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Integrating the multiple perspectives of people and nature in place-based marine spatial planning

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Marine spatial planning (MSP) has emerged as a tool to enable marine ecosystem-based management that seeks to balance human demands for ocean space with environmental protection. However, there is a history of thinking about our ocean systems as spaces, not places. As a result, most MSPs have been implemented without consideration of place. The relationship between people and the rest of nature is at the core of the UN SDGs (Sustainable Development Goals). Due to significant knowledge gaps in sociocultural connections, people and their place-based perspectives and needs are often overlooked in the MSP process. New approaches are required to equip societies with information to inform sustainable ocean planning relevant to environmental change and the local sociocultural context. We encourage the inclusion of a distinct place-based characteristic in MSP and argue that bringing in the concepts of space and place from the discipline of geography can enable a broader view of the seascape in MSP. Here, we provide five core considerations of place-based MSP that include: (1) sense of place; (2) social-ecological systems; (3) ocean and human health; (4) multiple ways of knowing; and (5) social knowledge. We review available methods and suggest a multi-evidence-based approach that can highlight dynamic eco-cultural connections between people and the biophysical patterns and processes of interlinked landscapes and seascapes. Moving towards place-based MSP can help to solve three important issues in the current context of global socio-environmental transformations. First, these key concepts are relevant for interdisciplinary science, as solving problems raised by MSP requires more than superimposing spatial layers of scientific knowledge. Second, marine planning and management is less efficient if policies are not integrated and if issues are addressed by each individual sector rather than in a holistic manner. Third, a place-based approach accounts for individual and collective values and may open new ways to solve governance issues. A shift from understanding and managing ocean spaces to including ocean places can support progress towards sustainable and equitable MSP goals.

A healthy ocean supports human well-being, regulates global climate, sustains a range of biodiversity, and delivers other benefits to people and the planet[1,2]. Multiple competing societal, environmental, and economic interests have arisen that highlight the ocean as a highly contested space, presenting a major challenge for the sustainable and equitable management of marine resources[3,4]. Ecosystem-based management was established using mainly ecological criteria to mitigate ocean decline and enhance its capacity to support human livelihoods[5]. The argument that the natural environment should be managed as an integrated landscape unit through an ecosystem-based management approach gained momentum on land[6] and was later

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fostered in the marine environment[7,8]. In the next decade, there was a growing shift towards integrating social considerations into ecosystem-based management[7], where a definition expanded in 2005 to encompass the entire ecosystem "including humans"[9] aligned with Odum's ecosystem concept that included people[10]. With ecosystem-based management as the basis, a new approach was emerging to guide ocean governance toward spatial management of marine ecosystems through comprehensive ocean zoning[9,11]. Novel geospatial tools and technology enabled spatially explicit analyses and evaluation of marine management scenarios that were not previously possible, ultimately enabling the advancement toward dynamic ocean management using spatial biophysical variables[12–14].

Within a portfolio of comprehensive ocean planning strategies, marine spatial planning (MSP) has emerged as a tool to enable marine ecosystem-based management[8]. MSP has evolved to become an ecosystem-based planning process that aims to balance human demands for ocean space with environmental protection[15,16]. MSP focuses on identifying biophysical heterogeneity to enable the management of multiple objectives and users across the wider seascape, and this process is increasingly being considered essential for achieving ocean sustainability goals across a range of geopolitical scales (e.g., UN Sustainable Development Goal 14)[15,17]. MSP can mitigate conflict and ensure the delivery of benefits to ocean users by maintaining a healthy ocean during socioeconomic development[18–20].

Although MSP has the goal of sustainable management of marine resources, there has been a lack of attention given to understanding the meaning of the ocean to people[18,21] and instead, current practice tends to emphasize predominantly spatial information on economic, ecological, and administrative considerations[22]. This 'spatial turn' largely neglected the sociocultural seascape, compounded by inherent challenges in translating terrestrial approaches to marine systems[23,24]. Pioneering work by St. Martin and Hall-Arber[24,25] first described place at sea within academia and was used as an example in the first UNESCO Guide to MSP[26]. While this useful work has not been repeated, there has been subsequent related development toward implementing place in MSP[27,28]. People live with(in) seascapes, forming intimate relationships tied to terrestrial communities. These relationships are connected to place through plural cultural, spiritual, and philosophical meanings[29,30].

The relationship between people and the rest of nature is at the core of the UN Sustainable Development Goals (SDGs). However, due to significant knowledge gaps in sociocultural connections, people and their place-based perspectives and needs are often overlooked in MSP[31]. Although significant advances have been made in quantifying and mapping biophysical aspects of marine ecosystems, the remaining challenge is to more fully incorporate diverse human cultural patterns and processes as key components within the ecological system[4,32,33]. This major knowledge gap hinders identifying and prioritizing sustainable MSP options and diminishes opportunities to mitigate and repair coupled human-natural ecosystems[19]. To forestall the widespread decline in coastal communities and the associated social and ecological consequences, it is critical for MSP to identify and characterize locations that represent both culturally and ecologically important pathways, places, and events in the coastal zone. New approaches must equip societies with information to inform sustainable MSP relevant to environmental change and the local cultural context[18,34,35]. We argue that bringing in the concepts of space and place from the discipline of geography[36] can enable a broader view of the seascape in MSP.

In order to address this ontological and applied challenge in MSP, we suggest five core considerations of place-based MSP from the roots of systems ecology and human geography that include: (1) sense of place; (2) social-ecological systems; (3) ocean and human health; (4) multiple ways of knowing; and, (5) social knowledge (Table 1). We review available methods and suggest a multi-evidence-based approach that can highlight dynamic eco-cultural connections between people and the biophysical patterns and processes of interlinked landscapes and seascapes. By treating human spatial dynamics and perception of place at sea as an integral part of Earth's living system rather than solely as drivers of system change, we explore the potential for a more holistic place-based science to inform MSP. We conclude by outlining how a further shift towards place-based MSP can help to solve three important issues in the current context of global socio-environmental transformations.

Sense of place

A place is a space with meaning—an incarnation of the experiences and aspirations of people[36]. The material environment forms 'space', within which lived relations, understandings, histories, and meanings of space form 'place'[36]. Depictions of space can produce reality as much as represent it[37–39]. Place is particularly overlooked at sea, where depth and fluidity alter human relationships to the Earth's surface, each other, and thus placemaking[40]. As a result, defining place within an oceanic context requires different understandings from terrestrial places[41], compounded by designations, and ownership typically less codified or enforceable than on land[42].

