (e.g. fisheries: Mahon and McConney 2013), area-based solutions in various coastal and marine ecosystems (e.g. MPAs: Alexander and Armitage 2014; Gorris et al. 2015; Corrêa et al. 2020), and knowledge-exchange interfaces in marine science-policy arenas (e.g. Cvitanovic et al. 2015; Gerhardinger et al. 2018). Nevertheless, SNA-informed sustainability research agendas face methodological challenges to optimise social learning outcomes. For instance, we may cite the mismatch between the timing of data-intensive collection programs, analysis of results and timely social learning feedback to support social innovators navigating respective interactional structures. Therefore, the importance of actively involving social actors in research to achieve social learning goals and to create actionable knowledge calls for the application of transdisciplinary research.

Participatory SNA approaches (net-mapping; Schiffer and Hauck 2010) offer a promising methodology in that regard. Net-mapping enables social actors (e.g. innovators) to learn through systematically exploring, visualising, and reflecting on their knowledge and perceptions of the formal and informal relationships, and power structures at particular ocean governance problem-domains (e.g. Glaser and Schröter 2020). While the application of net-mapping may boost participants’ learning, it also offers an opportunity for a quali-quantitative analysis of their perceptions on governance strategies and potential pathways. It is essentially these perceptions that hinge upon actors to guide their behaviour towards nature and natural resource management and conservation (Glaser et al. 2018).

The study of perceptions in environmental governance and management is critically emerging to address how human and institutional actors interact and affect each other given their respective interests and influence within socio-political arenas (Glaser et al. 2018; Breckwoldt et al. 2018; Glaser and Schröter 2020). However, most SNA and net-mapping research only takes and empirically analyses static snapshots of specific realities. The low number of examples of studies on governance network dynamics (Cvitanovic et al. 2017) still limits our understanding of how SNA research insights may optimally feedback the evolution of institutional-building and entrepreneurship processes. Network studies that consider the perception of actual governance structure and their envisioned potential future(s) are

still scarce. To support ocean actors in the imagination of radically alternative pathways, sustainability researchers can engage with complexity through phronetic approaches such as scenario-building and net-mapping that stimulates co-production of knowledge and reflexive learning about the past, present, and future of social networks in environmental governance (Aswani et al. 2017; Arbo et al. 2018; Alexander et al. 2019; Glaser and Schröter 2020).

Navigating Brazil's ocean governance regime transformations

The Brazilian national ocean governance system is currently dominated by the operation of an Interministerial Commission of Marine Resources (CIRM) composed of fifteen high-level authorities of the federal government and the navy (e.g. ministries, civil house) and chaired by the Brazilian Navy's Command. CIRM was created in 1974 as a national response to discussions about the United Nations Convention on the Law of the Sea (1973) and of the Stockholm Convention (1972), as well as the global impulse to address environmental issues. It was born during a military regime (1964–1985) when the country was adapting to the oil crisis. The crisis, seriously affecting the economy, became the setting to a new phase of national oil exploration and economic autonomy (Marroni 2014). Brazil turned out to be a globally potent oil producer, and with massive oil reserves located offshore, CIRM consolidated its importance for the realisation of Brazil's economic aspirations. Under the strong leadership of the Navy, CIRM became a resonating platform for the country's sovereignty and entrepreneurial spirit towards the exploration of Brazilian oceanic treasures (Gerhardinger et al. 2019). CIRM's involvement in ocean issues was particularly important in relation to geopolitical claims over the Brazilian Exclusive Economic Zone and Extended Continental Shelf, which demanded a series of oceanographic studies coordinated under CIRM.

In the past decades, Brazilian governments have developed several laws, policies and programs for integrated coastal management, protected areas, environmental licencing, and other territorial or sectoral management policies (Stori et al. 2019). With the enactment of the National Constitution of 1988, ocean policies were embedded in democratic principles. The Coastal Management National Plan, also created in 1988 and regulated in 2004, led to the establishment of the Coastal Management Integration Group (GI-GERCO) within CIRM. GI-GERCO is the most participatory national ocean governance arena in Brazil, as it is the only one encompassing a seat for civil society and an academia representative. Brazilian governments and parliaments have developed further policy instruments to advance participation, integration, and sustainable approaches to ocean governance (Gonçalves et al. 2021).

In 2013, a new overarching marine bill was proposed in the National Congress that advances the ecosystem-based management (EBM) approach and cross-sectoral integration through marine spatial planning (MSP). The passage of this bill, however, has challenged progressive policymakers ever since.

While policies on how to govern the ocean have advanced into an extensive legal framework, in several circumstances these policies lack appropriate levels of implementation to steer more sustainable pathways—which is especially poignant against the backdrop of attempts to accelerate coastal and ocean-based economic development (e.g. Carvalho-Costa and Gerhardinger 2020; Nicolodi et al. 2021). A Brazilian MSP arena emerged in 2011, and the pre-planning phase developed significantly in subsequent years (Gerhardinger et al. 2019). In 2013, a special working group was officially designated within the CIRM system to become the governmental think-tank for the country's MSP process, namely the GT-UCAM (an acronym for 'shared use of the marine environment' working group in Portuguese). After the implementation of the special task force, however, the innovation process led by GT-UCAM entered a phase of quiescence, even though the number and diversity of non-state agents in the MSP policy arena has increased since then (Gerhardinger et al. 2019). Thus far, 8 years have passed and the Brazilian MSP continues in pre-planning mode, both at the legislative process aimed at crafting a new Marine Bill that includes MSP among other policy instruments, and at the heart of federal government efforts to take this agenda forward (GT-UCAM has ever since 2019 been renamed as MSP working group: GT-PEM, an acronym for 'marine spatial planning' working group in Portuguese).

In the past decade, Brazil has seen a surge in the number of aquatic transport infrastructure projects undergoing fragmented licencing processes (Gerhardinger et al. 2017; Herbst et al. 2020). The fragmentation and disconnection of major infrastructure licencing and urban development to sectoral planning add to a lack of fully developed MSP at the national level. Therefore, despite having an established legal framework for integrated coastal and nearshore (shallow) marine planning, the broader Brazilian ocean governance system presents overall low-performance levels and is largely operating in a politically unstable, fragmented, and sectoral policy-based regime across the jurisdictional scale (Gerhardinger et al. 2018; 2019). This is arguably the case from the level of integrated city planning, from states up to federal ordinances of the country's immense Exclusive Economic Zone (EEZ) and Extended Continental Shelf, with a total area larger of 5.7 million km².¹ For instance, in 2018, less than half of the seventeen Brazilian coastal states had

¹ https://www.mar.mil.br/hotsites/amazonia_azul

developed integrated coastal-marine management (ICM) plans to handle the uses and resources of over three hundred cities distributed along the coast (Nicolodi et al. 2021). This wicked context seemingly favours the relational atmosphere for political speculation, lobbying and bargaining in favour of traditionally powerful private actors or governmental national sovereignty interests, hence fostering unjust ocean policy-making arenas in Brazil (Gerhardinger et al. 2017; Carvalho-Costa and Gerhardinger 2020).

Previous inter- and transdisciplinary research (TDR) has assessed the conditions outlined above, attempting to understand Brazil's ocean governing capacities in further detail and identify contexts of opportunity for promoting transformative change. Gerhardinger et al. (2018) argued these flaws in the ocean governance system should be confronted with the evolution of polycentric, hierarchic and coevolutionary governance contexts (Jones 2014; Gerhardinger et al. 2018). Until 2018, Brazil's ocean governance system was still opening for transformation, inclined to develop from fragmented and sectoral approaches towards an integrated and ecosystem-based regime. Although the dominance of old institutions and premises were still evident, Gerhardinger et al. (2018) reported that signs that the system could be releasing resources as small pockets of and support to experiment with ongoing innovative ideas were present (see Gerhardinger et al. 2018 pg. 9). After this diagnostic was released, attempts to uptake such innovations in TDR co-design are being made by at least one ongoing sustainability research-action program in Brazil.² Institutional and political affairs of the Brazilian state, however, have radically changed with the election of a far-right government in early 2019. This shift directly affected the country's ocean governance arena, dissolving GI-GERCO permanently (Gonçalves et al. 2021) and shadowing the pathway towards a more participatory process. The new government's aversion to participatory democratic structures impelled an updated assessment by Gonçalves et al. (2021) of the opportunity context for transformation in the Brazilian ocean governance system. Their analysis argued that the recommendations by Gerhardinger et al. (2018) still hold valid. Institutional entrepreneurs are still under pressure to lower the undesirable resilience of the dominant (fragmented and sectoral) ocean governance system by introducing novelty using a series of

tailored strategies, employed skills, and types of agency that can steer evolution towards an integrated and ecosystem-based regime.

This paper, therefore, reports on the development and application of a scenario-building net-mapping protocol to analyse the perceptions of high-level Brazilian governmental authorities on the structure and dynamics of the social network of stakeholders involved in the country's emerging MSP arena. What can these perceptions tell us about the challenges to transforming the current regime and governing the Brazilian ocean territory and resources in a participatory, integrated and ecosystem-based approach? The material and methods section explains the combined data collection and analytical frameworks developed to generate insights and recommendations. We then provide the core results and use interactive governance theory (Jentoft and Chuenpagdee 2013) to discuss how the insights derived from the SNA analysis evidence how network-based marine spatial planning or other ocean sustainability research attempts may facilitate the identification of pathways to improve our shared 'capacity to govern the ocean' (hereby: ocean governability). We conclude by distilling five key potential contributions of participatory network mapping to radically transform ocean functional governability.

