ANNUAL REVIEWS

Annual Review of Marine Science

The State of Marine Social Science: Yesterday, Today, and into the Future

Ana K. Spalding[1,2] and Emma McKinley[3]

[1]Smithsonian Tropical Research Institute, Panama City, Panama; email: spaldinga2@si.edu

[2]School of Public Policy, Oregon State University, Corvallis, Oregon, USA

[3]School of Earth and Environmental Sciences, Cardiff University, Cardiff, United Kingdom; email: mckinleye1@cardiff.ac.uk

Annu. Rev. Mar. Sci. 2025. 17:143–65

First published as a Review in Advance on July 10, 2024

The *Annual Review of Marine Science* is online at marine.annualreviews.org

https://doi.org/10.1146/annurev-marine-121422-015345

Keywords

community, governance, ocean literacy, valuation, well-being, equity

Abstract

Rapidly changing ocean conditions are resulting in changes in marine species and across entire ecosystems that, in turn, affect communities and individuals who rely on these resources for their livelihoods, culture, and sustenance. Marine social science, an emerging field that embraces diverse methods to understand human–ocean relationships, is increasingly called on to contribute to transdisciplinary ocean science that can inform the evidence-based policy and management needed to address these changes. Here, we review the state of marine social science as a growing field of study. First, we outline the history of marine social science, including the emergence of the field and the social science disciplines and community it encompasses. We then discuss current marine social science research themes as a framework to understand key ocean issues, which is followed by a commentary on the future of marine social science research.

INTRODUCTION: WHAT IS MARINE SOCIAL SCIENCE AND WHY DOES IT MATTER?

The global ocean, coasts, and seas are facing significant threats from overexploitation, unsustainable development, and climate change. Unprecedented rates of change are reflected through higher ocean temperatures, rising sea levels, ocean acidification and decreasing oxygen levels, melting sea ice, and changes in ocean currents (Herbert-Read et al. 2022). As a result, the ranges of marine fishes are shifting poleward and deeper, corals are bleaching, marine mammals are starving, and entire ecosystems are shifting (Herbert-Read et al. 2022). These conditions, in turn, affect communities and individuals who live by the coast or rely on marine resources for their livelihoods, with highly vulnerable Indigenous and other local communities disproportionately impacted by changing ocean conditions (Bennett et al. 2023, Gill et al. 2023, Österblom et al. 2020).

As global environmental challenges evolve into what we now understand to be co-occurring climate, biodiversity, and social crises, there is an increasing recognition of the marine environment[1] as a peopled space (Bennett 2019). In other words, the human–ocean relationship is reciprocal, meaning that the marine environment is affected by human activity and, in turn, has important implications for human communities. Despite the growing recognition of the dynamism and complexity of ocean–society relationships, we have continued to rely on conventional natural science approaches to explain environmental changes, design marine policies, and make management decisions (Spalding et al. 2023), often failing to collect and analyze the necessary information to understand associated changes in human communities (Claudet 2021). Moreover, monitoring data that document changes in ocean systems do not necessarily offer policy and management guidance grounded in relevant societal contexts, nor do they consider the equity and justice dimensions of that guidance or specific pathways for sustainable futures. As a result, calls for transdisciplinary[2] and social science[3] research have increased over the past 10 years, including a special focus on marine issues (*Nature* 2015, Partelow et al. 2023). Notably, in the case of marine issues, the nature of ocean and coastal environments and resources shapes these social scientific approaches and ensuing policy and management decisions. For instance, the multiple dimensions of the ocean (e.g., the surface, the water column, and the seafloor) and varying nation-states' jurisdiction over resources, especially the farther away they are from the coast (e.g., jurisdiction over resources in the exclusive economic zone up to 200 nautical miles away from the shore versus sovereignty over the ocean space, the airspace above it, and the seafloor typically found within 3 nautical miles of the coast), affect questions related to the design of management tools as well as access to, ownership of, and control over resources (Carr et al. 2003, Zacharias 2014). As Partelow et al. (2023) point out, these characteristics further complicate the generation of knowledge about social dynamics in ocean and coastal spaces.

[1] By marine environment, we mean the oceans, coasts, or any marine geographic feature near the coast that is influenced by salty or brackish water. Throughout this article, we often use marine interchangeably with ocean to reflect how the term is used by scholars in this field.

[2] By transdisciplinary, we do not mean only the integration of, for instance, biology and chemistry, but rather the inclusion or consideration of natural and social sciences as well as the acknowledgment of a societal context and engagement with nonacademic partners (Rosenfield 1992).

[3] Spalding et al. (2017) define the human dimension as the range of human processes that relate to natural resource use outcomes and uses and that are studied broadly by the social sciences and humanities. Of relevance to this review, the term social science refers to disciplines (including psychology, anthropology, political science, economics, and others) that are scientific in that they describe and analyze trends in and determinants of human behavior, using approaches based on established social science theories, methods, and philosophies on the nature of knowledge.

Indeed, along with documentation of global ocean change and calls for transdisciplinary and applied social sciences, the past decade has seen a turn in ocean governance toward what is known as the Anthropocene ocean (Levin & Poe 2017, Spalding & de Ycaza 2020). Peters et al. (2022) refer to this as a social science oceanic turn, where, for instance, the authors of the various chapters included in *The Routledge Handbook of Ocean Space* describe and explore the complex and policy-relevant relationship between people and the sea. This so-called Anthropocene ocean is characterized by observations of environmental degradation in the ocean and along the coast (typically gathered using traditional natural science ocean observations), rapid growth in technology and innovation (more recently as a source of solutions to climate change), and the emergence of the idea of the blue economy as a pathway to ocean sustainability (Barbesgaard 2018, Campbell et al. 2016, Voyer et al. 2018). It has also been accompanied by an elevation of the ocean to the global development agenda, as evidenced by the adoption of Sustainable Development Goal 14 (life below water) as one of 17 Sustainable Development Goals under the United Nations (UN) 2030 Agenda for Sustainable Development. Additional high-profile global initiatives, such as the Our Ocean Conferences (held annually since 2014), the UN Ocean Conferences (2017, 2022, and planned for 2025), the High Level Panel for a Sustainable Ocean Economy (2018–2022), and the UN Decade of Ocean Science for Sustainable Development (2021–2030) (hereafter the UN Ocean Decade), showcase national- and regional-level efforts that have brought increased attention to the intersection of natural, social, and physical elements of the ocean. Specifically, the UN Ocean Decade calls for an expansion of traditional definitions of ocean science, recognizing its breadth and multidisciplinarity, stating that "ocean science. . .encompasses natural and social science disciplines, local and indigenous knowledge; it includes the science-policy and science-innovation interfaces, as well as technology and infrastructure" (UNESCO-IOC 2021, p. 4). In this context, for this review we use Partelow et al.'s (2023) definition of marine social science as an emerging field or "branch of the social sciences that embraces quantitative and qualitative methods to provide multiple empirical and conceptual lenses through which the relations between humans and the ocean can be understood" (Partelow et al. 2023, p. 24).

Despite the increased emphasis on human–ocean relationships, to date, marine social science papers represent less than 5% of the ocean science literature published since 1990 (Partelow et al. 2023). Moreover, scholars suggest that failing to consider marine social science contributions to knowledge of ocean and coastal systems and the people who depend on them limits opportunities to generate integrative and holistic marine science that can inform evidence-based policy and management in support of ocean sustainability (Bennett 2016, McKinley et al. 2020, Partelow et al. 2023). Admittedly, not all marine research must necessarily incorporate a human dimensions component. However, research that seeks to address or provide solutions to global ocean and coastal challenges must incorporate socially relevant and social science evidence-based inputs (Spalding & Biedenweg 2017). The growth of marine social science over the past decade supports a new narrative that positions human dimensions as crucial for the understanding and management of global ocean and coastal challenges and related solutions. Here, we document that growth and present a review of the state of marine social science. First, we provide a brief background on the history of marine social science, including a discussion on the emergence of the field and the social science disciplines and community it encompasses. We then outline marine social science themes and approaches to understanding key ocean issues, which is followed by a commentary on future and emerging issues for marine social science research. While not intended to be exhaustive, the review provides a much-needed overview of the current and emergent themes in marine social science and concludes with a discussion of the challenges facing marine social science and suggestions or opportunities to help shape its future.

BACKGROUND: A SHORT HISTORY OF MARINE SOCIAL SCIENCE

Emergence of the Field

Marine social science research emerged as a marine-specific branch of environmental studies, a field that developed over time by merging several social and ecological science disciplines and that applies a human dimensions lens to environmental issues at various scales. Since the early 1970s, environmental studies scholars have examined environmental challenges as social, political, cultural, or economic phenomena, pushing back on the idea that the environment could be used as an explanation of societal outcomes (Livingstone 2011). Using various approaches from traditional social science disciplines such as anthropology, economics, history, sociology, and political science, and often combining ideas from each, environmental studies scholars further described social and ecological events as interconnecting drivers that shaped both societies and landscapes. A more critical turn in environmental studies, known as political ecology, further pushed the field to question relationships of power at various scales, including political and economic systems of oppression that have perpetuated cycles of poverty and associated environmental degradation. Political ecology, thus, gave voice to human and nonhuman elements of the environment that had historically been subdued by hegemonic epistemes of the natural science world that tended to oversimplify causal relationships between local resource use and negative environmental outcomes. With close ties to human geographers—who, by definition, study the relationship between people and the environment—political ecology and environmental studies scholars acknowledged and actively called for the integration of social, political, and economic contexts into environmental research (Robbins 2019, Wolf 1972). Beyond simply acknowledging the existence of interactions between people and nature, environmental studies scholars increasingly seek to understand socioenvironmental relationships and explore drivers of change in order to identify solutions to global environmental problems. Marine social scientists do this in marine spaces and contexts (Spalding 2023).