Cree geographer Michelle Daigle argues that more dialogue on the underpinnings of place is needed, where place is understood as an animate being[43]. For instance, in ancestors' stories, place often has agency and speaks, creates, teaches, and is imbued with the life force of spirits that must be considered to understand the different ways of being in place[44]. Some peoples have maintained distinct systematic, localized, and place-based environmental knowledge over extended time periods[45]. For example, in traditional coastal Sámi communities, place names have provided the basis for transmitting cultural landscapes and seascapes through an oral mapping built around narratives and landmarks[46]. Such a view results in a markedly different cultural representation and perception of the seascape by highlighting not only place names but also the language and epistemology of unique cultures[47].

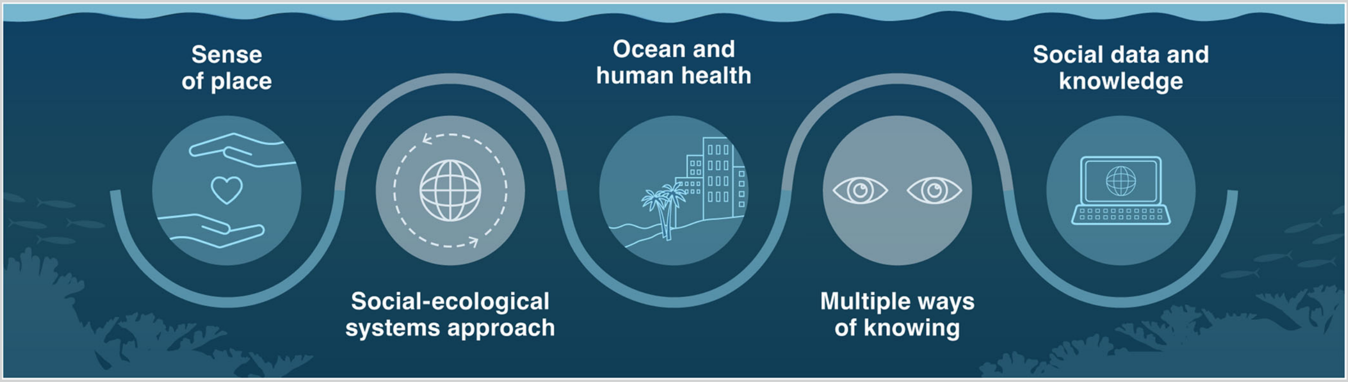
UNESCO established guiding principles to move MSP towards ecosystem-based management, where they identified key components to enable effective MSP, including: (1) ecosystem-based, (2) integrated, (3) place-based or area-based, (4) adaptive, (5) strategic and anticipatory (hereafter, strategic), and (6) participatory[26]. Here, we re-consider the third characteristic of effective MSP (place-based or area-based) and suggest that 'area-based' encompasses the spatial area-based management of the ocean. We recommend a distinct place-based perspective in MSP and suggest that bringing in the concepts of space and place from the discipline of geography[36] can enable a broader and more inclusive perspective in MSP.

Social-ecological systems

Seascapes are created through more than just overlapping subjective realities, as they include interconnected social and biophysical elements[48]. Complex relationships exist between the ocean and its users, and these connections are changing in response to various social, cultural, economic, political, and environmental factors[22]. Social-ecological systems describe intertwined sociocultural and biophysical actors and processes that influence each other[49]. Coastal people directly and indirectly create, modify, and respond to ecosystems at various scales within an adaptive social-ecological system. Equitable, holistic management of marine space relies on understanding coastal societies as situated within dynamic social-ecological systems[50–52]. While social-ecological system approaches have advanced our understanding of ecosystems, the models often neglect to consider feedbacks on key social phenomena that can form pivotal roles in system behavior.

To achieve this, MSP will require a transdisciplinary approach that considers interconnected social-ecological systems across land and sea boundaries from the coastal zone perspective[15]. In order to do so, it will be important to establish a wider lens through which we view the ocean, which includes both the biophysical seascape often mapped as a foundation for MSP processes, and the cultural seascape, which together form a social-ecological seascape (Fig. 1). The inclusion of cultural seascape variables enhance knowledge pluralism and are increasingly considered vital to explain the coupling processes

Table 1 | Definitions and applications of five core considerations to advance the inclusion of place in narine spatial planning



	Theme	Definition	MSP application
1	Sense of Place	A place is a space with meaning that includes lived experience, understandings, and histories related to a location[36]. Sense of place is highly individual and so requires a plural approach that accounts for varied subjective experiences[156].	The understanding of ocean spaces to include ocean places can enable a broader humanistic view of the seascape in MSP and is key to sustainable and equitable MSP moving forward[31,157].
2	Social-Ecological Systems Approach	Social-ecological systems describe intertwined sociocultural and biophysical actors and processes that influence each other[49].	A shift to a pluralistic social-ecological systems approach may help to capture emergent properties and social-ecological system characteristics (e.g., vulnerabilities, resilience, feedbacks) and could inform a more holistic MSP process[55].
3	Human and Ocean Health	Healthy oceans support human health and well-being through varied means, such as nutrition, recreation, livelihoods, and cultural practice[158,159].	Understanding the linkages between ocean ecosystems and human eco-cultural relationships that maintain human health and well-being is important. Such efforts can increase stewardship and backing for marine management efforts in MSP[64,65].
4	Multiple Ways of Knowing	Diverse understandings of the world, or multiple ways of knowing, can blend Western science, lived experiences, and traditional and local knowledge systems[80,81].	A Two-Eyed Seeing approach has been advocated as a pragmatic way to bring together different worldviews to ensure the equitable weaving of perspectives[89,90] to inform place-based MSP.
5	Social Data and Knowledge	Social data and knowledge include a wide range of information on sociocultural and human dimensions[4,32,33] for MSP.	Social data and knowledge should be considered when collecting place-based information for MSP to create a new, more diverse ecological understanding of the human relationship with the ocean[15].

between humans and other components of nature in social-ecological systems[53]. A shift to a pluralistic social-ecological systems approach must capture and track both dynamic relationships between components and emergent properties of the whole system (e.g., vulnerabilities, resilience, feedbacks)[54,55] to inform a more holistic and place-based MSP process.