Materials and methods

Enacting future functional ocean governability narratives

The use of inspirational stories or narratives is increasingly recognised as a key component of sustainability transformations (Pereira et al. 2018). Visioning methods can potentially help social innovators (e.g. such as ocean policymakers) shape institutional futures—but only when they are able to facilitate changes in understanding and behaviour of stakeholders in a given socio-political arena and influence what they expect and deem possible in the world (van der Helm 2009). This paper reports on a participatory visioning method that generates qualitative and quantitative social network data on social networks to inform an assessment of present and future ocean governance capacities and interactions in Brazil.

This is the third of a series of three papers, each using interactive governance (IG) theory (Kooiman 2008) to assess existing and envision future functional ocean governability narratives in Brazil. Complete descriptions of IG theory, terminology, and applications to assess coastal and marine socio-political systems are abundantly available elsewhere (see Chuenpagdee and Jentoft 2009; Kooiman and Jentoft 2009; Jentoft and Chuenpagdee 2013; Triyanti et al. 2017) and in the context of the research program, this paper is a

² The recommendations derived from Gerhardinger and collaborators' (2018) application of the Theory of transformative agency was presented during the launching seminar of the Brazilian Ocean Horizon program hosted by the Brazilian Future Ocean Panel in April 2019 (Brasilia city, Brazil)—with the participation of over 50 early career ocean professionals from across Brazil. Ever since the program has supported the evolution of 8 thematic action research teams operating at the interface of knowledge and ocean policy in the country. <https://www.painelmar.com.br>

part of (Gerhardinger et al. 2018, 2019 and 2020). We used IG as a general heuristic to explore (the present and future of) five functional ocean governability analytical steps in the Brazilian MSP socio-political arena, entailing: i) the presence and quality of governing interactions (information sharing, co-learning, adaptiveness); ii) the fitness of governing elements (actions, instruments, and assumptions/images) to properties (dynamics, scale, complexity, and diversity) of the systems-to-be-governed (social and natural systems); iii) the responsiveness of governing modes (self-governance \Rightarrow led by civil society; collaborative governance \Rightarrow co-led by multiple organisations; and hierarchical governance \Rightarrow led by government authorities); iv) the performance qualities of governing orders (1st order = problem-solving and opportunity creation; 2nd order = institutional-building; and 3rd order = meta values, norms and principle-setting, and; v) the enabling and restrictive role of power relations (in regard to inclusiveness, representativeness, participation).

Gerhardinger et al. (2019; 2020) used the framework above to conduct document-based (2019) and key informant interview-based (2019) governability analysis of the nascent MSP arena (2011–2019). Building on the work of Jentoft and Chuenpagdee (2013), these authors also started a series of pressing future narratives on how engagement with network-based MSP transition experimentation in Brazil might offer opportunities to evolve the socio-political arena's functional ocean governability in structural ways. However, Gerhardinger et al.'s research had so far predominantly engaged with non-state actors' perspectives and largely conducted metaphorical and descriptive social network research approaches (cf. Alexander and Armitage 2014). This paper advances this analytical series, now building on the insights of structurally explicit social network analysis. It draws attention to how our informants, formally designated members of a Brazilian federal government's MSP think-tank (GT-UCAM), perceive the social structures in the governing system they are fundamental parts of. We use a novel participatory network mapping routine to synthesise their (governmental) perception of the structure and evolution of the MSP arena and to enable future visioning of social network properties and evolutionary dynamics.

Net-mapping of the Brazilian MSP arena

Participatory network mapping of perceived ocean governance networks has been used to assess features of social networks in marine protected area governance in Brazil and elsewhere as mentioned earlier. This study, however, is one of the first scholarly researches to report on the application of an adapted net-mapping protocol (after Schiffer and Hauck 2010) to facilitate an envisioning exercise of the future of ocean governance networks and to inform a functional ocean governability analysis. Holzkamper and

Gerhardinger (in review) provide a more detailed outline of the SNA methods and associated descriptive statistics used for metrics applied to generate the visualisations (e.g. indexes) we report in the present research paper. We used the novel net-mapping protocol to map the perceptions of members of GT-UCAM (hereby 'key informants') about the organisational structure emerging out of the incipient Brazilian MSP arena. The Secretary of CIRM generously contributed to the scheduling of focal group interview sessions which were undertaken in May 2018 in Brasilia, Brazil's capital city. Twelve net-mapping focal group sessions with 10 ministries³ involving several participants each were conducted, and audio recorded after formal written consent. Both the current structure and desired/anticipated changes in the governance system were mapped on these occasions.

In the first step of the protocol, the informants identified the actors of the Brazilian MSP arena. Informants named the actors and attributed one of the following pre-categorised labels to them: 'public' (to designate representatives of state); 'resource user' (to identify actors representing marine ecosystem users); 'non-governmental organisation' (to point out other organised non-state actors); and 'public forum' (to highlight decision-making bodies or platforms). Key informants also pointed out those actors that were not active agents in current discussions regarding the national-level MSP process but should be integrated in the future (anticipated MSP arena). Further, our informants characterised how the actors of the Brazilian MSP arena are interrelated by drawing directed links between them. Links represented their perception of the different types of relationships, i.e. 'implementation or planning of common projects/actions'; 'exchange of financial, informational, or other resources'; 'inspection/complaints'; and relationships that 'need to be improved' (e.g. improved number and quality of interactions, communication, conflict resolution etc.). Informants also classified actors as already engaged or to-be engaged; and the relationships either as already established/existing or still required/anticipated. Finally, our informants characterised the structure of political influence (power) in the MSP arena by assigning levels of influence to each actor they had named: 'no influence' (level 0); 'less influential' (level 1); 'medium influential' (level 2); 'quite influential' (level 3); and 'very influential' (level 4).

³ Ministry of Tourism ($n=1$ focal group session); Ministry of Environment ($n=2$ focal group sessions); Ministry of Mining and Energy ($n=2$); Ministry of Planning, Development and Management ($n=1$); Ministry of Science, Technology and Communication ($n=1$); Special Secretary of Fisheries and Aquaculture ($n=1$); Ministry of Development, Industry and Commerce ($n=1$); Ministry of Defense ($n=1$); Secretary of the Interministerial Commission of Sea Resources ($n=1$); Civil House ($n=1$).

The outputs of the net-mapping focal group exercises were twelve visual depictions (on paper) of the Brazilian MSP governance network. We digitised the quantitative data about actors, associated linkages and influence levels for the current and anticipated MSP arena and analysed the data using the software Gephi 9.0 (Bastian et al. 2009) and Rapidminer (Hofmann and Klinkenberg 2016). While this paper emphasises structural changes in the network, we also collected in-depth qualitative data on the most important perceived interactions recorded on paper. We semi-transcribed and organised the qualitative data in a spreadsheet jointly with the respective quantitative data.

Throughout this and our previous papers, we evoke qualitative information about the interactions to enrich the specific contexts of analysis. We conducted the following quantitative data treatments: (1) we simplified actor richness in common categories to render analytical coherence (annex I); (2) we integrated different network data sets to allow for an overview of the perceptions of all government authorities who participated in our research; and (3), to account for differences in perception, we assigned weights (= 1) to each time the link was named by a participant (this resulted in different link thickness in the network visualisation). We describe our data treatment and analysis in detail in Holzkamper and Gerhardinger (in review).

We use the following terminology for the aggregated networks: 1. The ‘current’ network is the network that informants perceive as established at the time of the interview (continuous lines in the net-map activity). 2. The ‘still required’ network is the network which only includes those links that still need to be established, as perceived by the informants. It is the network that is anticipated to ‘add on’ the current network in the future as it evolves (dotted lines in the net-map activity). 3. The current and the still required networks together form the ‘anticipated’ network (the complete network as anticipated in the future).

Next, we offer a summary of the SNA (Table I) and discuss the functional ocean governability insights provided by the key informant’s perceptions on actor diversity, actor linkages, link diversity and power distribution (reputational influence) in the investigated MSP arena. Governability insights acquired through the informants’ perceptions are then used to examine the opportunity context for the transformation of the Brazilian ocean governance system towards an EBM regime.

Results and discussion

Building functional ocean governability narratives

Our paper is the first to provide far-reaching explicit visualisations of interactional structures of the Brazilian MSP arena

(Fig. 1), revealing its perceived patterns, and identifying evolutionary challenges (Fig. 2) and opportunities (Fig. 3) to achieve more radical narratives to improve each of the five functional ocean governability dimensions.