Like environmental studies, albeit in a somewhat disjointed manner, discipline-specific marine social science research began to show up in the academic literature around the late 1950s (e.g., Schaefer 1957). Economic and anthropological studies of marine fisheries are the most common references, with fisheries economics being the most popular in light of the long history of fishing and fisheries management as well as the economic importance of the industry to coastal communities around the world. Fisheries economics is strongly influenced by and linked to fisheries biology and the associated economic valuation of marine resources (Lane & Stephenson 1995). Modern maritime and fisheries anthropology, in contrast, focused on fishers and fishing communities, using an ethnographic approach and socioeconomic and political perspectives to understand the industry and the various systems and structures required to participate in fishing activities (for a review of fisheries anthropology, see Acheson 1981). Several decades later, sociologists Longo & Clark (2016) called for the advancement of marine sociology, and Hannigan (2017) called for a sociology of the ocean—two approaches that use sociological theories, such as social metabolic analysis, to explain the impacts of social change on marine environments and the eventual impact of that environmental change on marine-resource-dependent societies. These contributions, which are vastly important to the current marine social science research literature, were arguably subfields, or geography-specific branches, within their respective disciplines and did not necessarily speak to scholars outside of economics, anthropology, or sociology.

While crucial to our understanding of human activities in and around the ocean, siloed disciplinary approaches, as applied to ocean issues, did not fundamentally change how we think about the human–ocean relationship as a whole, nor did they come together as one to define or characterize a social ocean. For instance, using a diversity of methods and studying an array of topics from individuals to ecosystems, marine biologists are collectively able to provide an ever more

complex environmental description of the global ocean, coasts, and resources therein. In contrast, a joint description or characterization of the ocean from a human dimensions perspective is much less well developed, probably due to siloed social science approaches that have not typically spoken to each other. Steinberg's (2001) book *The Social Construction of the Ocean* attempts to describe the social ocean. While heavily relying on social theory, Steinberg (2001) does a laudable job of describing historical and current social representations of the ocean and claims that the human conceptualization of the ocean space and associated cultural or economic activities has shaped global societies and environments.

The 1980s marked yet another turn in the (so far) siloed marine social science field (Jefferson et al. 2021). This turn aligns with the emergence of global change research—an interdisciplinary effort that linked the physical sciences with the life and biological sciences to better understand Earth systems in the face of climate change. Initially on the fringes, the application of social science approaches to understand the human dimensions of global change was increasingly recognized. Due to concerted efforts, over time, by social scientists from various disciplines working together, the human dimensions gradually became incorporated into global research and governance processes (for a detailed review of this gradual and not always smooth integration process, see Mooney et al. 2013). Importantly, this integration led to what became known as sustainability science in the 1990s, a systematic approach that brought together Earth systems, biodiversity, and human dimensions concerns, aiming to provide the scientific basis for the global sustainability agenda. At the time, this sustainability agenda was guided by the Millennium Development Goals through the global effort, between 2001 and 2005, of producing the Millennium Ecosystem Assessment (MEA 2005). While not without limitations, the Millennium Development Goals claimed to support the international community's commitment to human development in an environmentally sustainable manner, with targets set for the year 2015 (MEA 2005). At the time, ocean issues were only vaguely included in Millennium Development Goal 7 (ensure environmental sustainability). However, as part of the transition to new sustainability goals for 2015–2030—the Sustainable Development Goals—the ocean was officially recognized as a topic of importance under Sustainable Development Goal 14 (life below water). Thus, 2015 represents a crucial moment in global environmental governance where marine social science research was recognized as an important source of information in support of action for a sustainable ocean future.

Marine social science scholarship has experienced significant growth, from 3.4% of all papers in ocean science in 1990 to 7.4% in 2021 (Partelow et al. 2023). This increase is characterized by papers led by authors who are less tied to a given social science discipline and more focused on theoretical, applied, engaged, or use-inspired scholarship that centers the ocean and its human dimensions, instead of single-disciplinary traditions. In contrast, ocean science, broadly, has been used mainly to identify problems and justify the importance of ocean processes to global environmental challenges and solutions. Ocean science publications emphasize, for instance, the importance of the ocean to the global carbon cycle, the impact of fisheries declines on marine biodiversity, species range shifts due to changing climate, and monitoring of environmental variables, among other things. Absent a clear pathway for action related to this information, science is able to inform and describe problems but not necessarily design and implement solutions. The opportunity for marine social scientists, thus, lies in their ability to participate in transdisciplinary research teams and engage with partners at various scales in order to offer solutions for sustainable development (i.e., human environment) challenges (UNESCO-IOC 2021). Indeed, the increase in marine social science scholarship documented by Partelow et al. (2023) specifically reflects this move toward an applied intellectual focus on ocean sustainability: Between 1990 and 2021, of the 2.5% of ocean science papers that address sustainability, 16% come from marine social science disciplines (Partelow et al. 2023, p. 24), several of which explore and propose social science research

agendas (Arbo et al. 2018, McKinley et al. 2020). Echoing these papers, in 2020 the Manifesto for the Marine Social Sciences (Bavnick & Verrips 2020) explicitly called for scholarship in the field to expand beyond fisheries; promoted conversations among marine social scientists about the future of the field, specifically focusing on the expansion of themes that included gender, coastal management, blue growth, culture, and labor; and proposed new ideas for theory and methodological approaches.

Drawing from the research agendas proposed by Arbo et al. (2018), Bavnick & Verrips (2020), McKinley et al. (2020), and others, and shifting from a disciplinary perspective to an integrated approach for understanding ocean sectors and the issues and challenges associated with them, next we outline key human dimension themes related to ocean issues. Specifically, we provide background information, define the scope of each theme, and outline a selection of the methodological approaches used for data collection and analysis within it (for a list of themes and associated social science disciplines, see **Table 1**). Each of these themes is cross-cutting and reflects the fact that the relationship between humans and the ocean is, in fact, mediated by social perceptions of the ocean and its resources, as well as our global political and economic systems (Jefferson et al. 2015, Steinberg 2001).

Understanding the Marine Social Science Community

The marine social science community has been largely fragmented due, in part, to the dearth of marine social science academic training programs or departments. In the United States, a handful of marine-specific interdisciplinary degree programs have existed since the 1970s (the Marine Resource Management program at Oregon State University; the Marine Affairs programs at the Universities of Miami, Washington, and Rhode Island; maritime studies programs at various universities, etc.). However, these offer either exclusively undergraduate- or master's-level degrees that are highly applied, focus on training in natural resource management, and often lack a solid theoretical social science foundation. This is not a critique of these programs—indeed, they have trained a great number of students who are aware of and value the importance of the human dimensions in ocean governance and policy. However, they often lack the resources to provide a deep understanding of the theoretical foundations of social science and how they can be applied to global environmental issues. Australia and the United Kingdom also have programs that incorporate the natural and social aspects of oceans and coasts; however, these are typically integrated into marine science programs instead of being stand-alone programs for the study of marine social science or marine studies. Fortunately for the discipline and for those of us who work in this space, recent years have seen this begin to change. Efforts to foster collaboration and build networks are growing ever stronger—for example, established in 2000, the Centre for Maritime Research (MARE; **https://marecentre.nl**) in the Netherlands has been an active network for marine social science researchers and has hosted a biannual People and the Sea conference since 2001. Similarly, in 2018, the Marine Social Sciences Network (**https://www.marsocsci.net**) was established to support efforts to raise the profile of marine social science research, highlight its role in ocean governance, foster networking, and address feelings of isolation expressed by marine social scientists (McKinley et al. 2020). Indeed, in addition to the scarcity of interdisciplinary marine academic programs, feelings of isolation may also come from marine social scientists affiliated with siloed social science and humanities colleges or academic departments that have historically excluded environmental issues or intentionally focused on the purity of their disciplines.

Notably, many lead authors of marine social science publications come from natural science backgrounds. For instance, in a recent survey conducted by McKinley et al. (2022) on the global community of self-identified marine social scientists, approximately 58% of respondents self-identified as biologists, with 29% of those identifying as natural scientists, 36% as social scientists,

Table 1 Marine social science themes and associated relevant disciplines

Marine social science theme	Relevant disciplines
Governance and decision-making	Economics Law Planning Political science Public policy
Community- and place-based research	Human geography Social psychology Sociology
Perceptions and attitudes	Anthropology Social psychology Sociology
Ocean literacy, values, and behavior	Education Human geography Psychology Sociology
Economics and valuation	Anthropology Economics Political economy Psychology
Human well-being	Anthropology Economics Education Political science Public health Social psychology
Justice and ocean equity	Anthropology Human geography Political ecology Psychology Sociology
Climate change and adaptation	Anthropology Human geography Sociology

Table adapted from Spalding & Biedenweg (2017) with permission from Elsevier.

and 35% as both. This suggests that there is a tendency to engage in marine social science without having a background in the fields described in the previous section. The implications of this are explored by Martin (2020), who reflects on the challenges of non-social scientists engaging in the production of social science research, highlighting a lack of in-depth knowledge of relevant literature and inexperience with social science methods or data analysis approaches, leading to inaccurate reporting of results. Moreover, Schnoor et al. (2023) showed that the disproportionate interest from natural scientists in Integrated Ecosystem Assessments results in 99% of scientists working on such assessments being natural scientists who lack training in human dimensions research or collaborations with human dimensions scholars. This finding, in part, is due to the rapid evolution of the field and underscores the need for institutional change to embrace the new field of marine social science, as well as developing appropriate training and capacity building to further support marine social science scholarship and communities of practice.