Ocean and human health

More than 40% of the global human population lives within 100 km of the coast[56], and the relationship between humans and the seascape has never been more tightly knit[57]. At the heart of complex marine social-ecological systems are the place-based connections between human health and ocean health[15,58]. Places with marine cultural value represent unique spatial patterns at sea[31] and help identify human communities that rely on these coastal places for their health and well-being[59], such as in Manquemapu, Chile where Mapuche-Huilliche nutrition, livelihoods, and spirituality are tied to marine places[60]. In coastal communities where people are closely connected to the ocean through observation and experiences, understanding the ecological system dynamics and cultural consequences is necessary to safeguard human and ecosystem health and develop effective MSP strategies. We know very little about the influence of coastal seascape spatial arrangement and dynamics (e.g., ecological connectivity) on the geography of physical and mental well-being, resilience to disturbance, identity, and the delivery and quality of ecosystem goods and services[61].

MSP could better account for ecosystems' mutual benefits and regulating mechanisms affecting people's physical and emotional well-being. Reimagining place-based human-ocean relationships is needed to guide future MSP in informing how the mutual benefits of ocean health and related regulating mechanisms affect people's physical and emotional well-being. Moving forward, it will be important for MSP to incorporate the complex eco-cultural relationships that connect human health and well-being to ocean health. It is ultimately the role of place in developing an ocean ethic[62] that upholds a symbiotic relationship between humans and the ocean[1]. MSP can help by reducing conflict over contested spaces and resources by enabling safe and inclusive access to locally important coastal places to increase equitable distribution of benefits. Likewise, co-locating and sharing spaces for compatible ocean use could produce synergistic benefits for well-being. For instance, increased stewardship and backing for marine management efforts are often present in coastal communities that experience close connections to the ocean[63–66]. Integrating health and well-being within place-based MSP makes these contributions, and the ecosystem functions that underpin them, visible for MSP processes so they can be accounted for, sustained, and restored[19].

As we consider ocean health and human health central to MSP, we can look to other fields to support this advancement. A growing body of research on mental health highlights the importance of blue spaces and biodiversity for well-being, with frameworks from environmental psychology contributing to understanding these complex relationships (e.g., refs. 67–71).

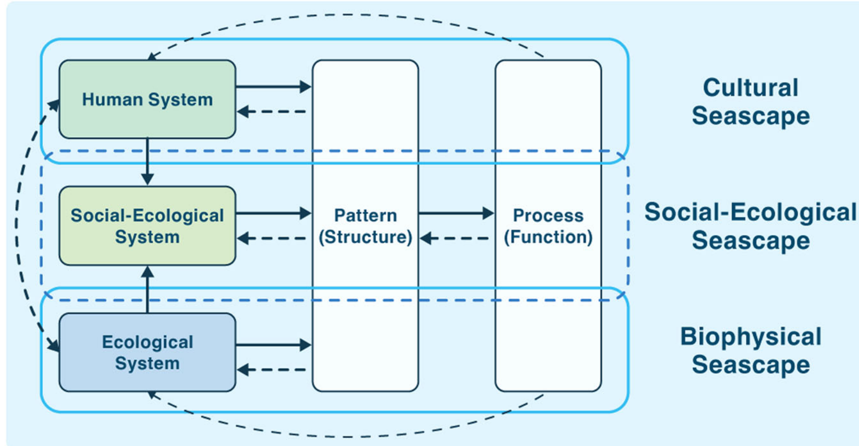


Fig. 1 | Social-ecological seascapes couple the ecological system and the associated biophysical patterns (e.g., habitat configuration) and ecological processes (e.g., the flow of energy) with the human system and their associated cultural dimensions (e.g., sense of place). The integration of the cultural and biophysical seascape results in a broader understanding of the social-ecological system that can inform more inclusive, sustainable marine spatial planning.

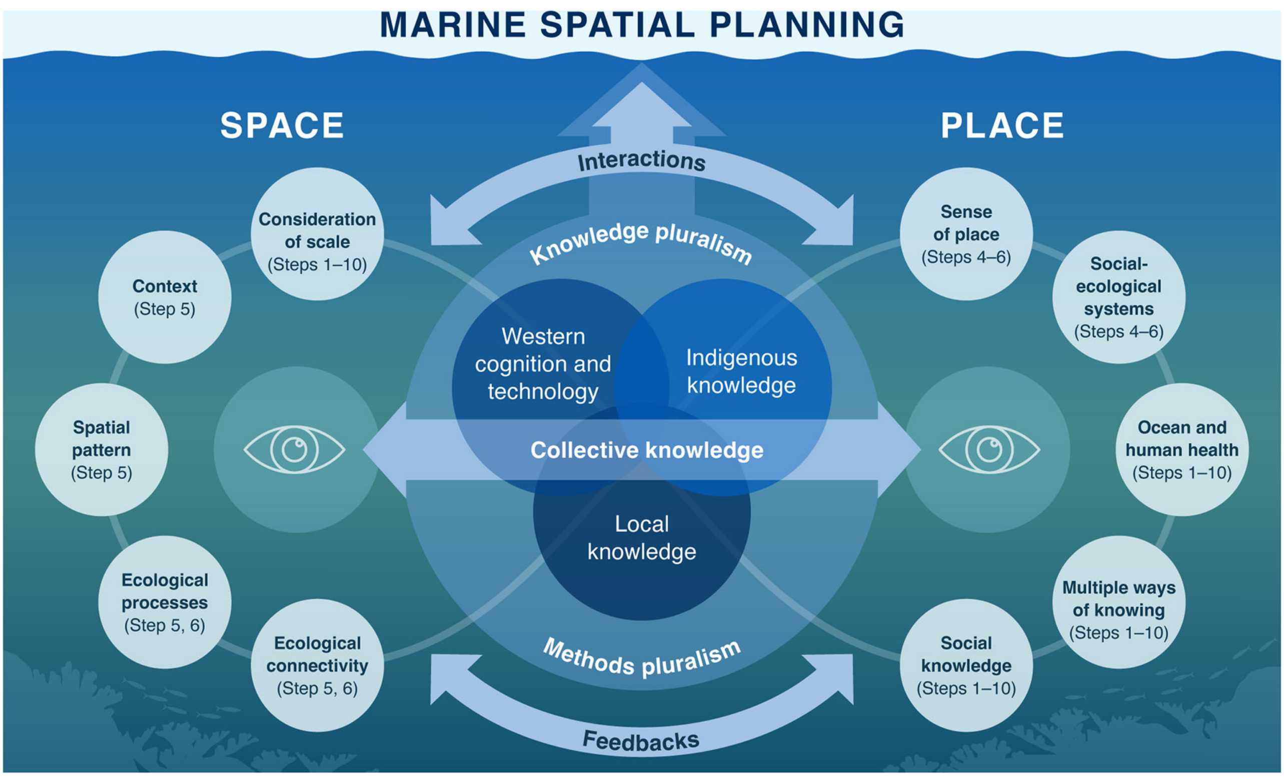


Fig. 2 | Considerations of marine space (scale, context, spatial pattern, ecological processes, and connectivity) and place (sense of place, social-ecological systems, multiple ways of knowing, and social knowledge) are connected through interactions and feedback loops between people and the seascape. Collective knowledge about the system can be obtained from a confluence of Western cognition, technological advances, indigenous science, and local knowledge through multiple ways of knowing and doing. The steps noted here refer to those of UNESCO's step-by-step MSP guide[26].