Presence and quality of governing interactions

In total, 144 interacting actors were identified in the Brazilian MSP network, and another 15 isolated actors are still anticipated to engage in MSP national discussions (plus one actor which is envisioned in the anticipated network only) (Fig. 1). We offer a summary of how SNA has informed the insights presented here on the evolution of functional governability in the MSP arena (Fig. 2). Our first analytical step (presence and quality of interactions) is important to elicit not only what type of network-based MSP interactions were perceived as present or still required, but also to underline how they influence ocean governability in Brazil. Interactive governance theorists argue that governability in coastal systems derives from the very existence (absence/presence) of governing interactions of various types (Chuenpagdee and Jentoft 2013). The more actors exist and interconnect their governing system to the natural and social systems (systems-to-be-governed), the more actors can reach out to each other, creating a greater diversity of interactions. This entails connectedness between actors from different spatial and administrative levels, parts of society, and sectors. Increased connectedness can improve governability, depending on their qualities and the institutional conditions framing them (Chuenpagdee and Jentoft 2013). Kooiman and Bavinck (2013) suggest that governability interactions should have qualities that enhance social learning, representativeness, the effectiveness of communication and level of information flow. Our data reveal important mismatches between 1) the Brazilian MSP arena as it is perceived by the informants now and in the future and 2) what characterises a good ocean governability.

Overall, our informants perceived an arena actively dominated by few, but very influential federal government actors. They also anticipate that this arena will remain relatively unchanged during the early design of the Brazilian MSP. The informants expect that public actors’ reputational influence slightly decreases relative to the overall influence in the network. This signals the leasing of power to other agents in the MSP arena stemming from the addition of new players to the network. There are several currently isolated nonpublic actors that our informants anticipate engaging with the MSP network in the future (but usually with a low number of connections). These actors are mostly forums and other representatives of commercial and sport fisheries, aquaculture, nautical tourism, and aquatic transport workers. However, the expected change is very small and arguably does not broadly affect the state of affairs. Moreover, our informants appreciate the ongoing and continued operation of highly

Table 1 Main guiding questions, analytical and visualisation methods, and application for acquiring perception data through participatory future network mapping to understand the social network composition, interactional structures, and power in the current and future Brazilian marine spatial planning arena. See Holzkämper and Gerhardinger (in review) for detailed methodological information and visualisations

Network attributes	Guiding questions	Social network analysis	Visualisations	Current network	Anticipated network
Network composition: share of actor types and link types in the network	How many actors and links are there? Who is part of the main network component, and who is not?	Count the number of actors and links and identify the isolates	Overall simplex network graphs (current and anticipated)	<ul style="list-style-type: none"> • 144 actors in the main component • 15 isolates • 982 connections (simplex network) between the actors of the main component 	<ul style="list-style-type: none"> • New actor: idealised future colleague body • 8 isolates link up to the main component (mainly forums) • 7 isolates remain (mainly NGOs) • 559 new connections (simplex network) between actors of the main component
	What share do different actor types have in the network composition?	Calculate and compare the share of the different (simplified) actor types in the overall number of actors in the network	Bar graph	<ul style="list-style-type: none"> • Public actors dominate the network (40.3%) • Resource users are ranked second (25%), largely due to a large proportion of business organisations (18.8%) • NGOs reach 21.5% • Forums are less prevalent with 14% 	<ul style="list-style-type: none"> • The network remains dominated by public actors, undergoing only a slight decrease in composition (39.5%) • Resource user and NGOs' proportion in the network composition decreases very slightly • Forums undergo the most significant change: they increase their network composition to 15.0% • The network shifts towards a slightly more heterogeneous state, mainly because of an increase in forums connecting to the main component
	Which types of interactions are named by the respondents, and how often?	Count how often a connection between two actors is perceived and which link type the connection is attributed to. Conduct a proportion analysis on the frequency of link types	Table	<ul style="list-style-type: none"> • Total of 2075 links (multiplex network) • Fiscalisation (approx. 30%) • Project implementation (approx. 27%) • Flow of resources (approx. 19%) • Building norms (15.6%) • Conflict (approx. 9%) 	<ul style="list-style-type: none"> • Multiplex connections increase by approx. 32% (667 new connections) • Fiscalisation and implementation of projects still dominate the network, but their proportion decreases (23.2% and 26.6%, respectively) • Building of norms increases most (19.7%) • Resource links stay largely the same • Relations indicating conflict also increased significantly (12.1%)

Table 1 (continued)

Network attributes	Guiding questions	Social network analysis	Visualisations	Current network	Anticipated network
<p>Power in the network: actors' reputational influence and influence based on actor's centrality in the network (degree measure)</p>	<p>What share do different actor types have in the network's reputational influence?</p>	<p>Calculate and compare the share of the different actor types of influence in the overall reputational influence in the network</p>	<p>Bar graph and simplex network graphs with nodes sized by their reputational influence</p>	<ul style="list-style-type: none"> Public actors are the most influential (51.4%) actor type with an impressive portion of influence stemming from the federal government (40.1%) Resource users' influence is 16.5% distinctly lower than public actors' influence With 18.7%, NGOs' influence ranks second after public actors, surpassing the resource users Forums are the least influential actor group (total 13.4% influence), although federal multi-stakeholder forums (8.1%; such as GT-UCAM) are almost as influential as public interest groups from the NGO category (9.7%) 	<ul style="list-style-type: none"> Public actors show a slight decrease in influence (50.5%) Resource users' and NGOs' influence are anticipated to decrease very slightly Forums slightly increase their influence, mainly due to the new collegiate body (gaining 2.2% influence) The network shifts towards a slightly more heterogeneous state, mainly because of an increase in influence by forums
	<p>Which actors and actor sub-types are most/least central?</p>	<p>Calculate and compare the degree centrality of (a) actors and (b) actor subtypes</p>	<p>Simplex network graphs of the current and still-required expanded (actor type-level) and the condensed (actor subtype-level) networks with nodes sized by their degree centrality</p>	<ul style="list-style-type: none"> Public actors have the largest level of degree, with several very influential federal government actors dominating the network with the Ministry of Environment, MMA, and The Federal Public Prosecutor's Office, MPF being the most connected Government-led forums are also very central with the Interministerial Commission on Sea Resources, CIRM being the most connected forum Federal government-led multi-stakeholder and intra-governmental forums, academia, the press, public interest groups, and business are reasonably well connected Other public actors and most NGOs are peripheral/poorly connected Resource users are overall peripheral and with lower influence levels than other actor types with the best-connected resource users being 'big businesses' like the oil industry and ports 	<ul style="list-style-type: none"> Public actors remain central The overall increase in networking and thereby increase in centrality largely refers to the engagement of and between public actors, e.g., the increased interaction between the Fisheries and Aquaculture Ministry (SEAP) and other public actors Links from public interest groups to federal governments have a lower increase in degree level compared with that of other actors Forums that highly increase networking are the new collegiate body, CIRM, and GT-UCAM, with the new collegiate body also reaching out to NGOs and resource users Resource users and most NGOs overall remain peripheral, except for academic actors which are anticipated to become better linked to public actors

Table 1 (continued)

Network attributes	Guiding questions	Social network analysis	Visualisations	Current network	Anticipated network
Interactional structures	How (quantity, directionality) are the different actor types interconnected?	Aggregate the number of links perceived between two actor types and conduct a proportion analysis on the number of links between actor types	Sankey diagrams illustrate the number and direction of fluxes between different actor types	<ul style="list-style-type: none"> Public actors are the main active players in terms of interactions, sending and receiving approx. 55% of all links The network is dominated by the interaction of public actors with themselves (approx. 26%) Public actors maintain a balance between receiving and sending NGOs are more actively sending links than receiving, while forums and resource users are more passive targets of interactions rather than actively sending links 	<ul style="list-style-type: none"> The overall increase of links (32%) largely derives from new connections between public actors Forums and resource users remain strong receivers of links, with forums slightly increasing both sending and receiving of links NGOs and resource users are increasingly targeted NGOs also remain strong senders of links; however, the dominance of sending activities is less pronounced, mainly due to a decrease in NGO to public interactions Public actors increase their sending activities

influential federal government stakeholder forums (e.g. GT-UCAM, CIRM) for the future of MSP pre-planning in Brazil; and multi-stakeholder (linked to the federal government) forums that are somewhat open for limited public participation (e.g. GI-GERCO) are anticipated to remain largely as influential as they are today. Noteworthy, our informants did not anticipate the severe ruptures in the presence and quality of governing interactions caused by the instalment of an ultra-conservative federal government in 2019—in the few existing ocean governance democratic structures, e.g. termination of GI-GERCO and various other public participation forums (Gonçalves et al. 2021).

This analysis reveals a conservative perception of the evolution of MSP as a consensus among the informants: that the early phase of designing the Brazilian MSP will remain a governmentally enclosed process with emphasis on the federal level. Since ocean governability requires connectedness with actors operating at sub-national levels in the implementation of policies closer to where problems and opportunities arise, the lack of reputational influence and composition by state and municipal governments, for instance, signals such mismatch—hence the narrative points to continuing low governability. Moreover, interactive learning is another critical feature for promoting radical change in systems facing inertia, and it can lead to increased adaptiveness through a creative combination of a more diverse scientific and local ecological knowledge base (Armitage et al. 2009; Kooiman and Jentoft 2009). Most of the future MSP networking that informants anticipate originates from public actors, and to a lesser degree also from forums. The largely intra-governmental dynamic of the perceived Brazilian MSP arena and its timid evolution also greatly misses the purview of the potential MSP knowledge base that might be available outside the governmental sphere. Nevertheless, the significance of the message provided by our informants concerning what may be considered a ‘timid’ MSP arena evolution is not to be underestimated.