MARINE SOCIAL SCIENCE THEMES RELATED TO KEY OCEAN ISSUES

Key ocean issues include food from the sea (e.g., wild-caught fisheries and aquaculture), biodiversity and conservation [marine protected areas (MPAs), restoration ecology, etc.], and maritime industries (transportation, energy, ports, etc.). Research on these topics has traditionally been dominated by natural or technological science that describes fish biomass, life histories, or stock assessments; ecological outcomes of MPAs or characterization of ecosystem biodiversity; or techno-managerial aspects of shipping, oil and gas production, and port operations (e.g., Aksnes & Browman 2016, de la Peña Zarzuelo et al. 2020, Grorud-Colvert et al. 2021). This type of knowledge has traditionally been developed separately from human dimensions or social science knowledge that might, for instance, describe the cultural aspects of fisheries, governance, or social outcomes of MPAs, or gender considerations of marine industries (O'Leary et al. 2021). Social science studies of key ocean issues, analogous to natural science studies on those same issues, do exist. However, the marine social science turn toward sustainability provides an opportunity to use cross-cutting and transdisciplinary approaches to understanding those issues. In addition to marine fisheries, marine conservation, or marine industry social science expertise and knowledge, marine social science research increasingly covers a range of interconnected issues and methodological approaches and is well suited to addressing major challenges with a transdisciplinary and applied focus. Major themes related to key ocean issues covered in this review include governance and decision-making; community- and place-based research; perceptions and attitudes; ocean literacy, values, and behavior; economics and valuation; human well-being (HWB); justice and ocean equity; and climate change and adaptation (**Table 1**).

Governance and Decision-Making

All ocean issues require some form of governance or agreement over use of, access to, and distribution of resources that describes how actors and institutions (e.g., governments and civil society) make decisions related to the exercise of authority or power over marine spaces, resources, and activities (Campbell et al. 2016, Spalding & de Ycaza 2020). Ocean governance scholars focus on these types of agreements by studying legal frameworks, how those frameworks are implemented, the impacts of those agreements, and the associated actors (individuals, groups, and organizations) involved in environmental governance (Scott & Spalding 2023). For the ocean, global governance was defined through the decade-long negotiation on the UN Convention on the Law of the Sea between 1973 and 1982. This agreement established norms around rights over and access to resources in an exclusive economic zone and navigation safeguards within territorial waters; assigned responsibilities related to marine pollution, research in exclusive economic zones, and dispute resolution; and cemented the idea of an area of the high seas, beyond national jurisdictions, to be considered the common heritage of humanity (Miles 1999). Overlapping with some of the other themes discussed in this review, governance scholarship also studies how different systems of governance relate to local cultures, societies, economies, and politics, such that local norms and benefits from resources are adequately respected and allocated (Andonova & Mitchell 2010). Furthermore, ocean governance and decision-making are applied and studied at various interconnected scales. For instance, internationally, ocean governance (e.g., the UN Convention on the Law of the Sea) provides a framework for cooperation across nation-states and for decision-making related to transboundary issues such as fisheries, conservation, and pollution (Spalding & de Ycaza 2020). Regional governance mechanisms (e.g., regional fisheries management organizations) focus on the management of living marine resources across nation-state boundaries (Grip 2017). Lastly, national and local governance efforts (e.g., national ocean policies) outline nation-states' goals, policies, and processes with the goal of holistically managing ocean and coastal resources within the jurisdiction of nation-states (Cicin-Sain et al. 2015).

Of particular importance to governance and decision-making in marine environments, the perception of the ocean and its resources as a common pool resource is a complex theme (Berkes 1985, Sweeney et al. 1974). Governance of common pool resources (e.g., rights, access, and governance structures) has been widely studied, primarily through the work of Ostrom (2008). In the marine context, scholarship on the commons includes social science work related to fisheries management (e.g., Acheson 2003, Mansfield 2004, McCay et al. 2014) and has strongly influenced the conversation about the role of cooperatives, markets, and other forms of privatization of fisheries resources.

Ocean governance and decision-making are also closely tied to political science and public policy disciplines, aligning primarily with subfields that study approaches to global environmental governance and politics (Speth & Haas 2007). However, the emergence of cross-cutting ocean issues that integrate human activities, governance structures, and physical and ecological science information across environmental and geopolitical scales, such as climate change, has shifted the research landscape. For instance, scholarship on the ocean–climate nexus addresses the importance of the ocean as a solution to climate change that also supports HWB, increasingly with an emphasis on transdisciplinarity and inclusivity. In practice, these calls for collaboration and transdisciplinarity are reflected in what we call ocean governance for the Anthropocene ocean—a governance approach that focuses on integrated planning using technology and innovation, a diversified and more inclusive set of actors of environmental governance (including, for instance, local community and Indigenous knowledge and governance), and a shared vision for sustainability that is currently driven by narratives about sustainable ocean economies (Barbesgaard 2018, Campbell et al. 2016, LaPorte 2023, Levin & Poe 2017, Spalding & Suman 2023, Voyer et al. 2018).

Community- and Place-Based Research

With the increased emphasis on the human dimensions of ocean systems seen in the last two decades, marine social science research has experienced a corresponding increase in community- and place-based research. While calls for effective and meaningful stakeholder and community participation and engagement in ocean issues are not new, community- and place-based research remains a core focus of marine social science research (McKinley et al. 2022). Indeed, marine social science research offers a broad range of tools that can be utilized to explore ocean issues across a variety of community contexts and scales, from small-scale case-study-based work adopting qualitative approaches to national or even international studies, such as national surveys (Potts et al. 2016). This work has recognized a need to ensure meaningful and effective methods of engagement and participation, resulting in a shift from passive methods of consultation and engagement to studies that adopt more active, innovative, and inclusive interventions. Examples include, but are not limited to, participatory mapping to elicit community values to support natural capital assessments or the development of marine spatial plans (Blake et al. 2017, Burdon et al. 2019), evaluation of the role of community-based management and governance (Zuercher et al. 2023), and the design, implementation, and evaluation of MPAs and their implications for communities of different scales (Ban et al. 2009, Diedrich et al. 2017, Gurney et al. 2015).

Additionally, it is necessary to discuss the frequent conflation of community-based research with citizen science and the role of marine social science research within this discourse. Citizen science as a way of engaging communities on ocean topics and connecting them to ocean places and environments through the collection of observation and monitoring data is by no means new (Cigliano et al. 2015), and recent years have continued to see an increase in the volume of citizen, or community, science research (Garcia-Soto et al. 2021, Kelly et al. 2020, Sandahl & Tøttrup 2020). From a marine social science perspective, there are several opportunities to work within the citizen

science space. First, there are opportunities to build on emerging research exploring the notion of citizen science and redefining it as community science in a bid to address the power imbalances inherent within the notion of being a citizen (McAteer & Flannery 2022). Second, as calls for more citizen science initiatives continue, the fields of anthropology, human geography, sociology, and environmental psychology lend themselves to better understanding some of the challenges facing these initiatives and programs, such as those related to participant motivations (Martin et al. 2016, McAteer et al. 2021), the role of citizen science in developing social license and ocean literacy and fostering behavior change (Kelly et al. 2019), and power dynamics and participant roles (Salmon et al. 2021). Further, there is a need to consider how social science methodologies can be utilized within these citizen or community science programs, particularly when considering aspects of human behavior and agency, or how to evaluate societal connection with the ocean—something that is currently limited (Tauginienė et al. 2020). To truly deliver transdisciplinary ocean research, it is crucial to maximize the potential of marine social science research theories, concepts, and tools within the growing field of community- and place-based research of all kinds.

Perceptions and Attitudes

Coupled with the increased focus on community- and place-based research discussed above, the expansion of marine social science research in recent years has included an increase in public perceptions research. Drawing from wider social science disciplines and approaches, public perceptions research is a broad, interdisciplinary area that explores the knowledge, interests, and attitudes held by an individual or community about a topic (Bennett 2016, Jefferson et al. 2015) and can support an understanding of human–ocean relationships and the drivers influencing them. Research into public attitudes and perceptions relating to marine issues is not new; a recent review suggested that research of this nature began in earnest in the 1980s (Jefferson et al. 2021). However, despite its almost 40-year history, the recognition of the diversity and heterogeneity of societal perceptions and attitudes is perhaps more recent, as is the growing acceptance that perceptions research is a legitimate source of information and has a number of roles in supporting sustainable ocean management and governance (Jefferson et al. 2014, Potts et al. 2016, Rose et al. 2008). Using marine social science research methods, public perceptions research can help to develop understanding of the societal impacts of conservation and management interventions; provide insight into multiple perspectives, including the variation in views, values, and priorities that may be present between communities and topic experts; and help ensure and strengthen the legitimacy, transparency, and acceptability of ocean governance (Bennett 2016).

As efforts to understand, support, and effectively—and indeed sustainably—manage the Anthropocene ocean continue, public perceptions research will remain a core component of marine social science scholarship. While we must acknowledge the advances that have been made in this area over the last three decades, our understanding of public perceptions of ocean issues remains relatively nascent (Jefferson et al. 2015). As already outlined by others, there is a need to diversify the methodologies adopted to explore and understand perceptions, particularly to track changes over time, with recent work indicating an overdependence on questionnaire- and interview-based data collection tools (Bennett 2016, Jefferson et al. 2021). Further, a review of ocean public perceptions has highlighted that while there is evidence of perceptions research exploring an ever widening number of topics, there has been a tendency for research to focus on topical, attractive, and charismatic elements of the ocean [e.g., MPAs (Roberts et al. 2020, Trenouth et al. 2012) and marine mammals (Mazzoldi et al. 2019, Naylor & Parsons 2018)], with less focus on some of the more fundamental, harder-to-see, and less attractive ocean issues, such as salt marshes, blue carbon, and microecological aspects of the ocean (Jefferson et al. 2021). As in other themes,

there are, of course, challenges in establishing clear pathways to impact from perceptions research. How can understanding of community perceptions be harnessed and operationalized to leverage ecologically and socially beneficial conservation outcomes or to drive policy change for the Anthropocene ocean? And how can the insights gathered from public perceptions be used to support meaningful and inclusive engagement with ocean issues from a wide range of audiences? Expanding marine social science research efforts to further explore public perceptions research relating to the whole spectrum of ocean issues offers opportunities to understand these topics in more detail and to address existing gaps in geographic distribution, thematic focus, research methodologies, and more.