For instance, Rainisio and Inghilleri[72] highlight that environmental psychology provides insights into the nexus of culture, well-being, and environmental interactions. Further, Marsell et al.[73] offer methods to assess how biodiversity changes influence human mental health, while relational therapy provides tools for mending the human-ocean relationship (e.g., refs. 74–77).

Multiple ways of knowing

The dominant scientific framework in which we study the ocean and our relations with it are profoundly rooted in Western scientific thinking (e.g., scientific and evidence-based, reductionist, often quantitative). Integrating different forms of knowledge in ecology is not new but has remained outside the conceptual scope for most applications of MSP. Increasingly, the benefits of knowledge pluralism are being recognized, whereby the input of personal and cultural information from individuals, groups, and communities, including traditional and local ecological knowledge, can broaden the understanding of social-ecological systems[78] through the integration of multiple ways of knowing and doing[62,79].

A blend of Western scientific methods, cultural values, a sense of place, and traditional and local knowledge systems can be beneficial[80] to inform place-based MSP, as Fig. 2 outlines in relation to UNESCO's step-by-step MSP guide[26]. Considering a range of different epistemologies within a project can build a more complete picture of the subject[81]. Multiple knowledge types are rarely interwoven into MSP, yet there are clear needs and increasing advantages to both scientists and stakeholder groups[82–84] in building a wider ecological lens that includes a richer set of social epistemologies[85,86]. MSP initiatives should embrace a variety of epistemological worldviews to include multiple ways of knowing and doing when studying and making management decisions about the ocean (Fig. 2). Legal pluralism around the rights of nature may increasingly influence MSP and demand multiple ways of knowing and doing in MSP practice[87,88].

A Two-Eyed Seeing approach, originally *Etuaptmumk* in the Mi'kmaq language, has been advocated as a pragmatic way to bring together different worldviews by creating the ethical space to share different ways of knowing with potential for the equitable weaving of perspectives from both worldviews to provide solutions to common challenges[89,90]. As described by Mi'kmaq First Nation Elder Albert Marshall: Two-Eyed Seeing is learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to use both these eyes for the benefit of all[91]. This approach has enhanced environmental decision-making by providing coherent narratives of long-term social-ecological change beyond conventional monitoring programs[89].

MSP processes can value multiple ways of knowing by working collaboratively with individuals and communities who want to contribute their knowledge, including from recent lived experience. Marine spatial plans increasingly incorporate multiple ways of knowing, such as the Sea Change Tai Timu Tai Pari project in Aotearoa (New Zealand), which integrated Western science with *mātauranga* Māori[92]. In the Arctic, low-impact shipping corridors have been co-designed by Inuit communities, their ways of life, and their relationship to ice[93]. Through the Marine Plan Partnership for the North Pacific Coast, 17 coastal First Nations in British Columbia, Canada, have developed regional action plans and frameworks[94].

Social data and knowledge

Across millennia, coastal communities have formed cultural ties to the seascape through foods[95], fishing practices[96], and stories of their ancestors[97]. Spatially explicit studies of cultural seascapes are common in archaeological and anthropological literature. Nevertheless, there is still a significant information gap in social data and knowledge[4,32,33] for MSP. Social knowledge should be considered when collecting place-based information for MSP to create a new, more diverse ecological understanding of the ocean[15]. As human dimensions of the seascape vary across space, these values could be made spatially explicit[31] (where appropriate) to fill the sociocultural data gap in MSP[98].

Spatial representations of tangible and intangible cultural variables are increasingly emerging with progress in techniques such as participatory mapping, emotional cartography, and the use of geolocated social media or photo-elicitation data[99–101]. However, not all place-based social data and knowledge should be put into a spatial framework or integrated with biophysical information. When working with different social data and knowledge types, to ensure they are considered simultaneously and not merged, a Two-Eyed Seeing approach provides an opportunity to generate parallel streams of knowledge and enable learning across and between the systems[102]. Quantitative approaches focusing only on exteriority and treating people as simple objects in a system independent of cultural dimensions will be insufficient to comprehensively understand and manage many human-ocean interactions. Transdisciplinary interactions must begin by recognizing the humanity, sovereignty, and validity of place-based knowledge-holders claims to place, culture, and knowledge[103], including subjective phenomenologies. For example, the Dene peoples in the North American Subarctic believe that plants, animals, rivers, mountains, and glaciers are alive, have agency, and express free will[104].

When seeking to operationalize a place-based approach in MSP, researchers and practitioners should ensure significant value is attributed to research ethics to ensure all methods to collect social data and knowledge are conducted in a way that is respectful of the welfare and rights of human participants and their related culture[103,105,106]. Ethics are paramount to safeguarding just, consensual knowledge exchange 'in a good way' to ensure social data and knowledge is not marginalized, misused, misrepresented, or appropriated[105,107]. Ethical considerations could involve early discussions with local partners more closely connected with cultural norms, ensuring advanced consideration of the potential ethical issues surrounding receiving, caring for, and sharing sacred and ancestral knowledge. Potential issues could be mitigated by working with local partners to develop a set of culturally sensitive research protocols[103,106]. Projects should aim to engage with equitable information-sharing approaches to datafication by prioritizing the co-production of social data and knowledge through a collaborative approach with local partners and through an advisory committee to ensure research is conducted and shared back in an ethical manner. Criteria for carrying out culturally sensitive research protocols aligned with collective benefit, authority to control, responsibility, and ethics (CARE) can be found in guidelines from the Global Indigenous Data Alliance and are outlined in Jennings et al.[108].