Our results show critical progress is still needed to bring fundamental change in how and how much intra-government actors interact with one another. First, the currently perceived multiplex Brazilian MSP network regime is dominated by 1st order interactions such as fiscalisation and project implementation, however, this is anticipated to change in the future. The current figure largely derives from the important role of public agencies in charge of controlling the implementation of sectoral (area-based) policies and depicts the intensive participation of federal government actors regularly at CIRM and other subordinated forums. For instance, project implementation through GT-UCAM (now called GT-PEM), is a very important component of the overall network. Because our informants’ perspective is situated in their positions as designated members of this forum, this outcome is not

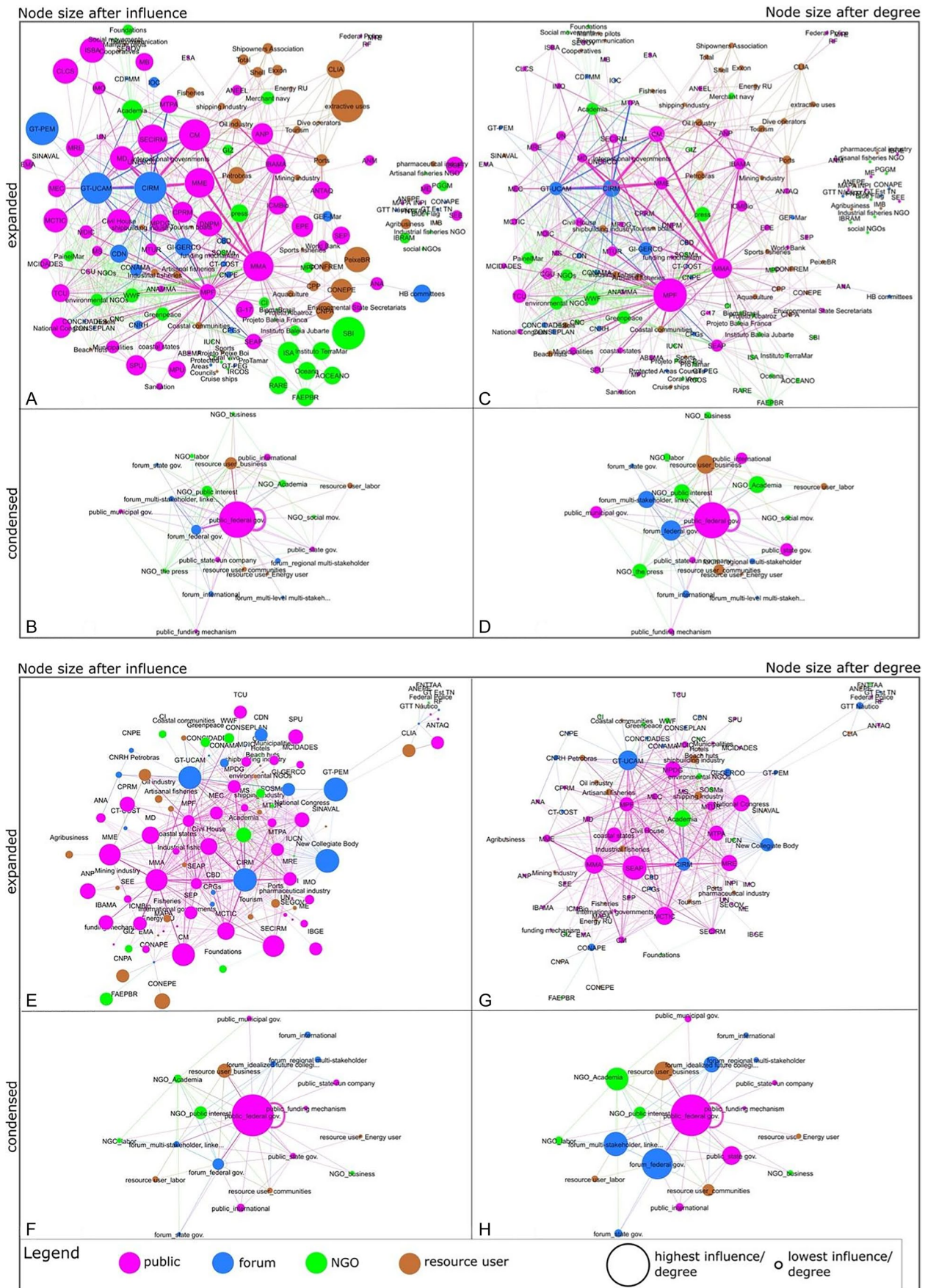


Fig. 1 Expanded and condensed current and still-required networks of the Brazilian marine spatial planning socio-political arena (left: node size after perceived influence; right: node size after degree/connectedness; edges width after the frequency of perception). **A–D** Current network; **E–H** Still required network

surprising. Their perceptions, however, are relevant for the entire governance process as the very mandate of GT-UCAM concerns the advancement of an MSP framework in Brazil. Interestingly, GT-UCAM is not a legislative body, as it is mandated only to generate guidance and alternative pathways to support the building of new MSP-related norms. Indeed, our informants anticipate that the arena will, in the future, strongly advance the building of new norms, largely following GT-UCAM’s statutory outcomes to generate recommendations and guidance to advance MSP in the country.

Second, we may cite a shared expectation for the Ministry of Fisheries and Aquaculture (SEAP) to effectively join the building of an MSP arena in Brazil, given that it has by far the highest degree measure in the still required network. Fisheries management in Brazil has arguably been a disaster in the past years (Pineiro et al. 2015), with recurrent changes in leadership, extinctions of fisheries management forums and over a decade of discontinued fisheries statistics

programs, among other severe socio-political and technical flaws. In 2018, Brazil has designated very large offshore marine protected areas around oceanic islands (Giglio et al. 2018), but the fisheries sector and the Fisheries Ministry were not quite involved with decisions taken at a very high level in the government concerning the designations of these MPAs (as reported by some of our informants). This has caused fury by some pelagic fishing operators (e.g. tuna fleet) that faced potential economic loss, and criticism by scientists supporting an alternative optimal MPA design (Magris et al. 2018).

This is just an illustration of how deficiencies in the existing approach to spatial planning still hinder Brazil’s ocean governability: by lacking institutionalised MSP governing interactions and by the insufficient quality of representation and information flows. It is also interesting to note that links classified as conflicts are also perceived to increase in the anticipated network composition because as the MSP network evolves, currently, immanent conflicts may find their way into manifestation in the interactional structure.

The assessment of the governing system’s capacities also calls attention to three features that will be discussed next: goodness-of-fit, responsiveness, and performance in addressing the outlined challenges and opportunities in the Brazilian ocean problem domain.

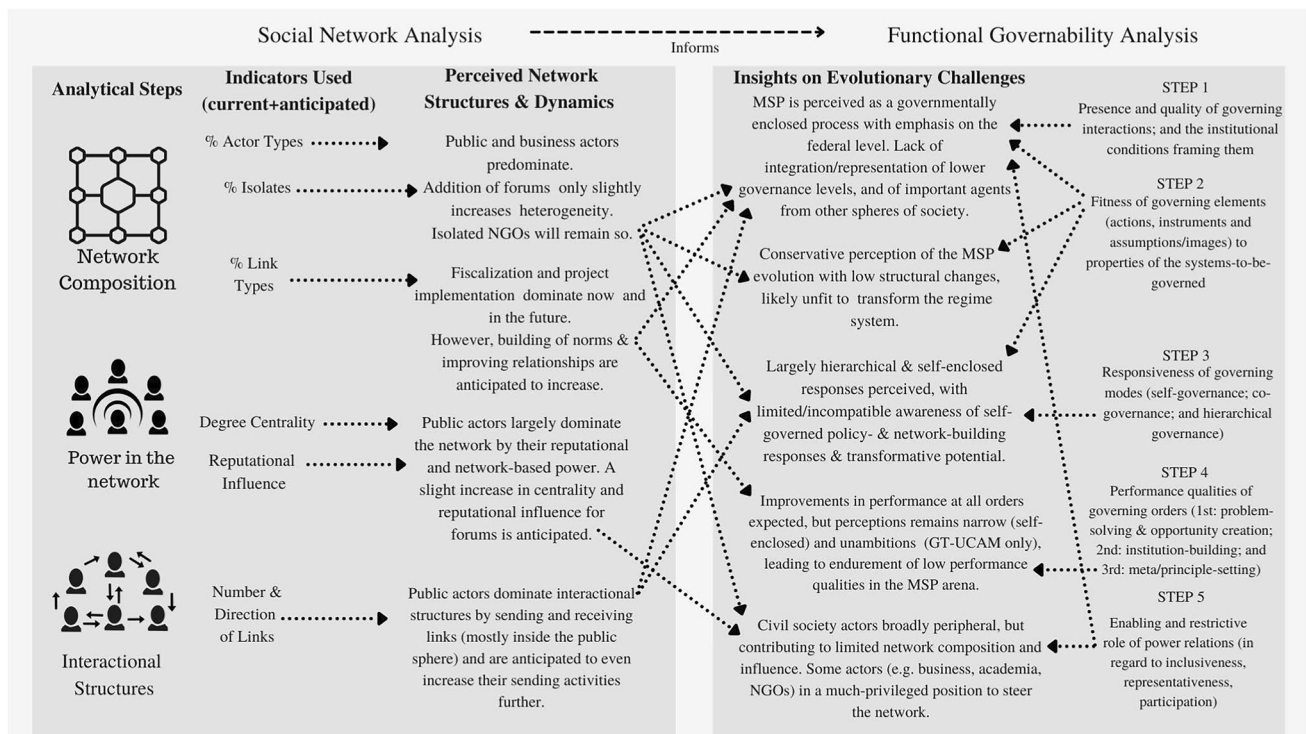


Fig. 2 Summary of the contributions of social network analysis of the emerging Brazilian marine spatial planning (MSP) sociopolitical arena, in generating functional governability evolutionary insights