Ocean Literacy, Values, and Behavior

Aligned with the growth in public perceptions research, recent years have seen a significant increase in research exploring the diverse values society places on ocean environments, resources, and experiences, as well as how these can be integrated into contemporary models of ocean literacy and behavior change. The importance of recognizing and integrating the different values (social, cultural, economic, etc.) that society holds toward the ocean has been championed by a number of scholars (Auster et al. 2009, Rock et al. 2020) and is related to a wide range of ocean issues, including planning and governance, as explored above (McKinley et al. 2019). In 2022, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services further cemented the importance of conceptualizing, evaluating, and assessing values attributed to nature and the environment, how these values influence human–nature relationships, and, crucially, how we can work toward sustainable management of natural resources (Anderson et al. 2022).

In an ocean context, the call for improved understanding of ocean–human relationships has recently gained the most traction as a result of an increased emphasis and focus on the concept of ocean literacy. Initially conceptualized in the United States in the early 2000s in response to a lack of marine education within the national curriculum, ocean literacy is most simply defined as "an understanding of the ocean's influence on you and your influence on the ocean" (Cava et al. 2005, p. 5; see also Payne et al. 2022). In the decades since its inception, ocean literacy has continuously evolved from an education- and knowledge-based concept to one that encompasses a broader range of dimensions relating to societal relationships with the ocean (Brennan et al. 2019, Kopke et al. 2019, McKinley et al. 2023, Payne et al. 2022). Although it is not a particularly new concept, momentum around ocean literacy has seen an upward trajectory since its positioning as a key policy driver and mechanism for transforming society's relationship with the ocean—the key topic of Challenge 10 set out by the UN Ocean Decade (UNESCO-IOC 2021). Sitting firmly within marine social science studies, ocean literacy research has historically been dominated by assessments of ocean education programs and awareness-raising campaigns (see, e.g., Guest et al. 2015, Steel et al. 2005, Winks et al. 2020). While these have produced much-needed assessment tools (e.g., Fauville et al. 2019) and provided valuable insights into levels and types of ocean knowledge, emerging research is drawing on new frameworks and models that have begun to expand the concept of ocean literacy to reflect its evolution. Marine social science research has begun to explore the role of the various dimensions now recognized as being a core aspect of individual and collective ocean literacy and ocean relationships more generally. For example, the importance of emotion in driving human behavior and action relating to the ocean is increasingly recognized as being central to understanding human–ocean relationships (McKinley et al. 2023), contributing to a new wave of research that draws on environmental psychology. Other topics now being explored by emerging research efforts include, but are not limited to, the transferability and appropriateness of the term and concept of ocean literacy in varying social, economic, and cultural contexts

(MacNeil et al. 2021, Spalding et al. 2023, Worm et al. 2021); how ocean literacy aligns with other emerging and relevant concepts, such as marine and ocean citizenship (Buchan et al. 2023, McKinley & Fletcher 2012), ocean identity (Kelly et al. 2023), and ocean connectedness (Nuojua et al. 2022, Pahl et al. 2017); and how the concept of ocean literacy can be operationalized to deliver against other ocean priorities, including marine conservation, the blue economy, and wider ocean sustainability and health (Paredes-Coral et al. 2021). Finally, the development of collaborative, participatory, and innovative methods of examining and measuring values and monitoring societal levels of ocean literacy, and how these might change in response to internal and external drivers, is emerging as a priority area of research. While numerous studies on ocean literacy have used traditional social science methods such as questionnaires and interviews (as identified by Jefferson et al. 2021), the field is increasingly adopting creative and arts-based research approaches.

Economics and Valuation

Economists, as social scientists, study the allocation of scarce resources, for production or consumption, by individuals or collectively. In the context of the environment, economists study the allocation of environmental resources and the goods and services they provide to humans. To do so, they often focus on calculating the value (market or nonmarket) of goods and services for various purposes. For instance, economic valuation may help with estimating costs and benefits associated with resource management policies (see Dundas 2017 on beaches and coastal policy and Lewis et al. 2019 on salmon management) or costs of damage from natural or human-caused disasters (Bakkensen & Barrage 2022, Hallstrom & Smith 2005) as justification for the conservation of high-value ecosystems, which might include, for instance, a payment-for-ecosystem-services mechanism that provides financial incentives for local communities to stop using natural resources of global importance (Lau 2013). Economists generally agree that, over the past two decades, the market and nonmarket value of the ocean and its resources is in the trillions of dollars. These assessments draw from decades of research on ecosystem services, defined as the benefits to HWB of environmental conditions and relationships, and use several economics methods, including market and nonmarket valuation, willingness to pay, and others (Barbier et al. 2011). Valuation of nature has also been used extensively to justify conservation activities as well as the importance of expanding industries that might be detrimental to marine and coastal environments but generate significant income and economic value to nations and corporations. Economists assess value by, in part, focusing on revealed-preference methods (determining value revealed by actual behavior and choices) and stated-preference methods (using surveys that ask individuals to state their values for environmental quality). Broadly, they use environmental and natural resource economics tools to explore complex trade-offs between environmental quality and economic development (Smith 1993). A detailed analysis of valuation approaches is beyond the scope of this review; however, we want to highlight that approaches to economic valuation of nature have been around for more than 50 years (Smith 1993). Literature on these themes is not necessarily found within a select group of journals. Beyond disciplinary journals, economics and valuation studies are also found across the board in environmental management and policy academic journals.

Within the marine social science literature, the most common areas of study are fisheries economics (e.g., Sanchirico et al. 2008), valuation of natural capital for coastal management and natural hazard insurance purposes (e.g., Dundas 2017), and, more recently, conversations about the role of the blue economy in supporting a sustainable future for marine resources and coastal communities (Barbesgaard 2018, Campbell et al. 2016, Spalding & de Ycaza 2020, Voyer et al. 2018). A more recent or emerging use of economic approaches to marine resources accompanies the elevation of the ocean as a natural solution to the climate crises (Dundas et al. 2020). Following the increasingly scrutinized conversation about forest-based carbon markets, the past few years

have seen an emerging set of studies on blue carbon, many of which lack clear considerations of the social dimensions beyond economic valuation (Bertram et al. 2021, Thomas 2014).

Human Well-Being

HWB is a concept used to describe the various elements of the human condition that are deemed essential for individuals or societies to thrive. Building on scholarship on economics and human development, the term HWB is broadly used to describe or assess the outcomes of development interventions, originally focused on improving economic indicators such as income and consumption (McGillivray & Clarke 2007). Sen (1999) and Nussbaum (2000) are often credited with further articulating the need to move beyond the goal of reducing poverty to include other dimensions of humanity, such as education and nutrition, that would allow individuals and societies to thrive based on their own capabilities to actively engage in their development. Initially, the concept of HWB was closely linked to environmental conditions following the publication of the 2005 Millennium Ecosystem Assessment report (MEA 2005), and it is currently linked more closely to strategies related to nature's benefits to people.

With this expansion of scope, the concept of HWB has become increasingly difficult to define and measure (McGillivray & Clarke 2007), and there are more basic and applied social science disciplines incorporated into these studies: economics, social psychology, political science, anthropology, and education. Broadly, HWB is understood to incorporate dimensions such as financial security, societal and familial relations, and mental and physical health, as determined by levels of poverty, education, nutrition, environmental health, governance, policy interventions, and so on. The links between conditions for and indicators of HWB and outcomes of these links are typically measured either subjectively (self-assessments) or objectively (assessed externally by others), but HWB scholars suggest that a combination of both subjective and objective approaches is probably best (Biedenweg et al. 2016). Transdisciplinary scholarship on HWB has led to the development and use of various frameworks to assess HWB across individuals and societies. While scholarship on HWB and other related approaches to understanding links between society and environmental conditions has grown since the 2005 publication of the Millennium Ecosystem Assessment report, the specific links between ocean health and HWB indicators and outcomes are less studied. Biedenweg et al. (2016) reviewed existing approaches to HWB for marine policy in the United States and proposed an empirical case for the use of the following HWB domains: physical, psychological, cultural, social, economic, and governance. Using this and other sources, several scholars have since adapted and applied a variety of HWB frameworks to various aspects of marine conservation and governance, including studies of outcomes of MPAs (Ban et al. 2019, Gill et al. 2019); considerations of how to expand indicators or better frame the links between ocean health, governance, and human condition (Biedenweg et al. 2023, Breslow et al. 2016, Rasheed 2020); fisheries management (Hornborg et al. 2019); and marine spatial planning (McKinley et al. 2019, Zuercher et al. 2022). A highly applied approach from the marine social science literature, led by scholars from a wide range of disciplinary backgrounds, HWB is increasingly intersecting with other applied disciplines, such as public health (e.g., White et al. 2023), and with members of a wide community of practice engaged in ocean governance, including environmental nongovernmental organizations and other nonprofits, international development agencies, and ocean philanthropy (e.g., Campbell et al. 2016).

Justice and Ocean Equity

As the field of marine social science expands, themes that draw from political ecology, environmental sociology and anthropology, and human geography, such as understanding power dynamics,

the development of social narratives and related issues of justice and equity, how these intertwine with ocean governance and management, and the often inequitable distribution of benefits or impacts, will be integral to understanding the Anthropocene ocean—and yet these areas have historically received limited attention compared with their terrestrial counterparts (Bennett et al. 2023). However, there are signs that this is changing, with justice and equity in an ocean context increasingly viewed as a must-have rather than a nice-to-have aspect of research. Moreover, despite their frequent alignment with the blue economy discourse (Bennett et al. 2021, Fusco et al. 2022, Lubchenco & Haugan 2023), topics relating to ocean justice and equity are increasingly recognized as being inextricably linked to all ocean issues (see, e.g., Armstrong 2020, Bennett et al. 2023, Crosman et al. 2022, Österblom et al. 2020).