Operationalizing place-based MSP: tools and techniques

Pluralistic approaches can contribute to the successful management of ocean resources[109–112]. Applying multiple ways of knowing in MSP also requires multiple ways of doing[113,114] (i.e., methods from different disciplines), and here we highlight a few of the commonly used tools and techniques available for operationalizing these core place-based considerations for MSP. A range of approaches can be used to uncover social data and knowledge surrounding a sense of place, cultural heritage, and other seascape values held by a range of ocean users (Table 2). Marine social science is a relatively new but growing field with diverse methods employed[115–117] for various purposes[118]. Some techniques which may be used to better understand social data and knowledge include oral history interviews, cognitive mapping, storytelling, and engagement with stakeholders, their histories, languages, and cultures[46,92,93,116,119,120]. In essence, bringing subjective, human-derived values into MSP requires consideration of how different stakeholders may experience and think about the seascape and why these experiences may differ. Ultimately, a thoughtful selection of appropriate and ethical methods to elicit this social knowledge is needed.

Cognitive mapping: applications and case study

Mental models are cognitive representations people hold[121,122], informing how people interact with social-ecological systems and can be studied through cognitive mapping approaches (Table 2; refs. 123,124). Mental models and maps can include spatial observations, personal experience, and social and historical relations[124], providing significant insight into cultural seascape knowledge and sense of place[125]. Multiple and varied mental models of the seascape often challenge how Western scientists quantitatively and objectively characterize the land-sea interface and can provide a complete understanding that includes a cultural connection to the ocean and a sense of place[126] (Box 1: mental models). For example, Aotearoa Māori use *whakapapa*, a type of mental map through which their phenomenological world is understood through a diagrammatic or oral representation of spiritual, spatial, temporal, and biophysical information about a place[127]. Further, a detailed map of significant seafloor features around Anuta Island in the Solomon Islands was created through mental seascape mapping by Polynesians of Anuta, depicting the locations and place names of hundreds of coral reef patches, rocks, and fishing grounds, many of which are named after Anutans or describe geomorphological and contextual geoinformation[128].

Arts-based methods: applications and case study

Symbols represented across a range of visual art are material elements that connect people to a location, helping to identify individuals' and societies' sense of place[129]. There is a need to understand how ocean users identify

Table 2 | Tools and techniques that can be applied to consider social-ecological knowledge in marine spatial planning

Theme	Tools and techniques	Related examples
Cognitive Mapping to Understand Mental Models	Conceptual content cognitive mapping involves participants proposing concepts and then spatially or visually organizing knowledge to depict their understanding of interconnected systems[123,160].	Wade and Biedenweg[161] used conceptual content cognitive mapping to investigate differences in mental models held by fishers and policymakers. Fishers' mental models contained all the concepts in policymakers' and numerous others, highlighting the importance of plural understandings for management.
	Fuzzy cognitive mapping is useful for assessing stakeholders'/local peoples' causal understandings of a system. Combined with graph theory tools and algorithms, human-ocean relationships can be understood more comprehensively[124].	St. Martin and Hall-Arber[24] used fuzzy cognitive mapping to understand the spatial patterning of fishing activity and communities in the Gulf of Maine, USA. This innovative and influential work revealed a 'missing layer' of people at sea and terrestrial-marine linkages, demonstrating key considerations for MSP regarding coastal communities, economies, and identities.
Arts-based Methods to Characterize Sense of Place	Arts-based methods use diverse media and creative activities to span different worldviews, allowing deeper engagement with individuals and communities to elicit and communicate their unique perspectives. These methods depend on knowledge production through music, photography, craft, poems, storytelling, theatre, and drawing to convey experiences, thoughts, ideas, values, beliefs, and knowledge[162] surrounding a sense of place.	Ainsworth et al.[63] used community voice to articulate a coastal sense of place in Scotland and England. Broadening participation beyond exclusively rational discussion towards more expressive, inclusive understandings revealed profound insights into coastal values.
		McNamara and McNamara[163] used participatory action research to build a calendar of Indigenous knowledge on Erub Island, Torres Strait, codifying marginalized knowledge in a process led by the local community. They turned the knowledge into a mural for a school, which helps preserve knowledge and imagine a more inclusive ocean management that celebrates long-held but threatened experiential understandings.
Oral History and Place Names to Recognize the Cultural Seascape	Storytelling is a method of sharing or recording indigenous knowledge and histories, such as creation stories and sites of cultural importance, and is often crucial to understanding place[164].	A study of marine tenure and fishing regulations in New Caledonia asked interviewees about historical and present fishing activities, marine territory rights, place names, and sociocultural practices and beliefs related to marine resources. Fishing rules were ultimately reformed based on local cultural practices and beliefs, complimenting Kanak cultural heritage[165].
	Place names result from unique ontologies and can demonstrate how people interact with the environment[166]. Interviews, historical records, and maps can give insight into place names' origins in past events, local geography, and meanings related to ancestors or local history.	Indigenous place names were collected by the Coastal Sámi Resource Centre in Norway through oral histories and interviews in the native Sámi language. The resulting atlas highlighted Sámi settlement areas and place names in a single map, locating indigenous peoples and referenced Sámi mythology, cultural symbols, languages, and worldviews[46,167].
Stakeholder Engagement to Map Values at Sea	Stakeholder engagement can be implemented through multi-directional dialogue[150], such as small stakeholder meetings and focus groups. Participants should represent local populations' values, needs, and desires[168]. Participatory mapping can capture various peoples' understandings of space and place[169].	Stakeholder engagement through participatory GIS-based mappingenabled an understanding diverse values and management preferences along the Kimberley Coast, Australia. Value mapping highlighted the potential for conflict over multiple desired ocean uses in a spatial format easily integrated into MSP[120].

This summary highlights four common place-based themes with related techniques and illustrative examples.

themselves and if this identification can be represented spatially, on land, or at sea. Symbols of the sea are part of a social construction conferring significance to the ocean and building an identity. Communications and social networks bring artistic symbols of ocean experiences back on land (Box 2: arts-based methods). Such artistic symbols can be significant, as exemplified in the Azores, where sailors follow a rite and paint on the docks of Horta's marina (Box 2, Fig. 2).