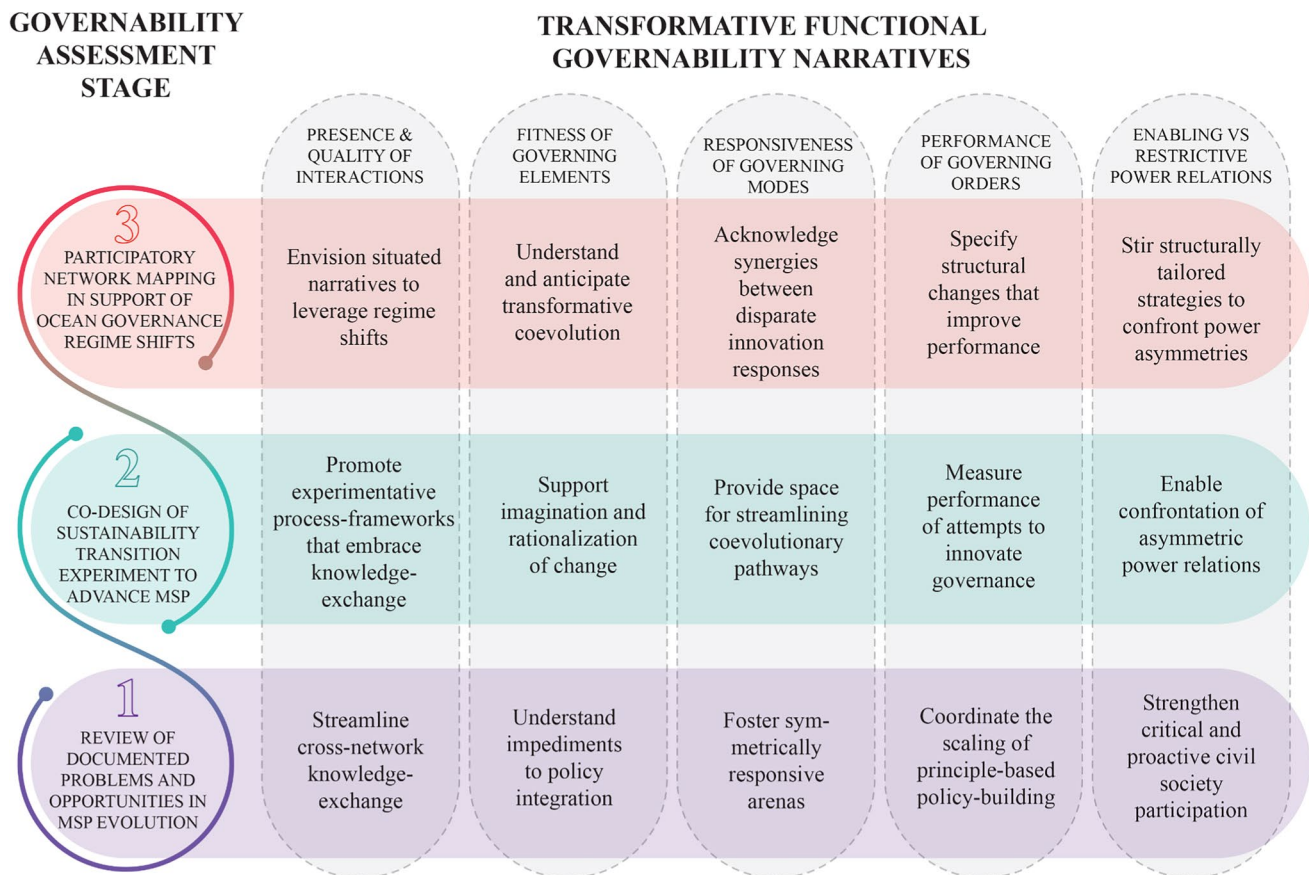


Fig. 3 Five potentially transformative narratives of functional ocean governability, designed following development and application of a three stepwise transdisciplinary diagnostic of the emerging marine

spatial planning arena in the Brazilian ocean governance system (Gerhardinger et al. 2019: stage 1; Gerhardinger et al. 2020: stage 2; and the present paper: stage 3)

Fitness of governing elements to properties of the systems-to-be-governed

This step of the functional governability analysis presupposes that the poorer the fit (i.e. compatibility) of governing elements (i.e. actions, instruments, and principles/images) to the properties of ocean systems, the greater the governability problems (Chuenpagdee and Jentoft 2013) affecting the evolution of the Brazilian MSP arena. How appropriate are these governing elements in promoting a regime shift? We turn out the analysis here to the inner design of the nascent MSP arena in terms of how its evolution is perceived, i.e. if the arrangements anticipated by our informants seem fit to address the current low levels of integration in the implementation of area-based governance.

Overall, GT-UCAM members clearly allocate the core of MSP activity within the federal government sphere (indicated by the higher frequency of perceived links and reputational influence). They might share a common ground in their view of the network's evolution. However, this view would not lead to radical structural changes

leading to systemic improvements in functional ocean governability, such as opening up government-enclosed processes to stakeholders from different parts of society and administrative levels and assigning these stakeholders the influence needed to co-govern the ocean. These gaps also pose a major challenge to improving the fitness of governing elements, because in the common perception of our informants, there is no consistent pathway for major system-wide institutional change. Therefore, a long but critically important way remains ahead of CIRM to acquire the operational institutional steering capacities, and an appropriate normative long-term vision for the country's future blue economy.

Improving Brazilian ocean governability will depend on achieving consistency between the emerging images, instruments, and actions and how they will address the enduring problems of fragmented, sectoral and non-inclusive ocean governance approaches. High hopes are currently placed in the ongoing debate around a new Marine Bill for the Brazilian ocean at the National Congress. This bill could provide a legal framework more explicitly addressing integration,

the ecosystem-based and other principles such as the precautionary approach (Kooiman and Jentoft 2009), as well as ordinances to improve procedural justice (Chung et al. 2019). However, our informants generally had not much to report on the relationships between this highly critical policy-building process and their work within GT-UCAM, as shown by the low number of meaningful interactions perceived with the National Congress (Fig. 1).

Achieving a minimum internal level of bonding social capital (see Bakker et al. 2019) is still needed for GT-UCAM to become more successful in achieving a cohesive vision and consensual work plan for MSP implementation in Brazil. Nevertheless, our informants' shared perception points to necessary key changes in intra-governmental dynamics, underlined by the perceived importance of connections associated with the construction of norms in the anticipated MSP network. We can regard this awareness as a condition for governability improvement.

Responsiveness of governing modes

The three governing modes, i.e. self-governance \Rightarrow led by civil society; collaborative governance \Rightarrow co-led by multiple organisations; and hierarchical governance \Rightarrow led by government authorities, and the two-way character of ocean governance responsiveness '...those governing should be responsive to the wishes of the governed, and the governed to measures taken by their governors' are acknowledged in the literature (Kooiman and Jentoft 2009). In this analytical step, higher governability in the emerging Brazilian MSP arena will derive from its effectiveness and ability to respond to ocean governance challenges (Chuenpagdee and Jentoft 2013).

The greater the diversity of actors in the ocean (such as is often the case with MSP), the greater the need for decentralisation of governance responses to deal with details and subtleties (Wever et al. 2012). But Chuenpagdee and Jentoft (2013) rightly note that decentralisation comes with a price, related to administrative order and efficiency challenges, rights, equality and the mobility of users that move across ocean systems. On the other hand, the more complex a system-to-be-governed is, authority is required by a central government to facilitate such coordination (Chuenpagdee and Mahon. 2013). Gerhardinger et al. (2018) argue for a nested 'coevolutionary polycentric hierarchical' ocean governance model (see Jones 2014) for Brazil. Governance needs to recognise the fact that ocean systems are spatially interconnected. Advancing an approach that addresses problems at different geographical scales would require multiple and simultaneous levels and modes of governance in the organisational hierarchy. This approach may nurture participation and institutional learning arising from a more sensitive hierarchical approach, in synergy with the enforcement

of strategic objectives through negotiation and compliance with and by resource users.