While recent years have seen an upward trajectory in research relating to justice and ocean equity (de Vos et al. 2023), as we move forward, it is important to consider how these concepts are being conceptualized and to recognize that, for many, Western philosophies dominate this discourse, limiting the inclusion of understanding and knowledge from different contexts and cultures, including traditional and Indigenous communities (Alexander et al. 2022, Fusco et al. 2022). As a community, we need to continue challenging the use of concepts, language, and terminology that marginalize and undermine communities and are therefore, in their very nature, unequitable (Fusco et al. 2022). Drawing on fields of inquiry such as sociology, psychology, anthropology, and others, marine social science research can support a true assessment of how justice and ocean equity have been realized, or not, across different geographies, scales, and times, and can consider historical social relationships, decolonization of ocean governance processes and ocean knowledge production, and its integration into decision-making and ocean science more broadly.

In the future, marine social science research will also need to consider issues of justice, equity, and inclusivity within the research community itself. Ocean science more widely is known to be lacking in diversity, with a number of barriers preventing people from underrepresented and marginalized groups from entering the profession (de Vos et al. 2023, Johri et al. 2021). Recent years have seen calls for the wider community to take action in multiple ways, including but not limited to the adoption of antiracist practices; the eradication of all aspects of gender discrimination; the codevelopment of research to stop parachute science; changes to publication models, including support for non-English languages and the removal of paywalls; and the development of paid training and volunteer positions to increase equitable access to capacity building (de Vos et al. 2023, Niner et al. 2020, Spalding et al. 2023). Marine social science scholarship is beginning to shed light on the complexities and nuances of equitable science and knowledge production and engagement with ocean issues. While efforts to address issues of inequity and injustice to date must be acknowledged, there is much more to be done, especially if we are to deliver on the UN Ocean Decade's promise of "the science we need for the ocean we want" and the transformation it aspires to deliver.

Climate Change and Adaptation

Climate impacts on the ocean have devastating outcomes for marine environments, resources, and coastal communities through melting ice caps, sea level rise, higher ocean temperatures, lower pH, and lower oxygen levels—all resulting in significant habitat and ecosystem changes. The ocean has traditionally been cast as a victim, but recent publications have showcased its importance as a refugium for biodiversity in a rapidly changing environment, for the regulation of global climate patterns, and in its ability to absorb excess CO_2 from the atmosphere (Gattuso et al. 2018). This has cemented the role of the ocean as a nature-based solution to threats from climate change, in what is known as the ocean–climate nexus (Germond-Duret et al. 2024). Observation,

monitoring, and even attempts to mitigate these drivers of change and their impacts on marine environments and resources have historically been led by oceanographers, engineers, and other technology innovators. However, the growing urgency and lack of progress toward addressing pressing climate threats suggest that the climate community must move beyond scientific observations and predicting future environmental scenarios through modeling to considering the range of human dimensions issues related to climate change. There are growing calls for the inclusion of marine social science research disciplines to better integrate the dynamic relationship between environmental variables, species responses, and human or social factors—all in the context of climate change (Germond-Duret et al. 2024). One topic that stands out from this rapidly expanding field is adaptation or adaptive capacity (Berrang-Ford et al. 2021). Cinner et al. (2018) and others broadly define adaptive capacity as the ability to anticipate or respond to change while reducing risk and being able to recover to a desired state. Marine social science research, using economic, anthropological, and public policy disciplinary approaches, is ideally suited to further building scholarship in this space (e.g., Green et al. 2023).

So far, climate change and adaptation science have covered the drivers of change and the desired outcome of adaptation. Another topic that marine social scientists are ideally suited to studying is the range of strategies used by coastal communities to adapt. These strategies might include inherent evolutionary traits, possession of a series of enabling conditions (assets, flexibility, networks, etc.), industry-specific responses (Cinner et al. 2018, Green et al. 2023), or policy interventions. On the latter, there is no ocean-specific governance framework that addresses climate change. As outlined in the section titled Governance and Decision-Making, global ocean governance focuses primarily on setting boundaries and assigning jurisdiction and collaboration mechanisms across nation-states on conservation, research, and resource management. However, there is no specific guidance or governance framework to regulate drivers or impacts of climate change on the ocean and the communities that depend on it. Therefore, in addition to adaptation, marine social science research related to climate change is focused largely on the science–policy connection, including a growing body of work on climate-ready MPAs and fisheries (e.g., Bell et al. 2020) and, more broadly, applied economics research related to risk, coastal hazards, and insurance (Dundas 2017).

ENVISIONING THE FUTURE OF MARINE SOCIAL SCIENCE RESEARCH

In this review, we have explored current trends in marine social science research themes (for themes covered in this review, see **Figure 1**). While it is evident that the level of research in this field has increased, there is still work to be done in terms of expanding research within and across themes and embracing new methodologies and theories to support innovation and adoption of solutions, as well as in efforts to build capacity within the wider marine social science research community. Below, we conclude with a discussion of suggestions or opportunities to help shape the future of marine social science (**Figure 1**).

From a methodological perspective, not unexpectedly, marine social science research has been dominated by traditional social science disciplines (see **Table 1**), theories, and data collection and analysis tools (Jefferson et al. 2021). As understanding of the complexity of human–ocean relationships continues to grow, so too does the suite of tools used to explore them (Gómez & Köpsel 2023, Gustavsson et al. 2021). Alongside the inclusion of participatory and reflexive methodologies, such as those outlined by a collective of marine social science researchers in a recent book exploring the methods and traditions inherent within marine social science research (Gustavsson et al. 2021), we are increasingly seeing researchers draw on arts and humanities scholarship and methods, positioning them not simply as a communication approach but as a critical lens to explore

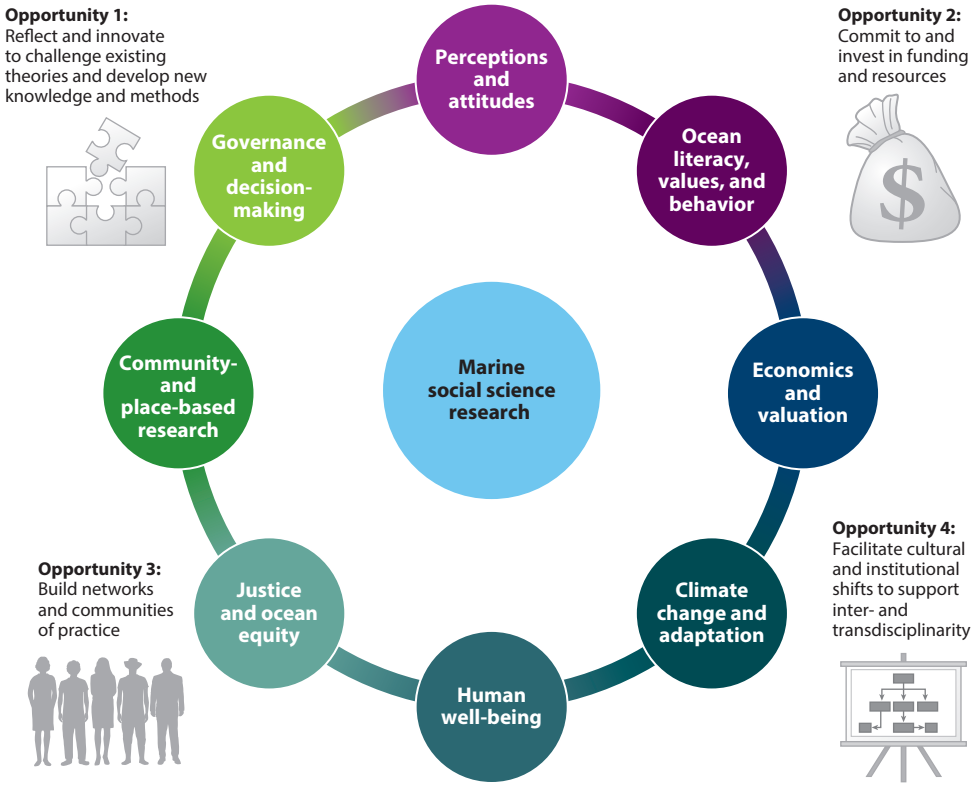

Figure 1

Current marine social science research themes and opportunities for growth.

human dimensions and as valuable data collection tools. These approaches can challenge and disrupt power dynamics, break down barriers between researchers and participants, foster creativity and innovation, and help to develop common language in a field where jargon and technocratic language can often dominate (Erwin et al. 2022). As the interest in human–ocean relationships expands and with a recognition of the gaps in our understanding, there is a clear opportunity for the marine social science community to reflect on where we have come from, challenge existing theories and methods, and adopt and develop innovative and interesting ways of integrating the human dimensions into ocean science to generate new knowledge and provide science-based solutions to pressing marine socioecological challenges.

It is evident that marine social science research is expanding and has recently undergone a significant evolution. Indeed, the social sciences and the broader notion of human dimensions of the ocean are now recognized as being fundamentally integral to a sustainable ocean future. However, despite this, recent research has shown that the field continues to face persistent challenges (McKinley et al. 2022). While increased research effort in marine social sciences should be viewed positively, questions remain about how to realize the potential of this field and about the future of a field that remains quite fragmented and has only a few dedicated academic programs. The relative youth and nascence of social science research in an ocean context, in comparison with other scientific areas, cannot be overstated. Indeed, despite recurrent calls for inter- and transdisciplinary thinking to address the challenges facing the ocean (Kelly et al. 2019), questions remain as to whether leading ocean science institutions are changing with sufficient scale and urgency. The

lack of consideration of the human–ocean relationship within the recent COP28 Dubai Ocean Declaration (Ocean Pavilion 2023) suggests that while there has been some progress, there is much still to be done. Despite the UN Ocean Decade's recognition of social science as a central aspect of ocean science and wider ocean research, the rate of change and efforts to effectively integrate social science into ocean science will continue to be limited if action is not taken (Arbo et al. 2018). Here, we echo and amplify calls from the marine social science community for improved investment of resources and commitment to building the next generation of marine social science researchers, better integration of marine social science research within the marine science–policy–practice interface, and improved support for building community within existing research and practice communities, such as MARE, the Marine Social Sciences Network, and Ocean Nexus (**https://oceannexus.uw.edu**) (Claudet et al. 2020, McKinley et al. 2022, Partelow et al. 2023, van Putten et al. 2021).