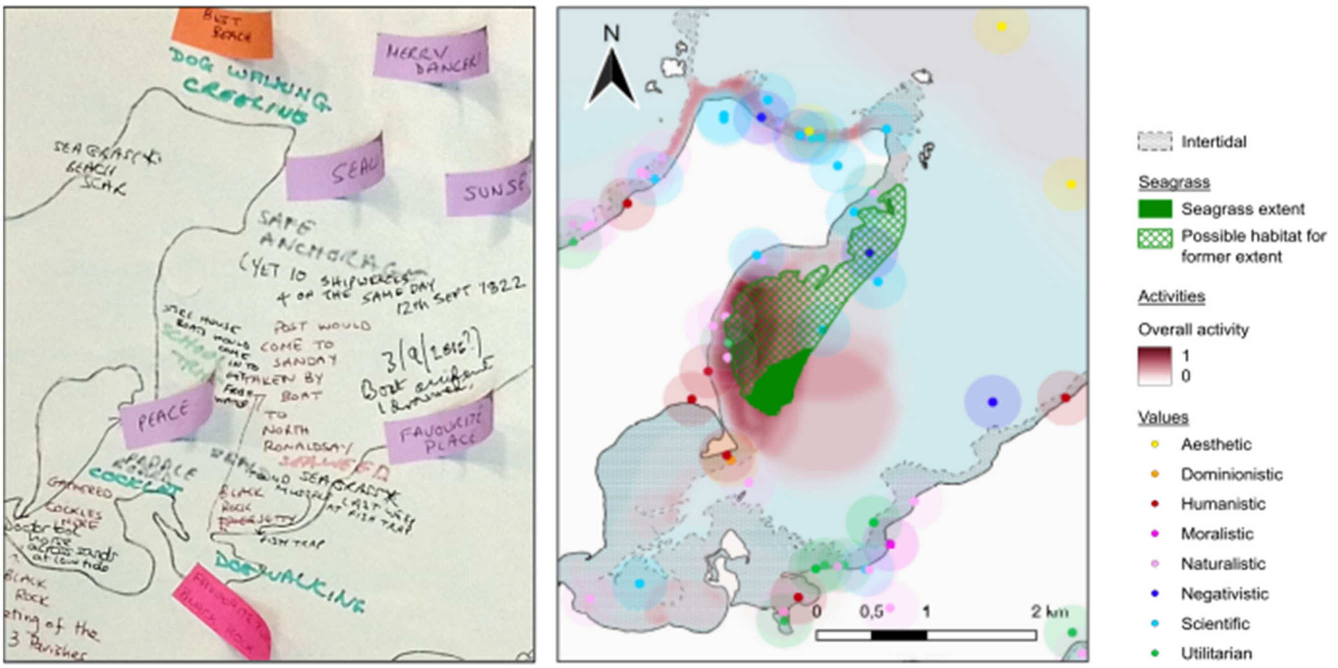
Establishing these material symbols across the seascape gives place identity, permanence, and significance, similar to the role of symbology on maps[130]. Considering the subjectivity of spatial representations, critical cartography can represent overlooked perspectives, particularly with the spatial focus of MSP[131,132]. Such reflexivity allows divergent spatial representations to be integrated within the language of MSP[133,134], co-producing spatial understandings to advance seascape management[135]. Spatial representations underpin spatial management, realizing communities' presence and claims, but also reflect the mappers' standpoints and intentions[136,137].

Place names: applications and case study

Culture anchors a people to a place-based reality[138], highlighting how the concept of seascapes exist through the interactions, oral histories, legends, place names, and narratives of particular people who live with the ocean. The ocean is a lived space for many cultures. The fluidity with which localized cultures vary spatially and temporally on both social and ecological scales makes them challenging to map and essential to understand (Box 3: Cultural identity). Cultural zonation of ocean space and place demonstrates that seascapes can be conceptualized and understood by more than biophysical characteristics and highlights the subjective realities in which we might view, categorize, and model seascapes across cultures. For example, Native Hawaiians' identities are shaped by cultural seascapes[29,139], connecting them with other Hawaiians in an ancestral web of ecological kinship[140]. Native Hawaiians have identified >30 ocean zones and place names across their cultural seascape, such as the *kai kāheka* (tidepools), *kai kilo he*ʻ*e* (the area of the ocean to look for octopus), or the *kai palaoa* (the area of the ocean where whales migrate)[141]. Some of the ocean zones, such as *kai kilo he*ʻ*e* and *kai palaoa*, are not represented on a two-dimensional map but portrayed through stories, place names, familial fishing grounds, and the social-ecological interactions that occurred in these three-dimensional ocean spaces[142]. Another important perceptual feature is the continuum between land and sea. Some indigenous cultures do not perceive land as existing separately from the ocean, with the land-sea considered one entity[29,143,144]. In contrast, Western science draws a line between land and sea in many ways, such as management jurisdiction,

Box 1. | Cognitive mapping to understand mental models

Mental models and maps represent the spatialization of meaning that dwells latently in the minds of individuals or groups of people[170]. Here, cognitive mapping to elicit mental models of a Scottish coastal social-ecological system investigated the diverse cultural associations of local people across the seascape (Box 1, Fig. 1 [171]). This example of fuzzy cognitive mapping allowed Scottish community members on the Island of Sanday to express their diverse relationships with the seascape and represent and visualize their individual and collective values. Such maps reflect valuable sociocultural data and local ecological knowledge, with divergent representations of space and place across the island. Mental models of social-ecological systems are important for MSP processes and can foster understanding or inform decision-makers about certain groups who may be disproportionately affected by management interventions[157,172]. By understanding coastal social-ecological systems through mental models, we can include plural understandings of space and place to better account for different stakeholders' values[23,42].



Box 1, Fig. 1: Mental Model of coastal social-ecological system in Sanday, Scotland. (Left) An example of a participatory map from interviews with community members that shared their relationships with the seascape and highlighted their activities, place-based values, and key biophysical features. (Right) A digitized fuzzy cognitive map was created in GIS to visualize the collective output from 32 participants.

mapping data, and cultural perspectives. Such understandings of space hold rich social-ecological information, which could be shared to inform MSP.

Stakeholder engagement: application and case study

Stakeholder engagement can enable an understanding of a diverse range of values and coastal management preferences. Values hold diverse meanings across disciplines[145], but can be generally understood as significance attributed to something by someone, and may be captured through economic or broader sociocultural methods (Table 2). The focus on value differs markedly across disciplines, ranging from monetary, intrinsic, to a shared set of values amongst a group of individuals (Box 4: Values). The primacy of monetary valuations in MSP does not represent how people construct and understand seascapes, necessitating broader conceptualization and diversified methods[30].