Our study explores the perception of key informants who are situated at the top of hierarchic modes, and hence are biased given their emphasis on the role of the federal government in the evolution of the MSP arena. Our results show that the informants have limited awareness of the potential contributions of linkages with other emerging or ongoing collaborative or self-governed responses to area-based challenges and solutions in Brazil. For instance, we refer to the lack of coordination between responsiveness with different state powers (e.g. low linkages with the National Congress institutional-building process described above); the modest levels of importance of the contributions of the only federal multi-stakeholder ocean governance forum in Brazil to advance MSP, namely the Coastal Management Integration Group (GI-GERCO); or poor coordination of intra-governmental sectoral responsiveness as in the case of major flaws in the implementation of specific policies (e.g. Fisheries and Aquaculture and designation of new MPAs) and in how these relate to the MSP arena.

We may also refer to other national or subnational area-based policy and network-building initiatives that have not been perceived at all, hence probably not deemed especially relevant to be engaged in the anticipated coevolutionary pathway. A case in point is the bottom-up claim for a new spatial marine management legislation to be submitted to the National Congress, arising from a massive campaign of small-scale fishers' groups throughout the country (Glaser et al. 2020). They were also mostly unaware of the fisher's organisation's pledges for the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication in Brazil, which strongly call for the protection of small-scale fisheries territorial rights and marine tenure systems (ICSF, 2016). Moreover, given the range of actor types perceived by our informants, it is revealing that there were very few mentions of 'networks' of organisations, despite the growing recognition of their potential to promote bridges at science-policy interfaces and to improve democratic governance of oceans more generally. Gerhardinger et al. (2018) report an incipient engagement (in 2012) of 64 ocean networks in joint transdisciplinary practise during the Rio +20 and the Peoples' Summit. These authors had identified 39 non-state (cross-organisational knowledge) networks (composed of various individuals and academic- and/or policy/advocacy-oriented organisations). Interestingly, only a few ($n = 1$; coded under NGOs: PainelMar) of such networks were mentioned by our government informants through participatory network mapping. This suggests their lack of understanding of the diversity of potential actor types and hence knowledge availability and accessibility, i.e. how to mobilise them to support the evolution of MSP in Brazil.

Finally, the potential role of linking up with actors involved in ongoing innovative subnational MSP processes have not been pointed out by our informants. An example is the highly collaborative multi-stakeholder forum formed in Santa Catarina state around the Babitonga bay, that has been supporting integrated, area- and ecosystem-based coastal governance even without a formally designated legal mandate (Herbst et al. 2020). Our informant's eminent lack of perception of the area-based initiatives outlined above suggests that these are not considered immediately important to steer the Brazilian MSP step-zero phase. We argue that linking these and other collaborative solutions with more sensitive hierarchical processes that go beyond the largely hierarchical and self-contained modes of response perceived by GT-UCAM members represents a great potential for innovation in area-based management solutions that remains to be explored.

Performance of ocean governance orders

The last aspect in the assessment of governing system capacities is a closer look at the performance of three different ocean governance orders (1st problem-solving and opportunity creation; 2nd institutional-building; and 3rd meta values, norms and principle-setting) and their capacities to function, operate and lead to desirable outcomes. Interactive governance theory postulates that the better these orders perform, the higher the governability (Chuenpagdee et al. 2008; Chuenpagdee and Jentoft 2013); but performance should be assessed in face of what the governing system is able to deliver and should do to enhance it, in other words 'what is good enough' (Jentoft 2007; Chuenpagdee and Jentoft 2009). This stresses that there might be limits to how governable the immense Brazilian Exclusive Economic Zone (EEZ) is, and to the level of performance one can expect under present and anticipated circumstances.

While the implementation of projects is dominating in both current and anticipated networks, the building of norms is the type of connection anticipated to increase most. A high-level working group (GT-UCAM) has been designated by the Brazilian federal government ever since 2013 to statutorily inspire new MSP norms. But the fact that it has been in operation for 8 years and has not yet reached a conclusion nor presented a consistent way forward is worrisome. The current state of the network offers an illustration of how the lack of an appropriate MSP framework is already hindering conflict resolution. For instance, we may refer to the recent case of conflicts with scientists and fish workers emerging out of the sub-optimal design of new offshore marine protected areas; or even the low levels of our informant's perceived importance of the adoption of indicators such as transparency, intra- and inter-generational justice to steer the advancement of the emergent MSP arena (Gerhardinger

et al. 2020). This assessment of ongoing conflicts is in line with the fact that relations indicating conflict are anticipated to increase significantly.

In general, Brazil is known to have achieved low levels of performance in the implementation of integrated coastal zone management policies (Nicolodi et al. 2021). While there are no formally established instruments to regularly assess in which ways these policies are being effective, the baseline is even worse if the question of performance encompasses what goes on beyond the coast to include offshore marine waters at the EEZ level. This highlights the urgency of institution-building and principle setting in relation to MSP so that the principles that some key stakeholders (such as small-scale fisheries) consider particularly important (e.g. justice and transparency) can be adopted. It also means that no clear accountability structures and mechanisms exist for social licencing, nor are there procedures in place to distribute ocean commons in an equitable way.

Meanwhile, the narrative of the blue economy or blue growth as an important force in the future Brazilian economy has gained traction in the federal government and academic circles. For instance, a new inter-ministerial working group at CIRM has been recently designated to discuss 'Ocean Gross Domestic Product' even though a GDP approach has been subject to profound criticism as it may not reflect human development (UNDP, 2020). However, our results indicate a low level of preparedness of the current and the anticipated Brazilian ocean governance system to perform well on the backdrop of the levels of economic growth expected by some blue economy enthusiasts.

Now, with the COVID-19 virus pandemic, the already poor social licencing of the Brazilian ocean resources risks becoming even more unjust if neoliberal policies are further accelerated by de-regulation of coastal development fostering further ocean grabbing. This scenario implies the hypothesis of further judicialization of socially-environmentally untenable development projects in the near future. This has the potential to increase the speculative atmosphere around coastal development, a pattern that in our opinion should not be welcomed by corporate interests in a blue economy setting. This is a serious concern given the tone of recent dialogues at the high-level federal governmental sphere. For instance, the Ministry of Environment loudly praised the government for taking advantage of the pandemic to accelerate massive deregulation, while neoliberal Brazil's Ministry of Economy Paulo Guedes stated '...we are going to earn money using public resources to save big companies. Now, we will lose money-saving small companies.' (April 2020).

How to confront the MSP arena's path-dependency in terms of such performance gaps and under dominant neoliberal mindsets is a critical challenge for actors willing to transform the ocean governance system. This challenge,

we argue, would be more appropriately dealt with by inter-network activities capable of accelerating the coordinated scaling of innovative area-based solutions through principle-based policy-building (e.g. social equity, ecosystem-based approach). The adoption of what is broadly known as ‘sustainability transitions experiments’ (Luederitz et al. 2017) or ‘transition management’ (Kelly et al. 2018) that combines peer-to-peer learning and a range of other networked-knowledge to action approaches between social innovators are a promising way forward for the Brazilian MSP arena (Gerhardinger et al. 2018; 2020; Dalton et al. 2020).

Enabling and restrictive role of power relations

Finally, the functional governability analysis of the nascent MSP arena should pay attention to another key aspect of governing interactions, the enabling and restrictive role of power relations (inclusiveness, representativeness, and participation) (Chuenpagdee and Jentoft 2013). Power concentration with certain stakeholders may constitute a governability challenge (Chuenpagdee and Jentoft 2013). Therefore, a closer look at how it is perceived to be distributed among actors in the Brazilian MSP provides insights on the extent and conditions under which the conditions under which the perceived evolution of power relations might facilitate or restrict area-based governance to achieve desired outcomes.

In our study, the reputational influence was perceived to be distributed differently unevenly among actors in the investigated MSP interactional structures: currently, the arena is largely dominated by a few very influential federal government actors (public and forums). In addition, our informants do not expect major changes to occur beyond achieving better intra-governmental cohesion. Business (resource users) were seen as the second most influential actors (Fig. 1), signalling the potential prevailing influence of private interest on Brazilian federal government ocean policymaking, which is even above the perceived influence of public interest groups (NGOs). Business actors are also more important targets by federal government actors than public interest groups, in our informants’ view. Given that what is at stake here is a precious public patrimony, the implications of such perceptual features for actual ocean policy-making requires vigilant and sustained transdisciplinary sustainability research and attention by concerned actors in the MSP arena.

Several actor subtypes, which are key players in MSP have not been perceived as influential, nor significantly present in the arena. For instance, the relatively low share of composition and influence by forums (especially those open to stakeholder input) can be associated with the incipient nature of MSP in Brazil or even the lack of appropriate participatory structures for ocean governance in Brazil. Coastal state governments are also major authorities in resolving

problems and enabling opportunities in the coastal-marine zone. However, they have a surprisingly low share of reputational influence in preliminary MSP discussions according to our informants. One could justify that MSP would predominantly embrace offshore areas, beyond the mandate of integrated coastal zone policies; but it is unequivocal that MSP should be inextricably linked to coastal management and development (e.g. who earns the Royalties of big oil exploration?) hence, the need to engage with state public actors early on.