Further, as an ocean science community with a shared vision for healthy ocean and human communities, we must continue to pave the way for successful inter- and transdisciplinary research by challenging existing ways of working and encouraging a cultural shift within ocean science more broadly. Delivering this will require a substantial shift in collaborations across the ocean research community. Developing funding models that properly integrate disciplines, improving collaboration outside academia, challenging existing publication and impact models and pathways, and supporting female leadership are just some examples of actions that must be taken to ensure that marine social science research is better supported within ocean science (Blythe & Cvitanovic 2020, Popova et al. 2023).

Finally, a key takeaway from this review is the need to acknowledge that although used as an all-encompassing catch-all term, marine social science research, like its natural science counterparts, is not one thing. Rather, as reviewed here, marine social science is made up of a diversity of disciplines, which use a range of methodological and theoretical approaches and scholarly inquiry to address an ever growing list of ocean issues. Indeed, marine social science research, like natural science research, can inform decisions and actions on the ground. However, it is important to note that marine social science research is, in fact, research, and is therefore different from general activities related to community engagement, communication, education, or activism. With this in mind, we recognize that the thematic overview approach taken for this review is limited in its capacity to adequately capture the diversity of the field and fully do it justice. This is not unique to marine social science; indeed, it would be challenging to conduct a comprehensive review of all aspects of marine natural science, for example. As such, while we have attempted to give an overview of this rapidly evolving field, given the still emerging and fragmented nature of marine social science research we suggest that further, more targeted reviews on specific marine social science themes, not limited to the ones discussed here, are warranted.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

LITERATURE CITED

Acheson JM. 1981. Anthropology of fishing. *Annu. Rev. Anthropol.* 10:275–316

Acheson JM. 2003. *Capturing the Commons: Devising Institutions to Manage the Maine Lobster Industry*. Hanover, NH: Univ. Press N. Engl.

Aksnes DW, Browman HI. 2016. An overview of global research effort in fisheries science. *ICES J. Mar. Sci.* 73(4):1004–11

Alexander KA, Fleming A, Bax N, Garcia C, Jansen J, et al. 2022. Equity of our future oceans: practices and outcomes in marine science research. *Rev. Fish Biol. Fish.* 32(1):297–311

Anderson CB, Athayde S, Raymond CM, Vatn A, Arias P, et al. 2022. Conceptualizing the diverse values of nature and their contributions to people. In *Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*, ed. P Balvanera, U Pascual, M Christie, B Baptiste, D González-Jiménez, pp. 31–122. Bonn, Ger.: IPBES Secr.

Andonova LB, Mitchell RB. 2010. The rescaling of global environmental politics. *Annu. Rev. Environ. Resour.* 35:255–82

Arbo P, Knol M, Linke S, St. Martin K. 2018. The transformation of the oceans and the future of marine social science. *Marit. Stud.* 17:295–304

Armstrong C. 2020. Ocean justice: SDG 14 and beyond. *J. Glob. Ethics* 16(2):239–55

Auster PJ, Fujita R, Kellert SR, Avise J, Campagna C, et al. 2009. Developing an ocean ethic: science, utility, aesthetics, self-interest, and different ways of knowing. *Conserv. Biol.* 23(1):233–35

Bakkensen LA, Barrage L. 2022. Going underwater? Flood risk belief heterogeneity and coastal home price dynamics. *Rev. Financ. Stud.* 35(8):3666–709

Ban NC, Gurney GG, Marshall NA, Whitney CK, Mills M, et al. 2019. Well-being outcomes of marine protected areas. *Nat. Sustain.* 2(6):524–32

Ban NC, Picard CR, Vincent AC. 2009. Comparing and integrating community-based and science-based approaches to prioritizing marine areas for protection. *Conserv. Biol.* 23(4):899–10

Barbesgaard M. 2018. Blue growth: savior or ocean grabbing? *J. Peasant Stud.* 45(1):130–49

Barbier EB, Hacker SD, Kennedy C, Koch EW, Stier AC, Silliman BR. 2011. The value of estuarine and coastal ecosystem services. *Ecol. Monogr.* 81(2):169–93

Bavnick M, Verrips J. 2020. Manifesto for the marine social sciences. *Marit. Stud.* 19(2):121–23

Bell RJ, Odell J, Kirchner G, Lomonico S. 2020. Actions to promote and achieve climate-ready fisheries: summary of current practice. *Mar. Coast. Fish.* 12(3):166–90

Bennett NJ. 2016. Using perceptions as evidence to improve conservation and environmental management. *Conserv. Biol.* 30(3):582–92

Bennett NJ. 2019. Marine social science for the peopled seas. *Coast. Manag.* 47(2):244–52

Bennett NJ, Alava JJ, Ferguson CE, Blythe J, Morgera E, et al. 2023. Environmental (in)justice in the Anthropocene ocean. *Mar. Policy* 147:105383

Bennett NJ, Blythe J, White CS, Campero C. 2021. Blue growth and blue justice: ten risks and solutions for the ocean economy. *Mar. Policy* 125:104387

Berkes F. 1985. Fishermen and "the tragedy of the commons." *Environ. Conserv.* 12(3):199–206

Berrang-Ford L, Siders AR, Lesnikowski A, Fischer AP, Callaghan MW, et al. 2021. A systematic global stocktake of evidence on human adaptation to climate change. *Nat. Clim. Change* 11(11):989–1000

Bertram C, Quaas M, Reusch TB, Vafeidis AT, Wolff C, Rickels W. 2021. The blue carbon wealth of nations. *Nat. Clim. Change* 11(8):704–9

Biedenweg K, Martinez-Harms MJ, Nahuelhual L. 2023. Manual for the creation of human well-being indicators in Chilean protected areas. Zenodo 7630211. **https://doi.org/10.5281/zenodo.7630211**

Biedenweg K, Stiles K, Wellman K. 2016. A holistic framework for identifying human wellbeing indicators for marine policy. *Mar. Policy* 64:31–37

Blake D, Augé AA, Sherren K. 2017. Participatory mapping to elicit cultural coastal values for Marine Spatial Planning in a remote archipelago. *Ocean Coast. Manag.* 148:195–203

Blythe J, Cvitanovic C. 2020. Five organizational features that enable successful interdisciplinary marine research. *Front. Mar. Sci.* 7:539111

Brennan C, Ashley M, Molloy O. 2019. A system dynamics approach to increasing ocean literacy. *Front. Mar. Sci.* 6:360

Breslow SJ, Sojka B, Barnea R, Basurto X, Carothers C, et al. 2016. Conceptualizing and operationalizing human wellbeing for ecosystem assessment and management. *Environ. Sci. Policy* 66:250–59

Buchan PM, Evans LS, Pieraccini M, Barr S. 2023. Marine citizenship: the right to participate in the transformation of the human-ocean relationship for sustainability. *PLOS ONE* 18(3):e0280518