People possess value orientations that influence how they relate to the seascape, but these may be more challenging to capture meaningfully alongside biophysical and socioeconomic measures. An individual's value orientation informs their assigned values, such as relative or monetary value, attributed to various features or activities across the seascape. Other value types include assigned values (e.g., values of objects), moral values (e.g., human rights), intrinsic values (e.g., nature in its own right), and held values (e.g., broad ideals such as fairness)[75]. A key challenge of incorporating value datasets into MSP is the nuance of individual versus shared value and what value information is more appropriate to enhance our understanding of social-ecological systems[31,146]. Incorporating stakeholder values, including subjective and objective values, of the seascape is vital to developing marine spatial management plans[147]. Integrating stakeholder values and perceptions into MSP can be done using collaborative digital mapping tools (Box 4).

Conclusions and future directions

Although systems ecology and marine social science have provided important advances to how we conceptualize marine ecosystems[3,148], we argue that the pressing MSP challenge of today is to accelerate the development of a sustainable, integrative, and regenerative approach. We call for the incorporation of a range of social knowledge types and multiple ways of knowing and doing into MSP practices. The five core considerations of

Box 2. | Arts-based methods to characterize a sense of place at sea

Sailors understand and symbolize biophysical areas at sea by representing characteristics such as wind patterns, type of clouds, type of swell, color, representative fauna, seaweed, marine debris, and type of human activity[173]. Yet, these symbols of the seascape could be influenced by internal and external parameters such as type and size of the boat, equipment, number of people onboard, psychological state of the team, their experiences, and their ability to adapt to the sea, weather conditions, and sea state[173,174]. Parrain[174] found that an ensemble of itineraries, lived spaces, seascapes, areas of belonging, and network organizations represented social construction at sea around the Azores. By understanding a sense of place through approaches such as oral histories and art-based methods, we can include a richness of meaning to better inform MSP and coastal management actions[175].

Box 2, Fig. 2: Symbols, such as paintings, represent a sense of place at sea near Horta, the island of Faial, Azores.

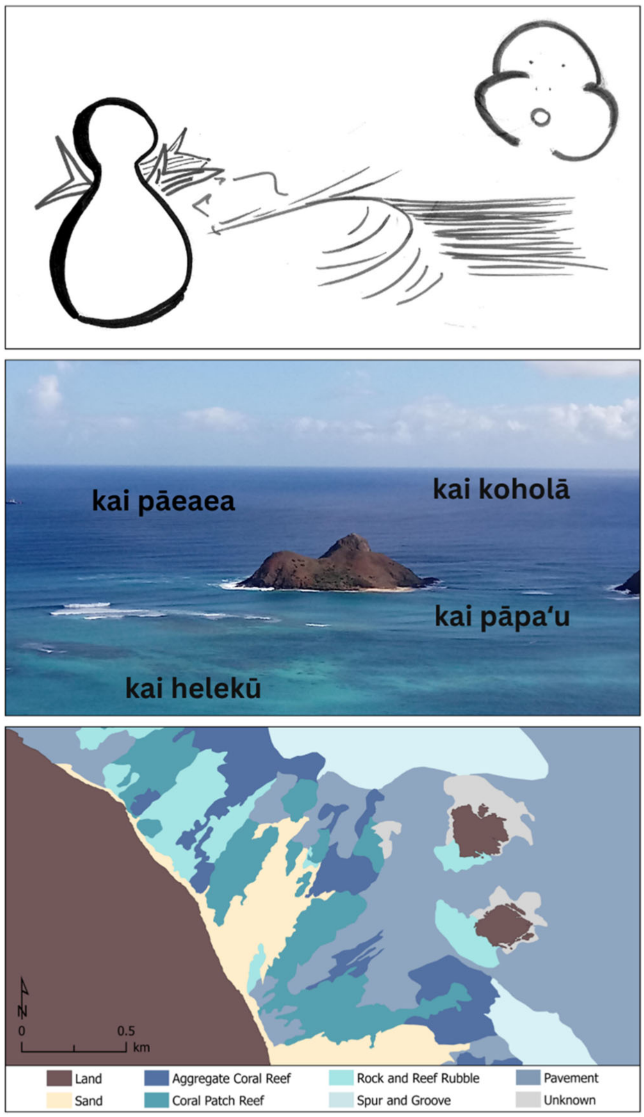
place-based MSP outlined here establish a pathway toward integrating the multiple perspectives of humans and nature in MSP. Moving towards place-based MSP can help to solve three critical issues in the current context of global socio-environmental transformations. First, these key concepts are relevant for interdisciplinary science, as solving problems raised by MSP requires more than superimposing layers of scientific knowledge. It requires integrating ecology, physical science, and sociology and including traditional ecological knowledge[149] and a range of perspectives. Second, marine planning and management is less efficient if policies are not integrated and if issues are addressed by each sector (transportation, fisheries, conservation, tourism, etc.) rather than in a holistic manner. Third, a place-based approach accounts for individual and collective values and may open new ways for solving governance issues.

As decision-making is political in nature, integrating local users in the different stages of marine policy (analysis of drivers and pressures, design of alternative solutions, impact of implementation on different users) is of higher importance. For example, engaging local stakeholders in the management process through multi-directional dialogues has increased the success of management projects involving local communities[150,151]. This integration results in marine governance models and management approaches that are very different from a top-down, engineering-based problem-solving style[152] and is a factor for long-term relevant management decisions based on co-learning and evaluation[153]. The integration of social knowledge is one of the conditions for efficient, just, and well-accepted management decisions[92,109,154], but it must be done 'in a good way' through ethical practice[107]. Enhancing place-based knowledge may support solution-focused research outputs and MSP initiatives in a swiftly changing ocean. While the theoretical and practical basis for place-based MSP exists, there may be obstacles to integrating social data and knowledge into marine spatial planning and management processes. The time and cost considerations for collecting place-based data will be context-dependent and not all social data should be coupled with biophysical data in a database for various ethical reasons[105,108].