Furthermore, the notably low levels of the composition of some other actors such as social movements and cooperatives, state government stakeholders, multi-level multi-stakeholders, and the press, among others, further depict an incipient, poorly organised arena that is still not much permeable to the influence of diverse societal structures. The limited level of composition of and reputational influence in the network by these important actors, as well as the implications of their apparently only modest contribution to shaping the Brazilian MSP pre-planning stage, raises critical points for future research, and action by agents in this arena.

Some actors show a relatively high reputational influence in comparison to their numbers in the arena. Given our informants’ background and official mandate in designing MSP pre-planning in Brazil, it is not surprising that federal government actors and stakeholder forums are seen as highly influential. However, the outstanding relative reputational influence of academia, labour organisations and state companies are noteworthy. The potential role of these highly regarded actors in the transformation of the MSP arena should be further explored by future research. The highly regarded reputational influence of academia can signal an appreciation for advancing a science-based MSP agenda. On the other hand, Gerhardinger et al. (2020) note that our informants had a focus on technical knowledge and expertise, not on a more diverse knowledge based including stakeholders’ knowledge. Nevertheless, we argue that academics interested in the evolution of MSP should use every opportunity to stress the importance of expanding and diversifying the knowledge-base in order to avoid an overly top-down, technocratic and depoliticized MSP arena.

Our results show that some particularly influential actors (e.g. business) are perceived to be in a much-privileged position to steer the governing system in their favour. This is a central governability challenge because it may render the MSP arena unable to cope with problems and opportunities in an environmentally sustainable and socially equitable way. In 2018, the current and anticipated state of operations in the arena was largely not inclusive. This condition probably limits the arena’s capacity to deliver cross-level knowledge exchange, to transform conflicting into synergic development pathways, to foster other actors’ buy-in of future MSP plans and to build social capital (Gerhardinger et al. 2019).

On the other hand, our qualitative data indicate several of our informants are aware that social participation is not desired at this stage, since a minimum level of trust, coordination and cohesion first had to be achieved within federal governmental structures before opening the arena for other actors. We argue that this notion seats at the top of a wicked-problem challenging regime transformation in Brazil. Such cohesion and inter-ministerial coordination are hardly possible to be achieved under the continuous political and institutional instability the country has been facing; at least since 2015 at the start of the quiescent phase of MSP pre-planning in Brazil (Gerhardinger et al. 2019). The wickedness of the problem spans from the fact that while the innovation process seemingly becomes halted, social injustice and environmental degradation thrive worryingly because of poor governability.

While the prospects shared by our informants are not at all alleviating in this regard, a window of opportunity has been pointed out by one of the informants, offering a possible leveraging point for actors willing to influence regime shifts in the Brazilian MSP arena. The participant anticipated the creation of an entirely novel collegiate body for MSP in the country, which would be responsible to steer MSP implementation through a more inclusive governance arrangement. This assumption represents bold anticipation of a possible outcome of the workings of GT-UCAM, and the most progressive of all visions in terms of transforming the current ocean governance system towards an inclusive and integrated regime.

Nevertheless, we highlight a pressing concern that actors attending and legitimising new MSP arenas should be aware of. There is always a risk of MSP becoming an instrument for further marginalisation and power asymmetry, reinforcing social and cultural vulnerabilities of particularly less influential actors such as small-scale fish workers (Jentoft 2017; Tafon 2019). These risks will be higher in Brazil if the MSP agenda led by the federal government remains void of social participation, or even if merely discursive power is warranted providing a semblance of democratic legitimacy that in fact reinforces the neoliberal exploitation rationale (Flannery et al. 2018).

Quesada-Silva et al. (2019) has recently proposed a stakeholder participation assessment framework to support strategic planning and evaluation of participatory MSP processes, that can potentially inform actors concerned with the transformation of the Brazilian ocean governance towards an integrated regime. Their assessment indicates that the choices made by federal governmental authorities on the level of stakeholder inclusion will be critical in Brazil; even before MSP moves to an advanced operational phase, actors should decide upon zones and build, implement, monitor, and evaluate spatially based norms and plans. Fostering inclusive ocean governance in Brazil will require a more diverse constituency in the ongoing and upcoming phases, i.e. normative (identification

of drivers and/problems, principles and visions) and strategic (defining goals, objectives and future scenarios, financing, analysing stakeholders, aggregating social-ecological data) MSP planning phases.

Bennett' and collaborators' (2019) overview discusses three principal stakeholder types (government, civil society, and private sector), three fundamental sets of interactions (collaborative management, public–private, and community–industry partnerships), and four questions that need to be reflected upon to steer inclusive governance of the blue economy, including; i) how the ocean will be developed and by whom; ii) how and to whom benefits will be distributed; iii) how harms will be minimised; iv) who will bear responsibility for environmental and social outcomes. While the perceived Brazilian MSP arena seems active in important components of this overview, such as the abundance of public–private interactions recorded, not much activity pertaining to community–industry nor collaborative management interactions were perceived (and probably do not exist in the real network) at the whole EEZ governance system-level. The shared perception of our interviewed GT-UCAM members represents a highly influential point of view and thus entails responsibility in the way the four questions enlisted above will play out in reality. These are not easy questions requiring superficial thoughts and policy measures. Rather, the informants' perceptions represented herein through participatory network mapping emanate from the highest levels of the governing system with potential repercussions on the well-being at the very fabric of Brazil's peopled seas.

Networked solutions to ocean governability transformations

Given the accelerating increase of various impacts to ocean ecosystems in the past decades and our general lack of capacity to respond to the implicate governance challenges in the Anthropocene era (Jouffray et al. 2020), transformative endeavours should identify and remain vigilant to nested and interrelated opportunities contexts for promoting regime shifts in ocean governance systems. The search for disruptive alternatives in the step-zero process of MSP in Brazil faces challenges that ocean stakeholders must overcome to radically improve the governability of the Brazilian EEZ, the so-called 'Blue Amazon.'

The research program this paper is a part of has engaged with various analytical approaches to identify sets of functional governability problems and provide tailored recommendations or opportunities to improve societal capacities to govern the Brazilian ocean using networked knowledge-to-action solutions. Figure 3 summarises these functional governability narratives based on Gerhardinger et al. (2019, 2020) and the present paper. The roadmap for the needed changes is informed by theory and based on empirical

evidence. However, we should not be naive in our expectations—we agree with Clarke and Flannery’s (2019) notion that (post-political) MSP might not be in the ‘...vanguard of the assault on broader neoliberal regimes.’ These authors have provided an insightful illustration of how England suffers from a post-political MSP in which engagement and meaningful debates are minimised, resistance to transforming the status quo remains, and contestation is replaced by elite and technocratic-managerial governance.

These authors point out five interrelated modalities of depoliticization in MSP that are symptoms of a post-political condition, with correlations possibly drawn to the Brazilian problem-domain, including 1) neoliberal governance (favouring corporate-interests): we found several signs that such policy mindset is vividly present in the rationale of Federal Government leadership, and are concerned that the high influence of business actors in the MSP arena and an emphasis on blue growth (increase in ocean gross domestic product) may lead to reinforcing social injustices and inequalities. (2) Choreographed participation (uncritical adoption of consensus, scaping conflict, and disruptive participation): while the choice of not including a broader array of social actors in GT-UCAM may render intra-governmental cohesion to discuss MSP affairs, it may also result in loss of awareness and sensitiveness to pressing blue justice issues and conflicts that exist in the real ocean. Moreover, the deterioration of democratic environmental forums the country has witnessed has tremendously disrupted the participation of civil society in MSP evolution (Gonçalves et al. 2021). (3) Path dependency (limiting the scope of innovation through bounded rationality and suitability to decision maker’s satisfaction): our results show they were clearly not able to envision a satisfactory pathway to transform ocean governability in more fundamental ways and have been struggling to navigate the institutional and political turmoil in the country. (4) Technocratic-managerialism (problems framed as data and knowledge gaps): the government-led process largely disregards the knowledge and expectations of ocean users from the on-set of MSP and perhaps the influence of academia, therefore risking it becoming an overly top-down, technocratic, and depoliticized endeavour. (5) The illusion of progressive change (tokenistic and non-disruptive approaches): the high-level MSP think-tank we studied seemed quite limited in scope (self-enclosed) and effectiveness after 8 years of operation, with no major outcome and/or disruptive attempt nor substantiated vision to confront complexity with a few exceptions (e.g. visualisation of a new democratic MSP forum by one informant).

Clarke and Flannery (2019) suggest core issues that need to be addressed simultaneously to allow for what has been later termed a ‘critical turn’ in MSP (Flannery et al. 2020). Their solution proposes deliberately redesigning and transforming marine governance regimes by

developing strategies to empower stakeholders and recentralizing conflict in marine governance. While our informants are aware that conflicts will become more pronounced as the MSP arena evolves, they largely lack the capacity to redesign and transform accordingly, nor have the means to empower stakeholders. While our informants anticipated some changes in network composition and influence in the future, the envisioned network is not fundamentally different from the current network in several important ways. Our informants perceived a nascent Brazilian MSP arena dominated by a few very influential federal government actors. While slight changes in network heterogeneity potentially signal the leasing of power to other agents in the future MSP arena, our informants shared a conservative perception of its evolution by anticipating it to largely remain self-enclosed within the federal government in the upcoming years. This network perception highlights the eminent need for vertical integration, between governmental actors from different administrative levels, as well as for a horizontal integration that spans sectors and parts of society, e.g. the link-up of fisheries management to integrated area-based ocean governance and the inclusion of relevant actors outside the public sphere like fishers. Only one informant boldly anticipated a progressive outcome of the workings of GT-UCAM, in terms of transforming the current ocean governance system towards a more inclusive and integrated regime.