Burdon D, Potts T, McKinley E, Lew S, Shilland R, et al. 2019. Expanding the role of participatory mapping to assess ecosystem service provision in local coastal environments. *Ecosyst. Serv.* 39:101009
Campbell LM, Gray NJ, Fairbanks L, Silver JJ, Gruby RL, et al. 2016. Global oceans governance: new and emerging issues. *Annu. Rev. Environ. Resour.* 41:517–43
Carr MH, Neigel JE, Estes JA, Andelman S, Warner RR, Largier JL. 2003. Comparing marine and terrestrial ecosystems: implications for the design of coastal marine reserves. *Ecol. Appl.* 13(sp1):90–107
Cava F, Schoedinger S, Strang C, Tuddenham P. 2005. *Science Content and Standards for Ocean Literacy: An Ocean Literacy Update*. Washington, DC: Natl. Geogr. Soc.
Cicin-Sain B, VanderZwaag DL, Balgos MC, eds. 2015. *Routledge Handbook of National and Regional Ocean Policies*. Abingdon, UK: Routledge
Cigliano JA, Meyer R, Ballard HL, Freitag A, Phillips TB, Wasser A. 2015. Making marine and coastal citizen science matter. *Ocean Coast. Manag.* 115:77–87
Cinner JE, Adger WN, Allison EH, Barnes ML, Brown K, et al. 2018. Building adaptive capacity to climate change in tropical coastal communities. *Nat. Clim. Change* 8(2):117–23
Claudet J. 2021. The seven domains of action for a sustainable ocean. *Cell* 184(6):1426–29
Claudet J, Bopp L, Cheung WW, Devillers R, Escobar-Briones E, et al. 2020. A roadmap for using the UN decade of ocean science for sustainable development in support of science, policy, and action. *One Earth* 2(1):34–42
Crosman KM, Allison EH, Ota Y, Cisneros-Montemayor AM, Singh GG, et al. 2022. Social equity is key to sustainable ocean governance. *npj Ocean Sustain.* 1(1):4
de la Peña Zarzuelo I, Soeane MJF, Bermúdez BL. 2020. Industry 4.0 in the port and maritime industry: a literature review. *J. Ind. Inf. Integr.* 20:100173
de Vos A, Cambronero-Solano S, Mangubhai S, Nefdt L, Woodall LC, Stefanoudis PV. 2023. Towards equity and justice in ocean sciences. *npj Ocean Sustain.* 2:25
Diedrich A, Stoeckl N, Gurney GG, Esparon M, Pollnac R. 2017. Social capital as a key determinant of perceived benefits of community-based marine protected areas. *Conserv. Biol.* 31(2):311–21
Dundas SJ. 2017. Benefits and ancillary costs of natural infrastructure: evidence from the New Jersey coast. *J. Environ. Econ. Manag.* 85:62–80
Dundas SJ, Levine AS, Lewison RL, Doerr AN, White C, et al. 2020. Integrating oceans into climate policy: Any green new deal needs a splash of blue. *Conserv. Lett.* 13(5):e12716
Erwin K, Pereira T, McGarry D, Coppen N. 2022. *Lalela uLwandle*: an experiment in plural governance discussions. In *The Palgrave Handbook of Blue Heritage*, ed. R Boswell, D O'Kane, J Hills, pp. 383–409. Cham, Switz.: Springer
Fauville G, Strang C, Cannady MA, Chen YF. 2019. Development of the International Ocean Literacy Survey: measuring knowledge across the world. *Environ. Educ. Res.* 25(2):238–63
Fusco LM, Knott C, Cisneros-Montemayor AM, Singh GG, Spalding AK. 2022. Blueing business as usual in the ocean: blue economies, oil, and climate justice. *Political Geogr.* 98:02670
Garcia-Soto C, Seys JJ, Zielinski O, Busch JA, Luna SI, et al. 2021. Marine citizen science: current state in Europe and new technological developments. *Front. Mar. Sci.* 8:241
Gattuso JP, Magnan AK, Bopp L, Cheung WW, Duarte CM, et al. 2018. Ocean solutions to address climate change and its effects on marine ecosystems. *Front. Mar. Sci.* 5:337
Germond-Duret C, Germond B, Katsanevakis S, Kelly MR, Mazaris AD, McKinley E. 2024. Thinking outside the ocean-climate nexus: towards systems-informed decision-making in a rapidly changing world. *Sci. Total Environ.* 910:168228
Gill DA, Blythe J, Bennett N, Evans L, Brown K, et al. 2023. Triple exposure: reducing negative impacts of climate change, blue growth, and conservation on coastal communities. *One Earth* 6(2):118–30
Gill DA, Cheng SH, Glew L, Aigner E, Bennett NJ, Mascia MB. 2019. Social synergies, tradeoffs, and equity in marine conservation impacts. *Annu. Rev. Environ. Resour.* 44:347–72
Gómez S, Köpsel V, eds. 2023. *Transdisciplinary Marine Research: Bridging Science and Society*. Abingdon, UK: Routledge
Green KM, Spalding AK, Ward M, Levine A, Wolters EA, et al. 2023. Oregon shellfish farmers: perceptions of stressors, adaptive strategies, and policy linkages. *Ocean Coast. Manag.* 234:106475

Grip K. 2017. International marine environmental governance: a review. *Ambio* 46(4):413–27
Grorud-Colvert K, Sullivan-Stack J, Roberts C, Constant V, Horta e Costa B, et al. 2021. The MPA Guide: a framework to achieve global goals for the ocean. *Science* 373(6560):eabf0861
Guest H, Lotze HK, Wallace D. 2015. Youth and the sea: ocean literacy in Nova Scotia, Canada. *Mar. Policy* 58:98–107
Gurney GG, Pressey RL, Cinner JE, Pollnac R, Campbell SJ. 2015. Integrated conservation and development: evaluating a community-based marine protected area project for equality of socioeconomic impacts. *Philos. Trans. R. Soc. B* 370(1681):20140277
Gustavsson M, White CS, Phillipson J, Ounanian K, eds. 2021. *Researching People and the Sea: Methodologies and Traditions*. Cham, Switz.: Palgrave Macmillan
Hallstrom DG, Smith VK. 2005. Market responses to hurricanes. *Environ. Econ. Manag.* 50(3):541–61
Hannigan J. 2017. Toward a sociology of oceans. *Can. Rev. Sociol.* 54(1):8–27
Herbert-Read JE, Thornton A, Amon DJ, Birchenough SN, Côté IM, et al. 2022. A global horizon scan of issues impacting marine and coastal biodiversity conservation. *Nat. Ecol. Evol.* 6(9):1262–70
Hornborg S, van Putten I, Novaglio C, Fulton EA, Blanchard JL, et al. 2019. Ecosystem-based fisheries management requires broader performance indicators for the human dimension. *Mar. Policy* 108:103639
Jefferson R, McKinley E, Capstick S, Fletcher S, Griffin H, Milanese M. 2015. Understanding audiences: making public perceptions research matter to marine conservation. *Ocean Coast. Manag.* 115:61–70
Jefferson R, McKinley E, Griffin H, Nimmo A, Fletcher S. 2021. Public perceptions of the ocean: lessons for marine conservation from a global research review. *Front. Mar. Sci.* 8:711245
Jefferson RL, Bailey I, Richards JP, Attrill MJ. 2014. Public perceptions of the UK marine environment. *Mar. Policy* 43:327–37
Johri S, Carnevale M, Porter L, Zivian A, Kourantidou M, et al. 2021. Pathways to justice, equity, diversity, and inclusion in marine science and conservation. *Front. Mar. Sci.* 8:696180
Kelly R, Fleming A, Pecl GT. 2019. Citizen science and social licence: improving perceptions and connecting marine user groups. *Ocean Coast. Manag.* 178:104855
Kelly R, Fleming A, Pecl GT, von Gönner J, Bonn A. 2020. Citizen science and marine conservation: a global review. *Philos. Trans. R. Soc. B* 375(1814):20190461
Kelly R, Kasinak JM, McKinley E, McLaughlin C, Vaudrey JM, Mattei JH. 2023. Conceptualizing the construct of ocean identity. *npj Ocean Sustain.* 2(1):17
Kopke K, Black J, Dozier A. 2019. Stepping out of the ivory tower for ocean literacy. *Front. Mar. Sci.* 6:60
Lane DE, Stephenson RL. 1995. Fisheries management science: the framework to link biological, economic, and social objectives in fisheries management. *Aquat. Living Resour.* 8(3):215–21
LaPorte CB. 2023. Truth-telling: understanding historical and ongoing impacts to traditional ecological knowledge (TEK). In *Oceans and Society: An Introduction to Marine Studies*, ed. AK Spalding, DO Suman, pp. 209–27. New York: Routledge
Lau WW. 2013. Beyond carbon: conceptualizing payments for ecosystem services in blue forests on carbon and other marine and coastal ecosystem services. *Ocean Coast. Manag.* 83:5–14
Levin P, Poe MR, eds. 2017. *Conservation for the Anthropocene Ocean: Interdisciplinary Science in Support of Nature and People*. London: Academic
Lewis DJ, Dundas SJ, Kling DM, Lew DK, Hacker SD. 2019. The non-market benefits of early and partial gains in managing threatened salmon. *PLOS ONE* 14(8):p.e0220260
Livingstone DN. 2011. Environmental determinism. In *The Sage Handbook of Geographical Knowledge*, ed. JA Agnew, DN Livingstone, pp. 368–80. Los Angeles: Sage
Longo SB, Clark B. 2016. An ocean of troubles: advancing marine sociology. *Soc. Probl.* 63(4):463–79
Lubchenco J, Haugan PM. 2023. Towards ocean equity. In *The Blue Compendium*, ed. J Lubchenco, PM Haugan, pp. 485–521. Cham, Switz.: Springer
MacNeil S, Hoover C, Ostertag J, Yumagulova L, Glithero LD. 2021. Coming to terms with ocean literacy. *Can. J. Environ. Educ.* 24(1):233–52
Mansfield B. 2004. Neoliberalism in the oceans: "rationalization," property rights, and the commons question. *Geoforum* 35(3):313–26
Martin VY. 2020. Four common problems in environmental social research undertaken by natural scientists. *BioScience* 70(1):13–16