There is a history of thinking about our ocean systems as spaces, not places. Most marine ecosystem-based management and MSP have been implemented using a spatial approach. We believe a shift from understanding and managing ocean spaces to including ocean places will be vital to achieving a regenerative relationship with the ocean. Anita Maurstad writes of Norway's oceanic communities highlighting that when fishers no longer use the cultural seascape and perpetuate their knowledge, place names, and understanding of local ocean conditions, it disappears and turns back into a "sea wilderness"[155]. But the Ocean is not empty. It is dynamic, heterogeneous, highly interconnected, and can be understood by people in many ways. Place matters in the sea, and the way we view the ocean determines how we manage it.

Box 3. | Oral history and place names to recognize the cultural seascape

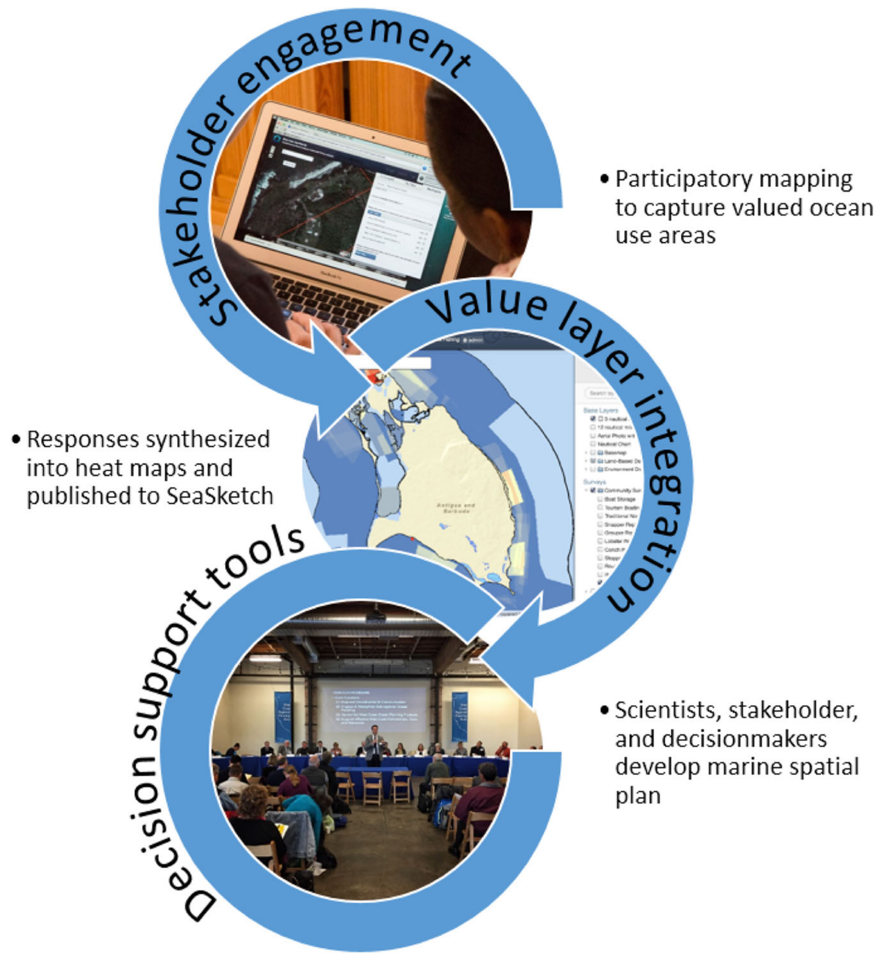
Cultural identity can be understood through seascape representations of the same ocean space as demonstrated in Box 3, Fig. 3, which exemplifies that recent biophysical mapping with geospatial technology reflects our present, personal, subjective place[37]. Here, the contrasting mental map and cultural zonation image challenges us to see the opportunity to find ways for marine spatial planning to be inclusive of more diverse and complex ocean cultures. In this example, the scales in which humans interact with their ocean, from an indigenous Hawaiian perspective, can only be understood through the viewpoint of a *kanaka* (human being)[125]. All elemental and earth processes are viewed from the surface of the ocean or land, being grounded in place[176]. If there is no culture to anchor us locally, untethered vantage points such as models viewed from a bird's eye view (e.g., habitat map in Box 3, Fig. 3) may be increasing the distance of our relationships with place at sea, instead of making the seascape more accessible[177]. From place names and mental maps, we can also understand what physical dimensions are essential to local coastal communities and how they define boundaries, habitats, and zones. Understanding their worldview can acknowledge and integrate this *mana'o* (knowledge or insight) and set of values to better manage coastal resources and take an ocean/human-centered approach to better inform MSP and coastal management actions.



Box 3, Figure 3. Multiple ways of knowing and communicating seascape characteristics. (Top) Mental map of the seascape created during interviews with local people highlighting the strong wind that blows on this kai (sea) and the bounty of fish it provides; (Middle) Nā Kai (sea) photograph that denotes cultural understanding of ocean zones such as Kai koholā: area of the sea where the whales roam, Kai pāeaea: area of smooth, calm sea, Kai pāpaʻu: shallow sea, Kai helekū: sea where one can stand or wade in the water. (Bottom) Benthic habitat maps of the same marine area that were created using a geospatial and subjective approach.

Box 4. | Stakeholder engagement to map values at sea

SeaSketch (www.seasketch.org) is a software interface that supports the participatory mapping of assigned values and integration of these data to characterize human dimensions across the seascape in a manner that can inform the planning process narrative[178]. SeaSketch uses online surveys that can either be accessed directly by stakeholders or used during in-person interviews or focus groups to sketch out areas and points in two-dimensional space (Box 4, Fig. 4). Individuals answer a set of attribute questions associated with each polygon they have delineated and then designate a relative value to that polygon[179]. Individuals interpret 'value' for themselves, so the maps of relative value reflect factors of importance to the stakeholders rather than simply economic value. Similar to mental models and graph theoretic approaches, these individual maps can then be integrated or compiled across individuals of a particular stakeholder or community group (e.g., a fishing community) to produce a map that shows cumulative similarities or differences across space, similar to a contour map (e.g., where members of the fishing community have shared agreement on productive grounds). Such approaches bring plural understandings of space and broader concepts of value into the spatial logic of MSP, including recreational uses of marine space[180], further extending which stakeholders matter in MSP[181,182].



Box 4 Figure 4. Fishing locations are mapped through the stakeholder engagement process in the Blue Halo Montserrat Ocean User Survey. Visualizing synthesized survey responses in a Fishing Value heatmap alongside other authoritative data layers in the participatory data-driven Ocean zoning process, Blue Halo Barbuda.

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Author contributions

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Competing interests

The authors declare no competing interests.

Additional information

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