What insights can we derive from our participatory network mapping on the MSP network that can potentially support actors pursuing regime shifts in complex regional ocean governance systems? Our SNA analysis informed a thorough assessment of how governable the Brazilian EEZ is and could become given the structural evolutionary challenges we identified (Fig. 2). Below, we synthesize the insights gained in our past functional governability assessment series (Gerhardinger et al. 2019 and 2020: document-based and sustainability transition experimentation analyses, respectively) and additionally distil herein the following five aspects of future governability narratives as potential contributions of the participatory network mapping method to transdisciplinary sustainability research, in particular, to advance networked solutions to the ocean challenges (Fig. 3).

Envision situated interactional evolutionary pathways that are more likely to leverage regime shifts in the socio-political arena

Our participatory network mapping approach was able to address what is pointed out as a major deficit in most ocean governance studies: to feed a theoretically anchored conceptualization of change in ocean governability with empirical insights (based on the perceptions of a social network’s structure and evolution). The structurally explicit network

analysis we conducted is the first to allow for the visualisation of the perceived overall Brazilian ocean governance arena, the very existence and quality of actors and their perceived interactions within and between public actors and others (resource users, NGOs and forums). The current emphasis of the multiplex MSP network on problem-solving (fiscalisation and project implementation), is anticipated to shift to the prominence of norm-building with a potential for increasing the manifestation of conflicts. We were also able to identify, from a highly situated perception of governmental institutional entrepreneurs at the forefront of innovation, some critical signs of potential hierarchic mismatches hindering innovation (e.g. integration/inclusiveness of relevant actors), that need to be addressed by MSP actors. MSP is perceived as a governmentally enclosed process with emphasis on the federal level. There is a lack of integration of lower governance levels, and of important agents from other spheres of society. Therefore, our informants' overview of the Brazilian MSP arena evolution might not be considered alternative and appropriate enough to anticipate an integrative pathway to promote a regime shift at the whole system level in the near future. Our analysis instead reveals important gaps in the presence and quality of interactions that need to be addressed within federal government interactional structures.

Nevertheless, the imagination of one key informant of a potential new collegiate forum represents leverage to inspire systemic quantitative and qualitative change in governability. Individual and unique contributions evoked by participatory SNA can potentially help other ocean stakeholders, importantly transformative agents within and/or outside federal government organisations, to more accurately streamline cross-network knowledge-exchange and political efforts required to transform the untenable ocean governance regime. The net-map activity inspires the informants to think about alternative approaches and to make their thoughts explicit. However, we contend that this method would be more useful (and perhaps more transformative) if nested in broader and sustained transdisciplinary programs. For instance, networked-based sustainability transition experiments offer a contextually tailored 'process-framework,' rendering social innovators real opportunities to navigate improvements in the overall presence and quality of area-based governance-related knowledge exchange at any given problem-domain.

Build a shared understanding of and anticipate transformative coevolutionary dynamics

Concerning the question of how to improve the compatibility of ocean governance elements (actions, instruments, and principles/images) through MSP in Brazil, our results highlighted gaps in perception that

may be addressed by transformative agents. The poor fit of perceived MSP-related interactions to the social and natural systems-to-be-governed sets the context for our informants' institutional entrepreneurship standpoint. Our informants' conservative and non-cohesive perception of the evolutionary pathways towards a new regime is an insight expanding the understanding of the institutional dynamics impeding policy integration in the country. Our analysis highlights a potential role for participatory network mapping in supporting a more coordinated policy-innovation process through imagination and rationalisation of appropriate institutional changes that may steer ocean governance regime shifts. Our results explicitly reveal interactional structures, hence the possibility of building a shared understanding and anticipation of current and required coevolutionary dynamics. The method of merging the perceptions of actors sharing a socio-political identity and purpose (e.g. members of GT-UCAM) is a practical case in point. Therefore, the outcomes of this paper may give feedback to ongoing and future social learning processes led under the umbrella of GT-UCAM, but also ocean actors' institutional entrepreneurship strategies at large.

Build awareness of the potential synergies among disparate but innovative area-based responses

Our participatory network mapping and analysis highlighted important gaps in informant awareness beyond their largely hierarchical standpoints on ocean governance responsiveness. In particular, sensitivity seems low towards potential sources of area-based innovations in bottom-up and collaborative approaches as well as networked responses. The maintenance of such a low level of awareness by highly influential agents at GT-UCAM will probably limit the evolution of a more symmetrically responsive ocean governance arena. Provided that future governability will at least be partly derived from a move towards a polycentric hierarchical coevolutionary ocean governance view, streamlining such disparate governing responses is a key challenge. We argue, however, that networked knowledge-to-action agencies operating at an 'inter-network' level (beyond operations of the individual networks) are more well suited to confront this challenge because of their additional permeability across the fragmented structure. The use of participatory SNA nested as part of longer-term sustainability transition experiments can illuminate what potential synergies will need to be activated to progress towards more transformative coevolutionary pathways of MSP arenas. Thus, these agencies may be able to create the space for building collective awareness and responding to untenable social structures and dynamics.

Specify inter-network-based limitations and the necessary changes underpinning potential leaps in performance levels

The net mapping exercise gave form to collective perceptions on emergent improvements needed in performance at all orders (Fig. 2), from problem-solving, institutional building and principle-setting. Among the evolutionary challenges for transforming governability through gains in performance this paper reports on, we highlight the need to overcome the narrow (self-enclosed) and unambitious views of the current GT-UCAM architecture. This in itself consists of a wicked path-dependent pattern signalling the persistence of the low-performance qualities in the MSP arena and ocean governance system at large. In face of pressing demands for equitable and environmentally sustainable ocean economic development and growth, the slow progress of the Brazilian MSP pre-planning phase is worrisome as it has still not been able to augment the performance of the ocean governance system. We argue that transdisciplinary research-action approaches are methodologically fit to allow for the construction and collective appropriation of more sound visions and principles to steer the better performance of the future desired ocean governance regime. These approaches offer rational and targeted opportunities for networks to measure changes (for good or worse) in the performance of area-based governance attempts where the net mapping protocol can be adapted and tailored to specific contexts. Therefore, our participatory network mapping methodology not only supports the specification of what structural changes need to occur for a leap in performance to emerge. It also highlights the limits to what our critically positioned informants perceive as possible within their mandates.

Make explicit power asymmetries to stir structurally tailored strategic action by less influential groups

Our results elicit critically important signals in the evolution of power structures in the Brazilian MSP arena that will likely affect the implementation of hierarchical polycentric ocean governance in Brazil. These signals include the risks of prevailing influence of private interest on Brazilian federal government ocean policy; lack of governance forums open to public interest groups; lack of perceived engagement of coastal governments in the innovation process; low composition of historically vulnerable actors (e.g. small-scale fish workers, etc.); and the under-appreciated value of academic and social knowledge-networks in the MSP arena. If unaddressed, these trends may render the MSP arena incapable of reaching environmentally sustainable and socially equitable paths, hence the importance of expanding and diversifying the knowledge-base in order to avoid an overly top-down, technocratic and depoliticized MSP arena. While major

system-wide changes in the arena were not foreseen by our informants, they pointed out critical intra-governmental changes in the interactional structure needed before major shifts can occur. This remains challenging given that inter-ministerial coordination and cohesion has been hardly possible under the continuous political and institutional instability Brazil faces. Only one informant offered a possible leveraging point for transformation based on the creation of a new, more inclusive collegiate forum. Given their importance, these signals in the evolution of the MSP arena should be considered in future (transformative) sustainability research. In particular, we urgently call for GT-UCAM members to confront asymmetrical power relations by embracing the critical but proactive civil society and multi-level participation in the evolution of the MSP arena.

This paper has outlined how participatory network mapping insights can benefit transformative action. We made a strong case for the potential role of inter-network strategies and actions to confront the symptoms of post-political MSP pathways and risks of becoming an instrument of further marginalisation and power asymmetry. Participatory network mapping can enable actors' visualising, learning about and become vigilant to power asymmetries. Tailored confrontations are needed to start fixing asymmetric power relations not only in their discursive but hopefully also in their structural manifestation in the emerging MSP arena. We argue participatory network mapping holds untapped potential contributions as a method to enable anticipatory governance (e.g. identify needed changes and tailored inter-network strategies) and advance transformational dialogues at the forefront of transdisciplinary attempts to promote regime shifts in ocean governance systems. While this paper is the final contribution of a three-stage assessment of functional governability in Brazil, we contend that both the stepwise diagnostic approach developed and the generated narratives (Fig. 3), may hold transferable contributions to ocean governance systems across the globe.

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Declarations

Conflict of interest The authors declare no competing interests.

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