Martin VY, Smith L, Bowling A, Christidis L, Lloyd D, Pecl G. 2016. Citizens as scientists: What influences public contributions to marine research? *Sci. Commun.* 38(4):495–522
Mazzoldi C, Bearzi G, Brito C, Carvalho I, Desiderà E, et al. 2019. From sea monsters to charismatic megafauna: changes in perception and use of large marine animals. *PLOS ONE* 14(12):0226810
McAteer B, Flannery W. 2022. Power, knowledge and the transformative potential of marine community science. *Ocean Coast. Manag.* 218:106036
McAteer B, Flannery W, Murtagh B. 2021. Linking the motivations and outcomes of volunteers to understand participation in marine community science. *Mar. Policy* 124:104375
McCay BJ, Micheli F, Ponce-Díaz G, Murray G, Shester G, et al. 2014. Cooperatives, concessions, and co-management on the Pacific coast of Mexico. *Mar. Policy* 44:49–59
McGillivray M, Clarke M. 2007. Human well-being: concepts and measures. In *Understanding Human Well-Being*, ed. M McGillivray, M Clarke, pp. 3–16. New York: UN Univ. Press. **http://hdl.handle.net/10536/DRO/DU:30008358**
McKinley E, Acott T, Stojanovic T. 2019. Socio-cultural dimensions of marine spatial planning. In *Maritime Spatial Planning: Past, Present, Future*, ed. J Zaucha, K Gee, pp. 151–74. Cham, Switz.: Palgrave Macmillan
McKinley E, Acott T, Yates KL. 2020. Marine social sciences: looking towards a sustainable future. *Environ. Sci. Policy* 108:85–92
McKinley E, Burdon D, Shellock RJ. 2023. The evolution of ocean literacy: a new framework for the United Nations Ocean Decade and beyond. *Mar. Pollut. Bull.* 186:114467
McKinley E, Fletcher S. 2012. Improving marine environmental health through marine citizenship: a call for debate. *Mar. Policy* 36(3):839–43
McKinley E, Kelly R, Mackay M, Shellock R, Cvitanovic C, van Putten I. 2022. Development and expansion in the marine social sciences: insights from the global community. *iScience* 25(8):104735
MEA (Millenn. Ecosyst. Assess.). 2005. *Ecosystems and Human Well-Being: Synthesis*. Washington, DC: Island
Miles EL. 1999. The concept of ocean governance: evolution toward the 21st century and the principle of sustainable ocean use. *Coast. Manag.* 27(1):1–30
Mooney HA, Duraiappah A, Larigauderie A. 2013. Evolution of natural and social science interactions in global change research programs. *PNAS* 110(Suppl. 1):3665–72
Nature. 2015. Why interdisciplinary research matters. *Nature* 525(7569):305
Naylor W, Parsons ECM. 2018. An online survey of public knowledge, attitudes, and perceptions toward whales and dolphins, and their conservation. *Front. Mar. Sci.* 5:153
Niner HJ, Johri S, Meyer J, Wassermann SN. 2020. The pandemic push: Can COVID-19 reinvent conferences to models rooted in sustainability, equitability and inclusion? *Socio-Ecol. Pract. Res.* 2(3):253–56
Nuojua S, Pahl S, Thompson R. 2022. Ocean connectedness and consumer responses to single-use packaging. *J. Environ. Psychol.* 81:101814
Nussbaum M. 2000. *Women and Human Development: The Capabilities Approach*. Cambridge, UK: Cambridge Univ. Press
Ocean Pavilion. 2023. COP28 Dubai Ocean Declaration. *Ocean Pavilion.* **https://oceanpavilion-cop.org/dubai-ocean-declaration**
O'Leary BC, Copping JP, Mukherjee N, Dorning SL, Stewart BD, et al. 2021. The nature and extent of evidence on methodologies for monitoring and evaluating marine spatial management measures in the UK and similar coastal waters: a systematic map. *Environ. Evid.* 10(1):13
Österblom H, Wabnitz CCC, Tladi D et al. 2020. *Towards ocean equity*. Rep., World Resour. Inst., Washington, DC. **https://oceanpanel.org/wp-content/uploads/2022/05/Towards-Ocean-Equity.pdf**
Ostrom E. 2008. The challenge of common-pool resources. *Environ. Sci. Policy Sustain. Dev.* 50(4):8–21
Pahl S, Wyles KJ, Thompson RC. 2017. Channeling passion for the ocean towards plastic pollution. *Nat. Hum. Behav.* 1(10):697–99
Paredes-Coral E, Mokos M, Vanreusel A, Deprez T. 2021. Mapping global research on ocean literacy: implications for science, policy, and the Blue Economy. *Front. Mar. Sci.* 8:648492
Partelow S, Schlüter A, Ban NC, Batterbury S, Bavinck M, et al. 2023. Five social science intervention areas for ocean sustainability initiatives. *npj Ocean Sustain.* 2(1):24
Payne DL, Marrero ME, Schoedinger SE, Halversen C. 2022. The rise and fall of the tide: ocean literacy in the United States. *Mediterr. Mar. Sci.* 23(2):270–76

Peters K, Anderson J, Davies A, Steinberg P, eds. 2022. *The Routledge Handbook of Ocean Space*. Abingdon, UK: Routledge

Popova E, Aksenov Y, Amoudry LO, Becker A, Bricheno L, et al. 2023. Socio-oceanography: an opportunity to integrate marine social and natural sciences. *Front. Mar. Sci.* 10:1209356

Potts T, Pita C, O'Higgins T, Mee L. 2016. Who cares? European attitudes towards marine and coastal environments. *Mar. Policy* 72:59–66

Rasheed AR. 2020. Marine protected areas and human well-being—a systematic review and recommendations. *Ecosyst. Serv.* 41:101048

Robbins P. 2019. *Political Ecology: A Critical Introduction*. Hoboken, NJ: Wiley-Blackwell

Roberts KE, Hill O, Cook CN. 2020. Evaluating perceptions of marine protection in Australia: Does policy match public expectation? *Mar. Policy* 112:103766

Rock J, Sima E, Knapen M. 2020. What is the ocean: a sea-change in our perceptions and values? *Aquat. Conserv. Mar. Freshw. Ecosyst.* 30(3):532–39

Rose C, Dade P, Scott J. 2008. *Qualitative and quantitative research into public engagement with the undersea landscape in England*. Rep. NERR019, Nat. Engl., Kendal, UK

Rosenfield PL. 1992. The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Soc. Sci. Med.* 35(11):1343–57

Salmon RA, Rammell S, Emeny MT, Hartley S. 2021. Citizens, scientists, and enablers: a tripartite model for citizen science projects. *Diversity* 13(7):309

Sanchirico JN, Smith M, Lipton D. 2008. An approach to ecosystem-based fishery management. *Ecol. Econ.* 64(13):586–96

Sandahl A, Tøttrup AP. 2020. Marine citizen science: recent developments and future recommendations. *Citizen Sci. Theory Pract.* 5(1):24

Schaefer MB. 1957. Some considerations of population dynamics and economics in relation to the management of the commercial marine fisheries. *J. Fish. Board Can.* 14(5):669–81

Schnoor P, Gomez MKS, Wisz MS. 2023. 99 percent natural scientists: major risks of embedding ocean science policy decisions in a holistic IEA framework. SSRN 4604683. **https://doi.org/10.2139/ssrn.4604683**

Scott I, Spalding AK. 2023. Ocean governance: definitions, framework, and implementation. In *Oceans and Society: An Introduction to Marine Studies*, ed. AK Spalding, DO Suman, pp. 157–74. New York: Routledge

Sen A. 1999. *Development as Freedom*. New York: Knopf

Smith VK. 1993. Nonmarket valuation of environmental resources: an interpretive appraisal. *Land Econ.* 69(1):1–26

Spalding AK. 2023. An introduction to marine studies. In *Oceans and Society: An Introduction to Marine Studies*, ed. AK Spalding, DO Suman, pp. 3–13. New York: Routledge

Spalding AK, Biedenweg K. 2017. Socializing the coast: engaging the social science of tropical coastal research. *Estuar. Coast. Shelf Sci.* 187:1–8

Spalding AK, Biedenweg K, Hettinger A, Nelson MP. 2017. Demystifying the human dimension of ecological research. *Front. Ecol. Environ.* 15(3):119

Spalding AK, de Ycaza R. 2020. Navigating shifting regimes of ocean governance: from UNCLOS to Sustainable Development Goal 14. *Environ. Soc.* 11(1):5–26

Spalding AK, Grorud-Colvert K, Allison EH, Amon DJ, Collin R, et al. 2023. Engaging the tropical majority to make ocean governance and science more equitable and effective. *npj Ocean Sustain.* 2(1):8

Spalding AK, Suman DO, eds. 2023. *Oceans and Society: An Introduction to Marine Studies*. New York: Routledge

Speth JG, Haas PM. 2007. *Global Environmental Governance*. Delhi: Pearson Educ. India

Steel BS, Smith C, Opsommer L, Curiel S, Warner-Steel R. 2005. Public ocean literacy in the United States. *Ocean Coast. Manag.* 48(2):97–114

Steinberg PE. 2001. *The Social Construction of the Ocean*. Cambridge, UK: Cambridge Univ. Press

Sweeney RJ, Tollison RD, Willett TD. 1974. Market failure, the common-pool problem, and ocean resource exploitation. *J. Law Econ.* 17(1):179–92

Tauginienė L, Butkevičienė E, Vohland K, Heinisch B, Daskolia M, et al. 2020. Citizen science in the social sciences and humanities: the power of interdisciplinarity. *Palgrave Commun.* 6(1):89

Thomas S. 2014. Blue carbon: knowledge gaps, critical issues, and novel approaches. *Ecol. Econ.* 107:22–38

Trenouth AL, Harte C, de Heer CP, Dewan K, Grage A, et al. 2012. Public perception of marine and coastal protected areas in Tasmania, Australia: importance, management and hazards. *Ocean Coast. Manag.* 67:19–29

UNESCO-IOC (Intergov. Oceanogr. Comm. UN Educ. Sci. Cult. Organ.). 2021. *The United Nations Decade of Ocean Science for Sustainable Development (2021–2030) implementation plan*. Doc. IOC/2021/ODS/20, UNESCO, Paris

van Putten I, Kelly R, Cavanagh RD, Murphy EJ, Breckwoldt A, et al. 2021. A decade of incorporating social sciences in the Integrated Marine Biosphere Research Project (IMBeR): much done, much to do? *Front. Mar. Sci.* 8:662350

Voyer M, Quirk G, McIlgorm A, Azmi K. 2018. Shades of blue: What do competing interpretations of the Blue Economy mean for oceans governance? *J. Environ. Policy Plann.* 20(5):595–616

White MP, Hartig T, Martin L, Pahl S, van den Berg AE, et al. 2023. Nature-based biopsychosocial resilience: an integrative theoretical framework for research on nature and health. *Environ. Int.* 181:108234

Winks L, Ward M, Zilch J, Woodley E. 2020. Residential marine field-course impacts on ocean literacy. *Environ. Educ. Res.* 26(7):969–88

Wolf E. 1972. Ownership and political ecology. *Anthropol. Q.* 45(3):201–5

Worm B, Elliff C, Fonseca JG, Gell FR, Serra-Gonçalves C, et al. 2021. Making ocean literacy inclusive and accessible. *Ethics Sci. Environ. Politics* 21:1–9

Zacharias M. 2014. *Marine Policy: An Introduction to Governance and International Law of the Oceans*. Abingdon, UK: Routledge

Zuercher R, Ban NC, Flannery W, Guerry AD, Halpern BS, et al. 2022. Enabling conditions for effective marine spatial planning. *Mar. Policy* 143:105141

Zuercher R, Motzer N, Ban NC, Flannery W, Guerry AD, et al. 2023. Exploring the potential of theory-based evaluation to strengthen marine spatial planning practice. *Ocean Coast. Manag.* 239:106594