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EDITED BY
Salvatore Siciliano,
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University of Santiago de Compostela, Spain
Emma McKinley,
Cardiff University, United Kingdom

*CORRESPONDENCE
Nane Pelke
nane.pelke@uni-hamburg.de

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Ocean-human relations in the Anthropocene: mapping trends in sustainability-related marine social sciences articles

Nane Pelke[1]* and Finn Christian Simonn[2]

[1]Faculty of Business, Economics and Social Sciences, Center for Sustainable Society Research (CSS), University of Hamburg, Hamburg, Germany, [2]Faculty of Business, Economics and Social Sciences, Chair of Marketing and Innovation, University of Hamburg, Hamburg, Germany

Research about ocean-human relations has significantly increased in recent years. Compared to other disciplines in the oceanic realm, the marine social sciences, as an umbrella term for diverse disciplines and research streams dealing with ocean-human relations, however only recently gained more attention. In this light, the UN Ocean Decade stresses marine social science's pivotal role in assessing future trajectories toward more sustainable ocean-human relations. Our study aims to identify research trends in sustainability-related marine social sciences. Therefore, we thoroughly analyzed the metadata of 1,215 peer-reviewed articles published between 1991 and 2023 and retrieved from the Web of Sciences (WoS) database by applying various bibliometric analysis methods. Our study provides insights into (1) the scientific production of sustainability-related marine social sciences and its evolution (2) the main topics and research streams of sustainability-related marine social sciences, and (3) how these topics developed over time. The findings demonstrate a significant increase in annual scientific production as time progressed, with some countries and institutions contributing more than others. We identified, discussed, and visualized six research streams: (1) Perceptions and benefits of marine conservation; (2) Fisheries, aquaculture, and food security; (3) Climate change and climate change responses; (4) Coastal landscape and land use change; (5) Coastal and marine management; and (6) Development and ocean-human health. Based on those discussions, our study points to four future avenues for research and discussions marine social sciences could potentially build on. These include (1) strengthening the capacity of sustainability-related marine social sciences; (2) enhancing cross-country studies and cooperation; (3) fostering dialogue between marine natural and social scientists; and (4) making (more) sense of sustainability-related marine social science's epistemic features.

KEYWORDS

marine social sciences, ocean-human relations, sustainability, Anthropocene, bibliometrics, research streams, trends, UN Ocean Decade

1 Introduction

As the climate and biodiversity crisis unravels, marine ecosystems and human societies are undoubtedly interwoven. Oceans play a crucial role in maintaining the earth's climate by producing half of the oxygen we require, absorbing a quarter of carbon dioxide emissions, and capturing 90% of the excess heat these emissions generate. The role of oceans as powerful and essential partners in the effort to stabilize the earth's climate could instill hope. But images such as those of deteriorating coral reefs, polar bears on receding ice, flooded coastal cities, and fishers pulling empty nets paint a somber picture. Those images demonstrate the potential consequences of threatened marine ecosystems and the impact on those who rely on them. It is becoming increasingly important to gain a deeper understanding of the complex relationships between climate change, biodiversity loss, human activity, and overall ocean health. And it is of even greater importance to work on sustainable solutions to ensure ocean wellbeing and transition to using oceanic resources more responsibly (Bleischwitz et al., 2022).

While marine science has historically been dominated by natural science perspectives (Sowa and Kołodziej-Durnaś, 2015; Franke et al., 2022) several scholars have highlighted an abundance of publications by social scientists in recent years (McKinley et al., 2020; Jefferson et al., 2021). The United Nations' "Decade of Ocean Science for Sustainable Development" (2021-2030) (hereafter: UN Ocean Decade) brings oceans and the role of science for sustainable oceans further into the spotlight. The UN Ocean Decade aims to put forth "transformative ocean science solutions for sustainable development, connecting people and our ocean" (UNESCO-IOC, 2021). Since this liaison comes in many shapes and forms, understanding how to better connect societies and oceans to provide sustainable solutions is not an easy task. Assembling a diverse set of social science disciplines, the marine social sciences engage with "the understanding of people's relation with the coastal and marine environment" (Bavinck and Verrips, 2020, p. 121). The marine social sciences therefore play a pivotal role in the UN Ocean Decade's endeavor.

Several studies already provide valuable insight into the state of the marine social sciences and its perspectives by drawing on various data sources (Bennett, 2019; Bavinck and Verrips, 2020; McKinley et al., 2020; McKinley et al., 2022). However, less attention has been given to marine social sciences' publication patterns. To the best of our knowledge, there have been no previous bibliometric analysis identifying trends in this field. Against the backdrop of current debates about the role of social sciences in sustainable solutions for "the ocean we want" (UNESCO-IOC, 2021), we decided to focus our research on sustainability-related marine social sciences. As our aim is to discover research trends in the sustainability-related marine social sciences landscape, we opted to concentrate on peer-reviewed articles. While the debate about the importance of monographs and book chapters in the social sciences continues (Bonaccorsi, 2018; Toledo, 2020), recent studies suggest that book and journal publishing complement each other rather than being mutually exclusive (Verleysen and Ossenblok, 2017; Engels et al., 2018). Articles provide the most up-to-date account of research at a certain point in time, and also offer a more concise and focused exploration of a research field. Notably, we retrieved peer-reviewed articles from the Web of Science database to inform our study. With the WoS as a data source, our article cannot account for articles published in the *Maritime Studies Journal*, an important journal in the field. Further bibliometric studies, focusing on this journal, could complement our analysis.

With a focus on sustainability-related marine social sciences articles[1], we provide insights into the current status of marine social scientists' contribution to ocean sustainability. While no clear-cut definition of ocean sustainability exists, based on the UNEP's International Resource Panel (2021) we understand it as a usage of marine and coastal resources that ensures "equitably distributed social and economic benefits for current and future generations, while restoring and protecting the intrinsic value and functionality of coastal and marine ecosystems" (p.6). The article's focus could also deduce how marine social sciences add to the UN Ocean Decade's effort to connect people and oceans to provide sustainable solutions.

In this study, we examine three main research questions:

- How has the scientific production (regarding articles, journals, and countries) of sustainability-related marine social sciences developed?
- What are the main topics of sustainability-related marine social sciences research and what research stream do those topics form?
- How have the main research themes of sustainability-related marine social sciences evolved over time and what niches will be the subject of future research?

By exploring those questions, this bibliometric analysis provides a macroscopic (although incomplete) overview of sustainability-related marine social sciences research. Our article is a valuable, selective resource for researchers who are interested in exploring the research structure of the sustainability-related marine social sciences article landscape and the evolution of various themes in this field.

Section 2 of this article introduces the field of marine social sciences to provide background information. In Section 3, the material and methods we used are explained. In Section 4, the results of our bibliometric analysis are discussed. Section 5 summarizes our findings and provides suggestions for future avenues.

2 Marine social sciences

2.1 Overview

Despite the fact that the social sciences are often associated with a research agenda that mainly focuses on terrestrial worlds

1 Referring to articles, that explicitly address issues connected with ocean and coastal sustainability through a social sciences lens. This emphasis is reflected in the search terms used for data extraction in section 3.1.

(Hannigan, 2017), ocean-human relations are not a new realm in the field. Social scientists have dealt with fisheries, fishing, and coastal communities for decades. One of these early attempts was a publication by sociologist Ferdinand Tönnies, sometimes called the father of maritime sociology (Tönnies, 2010), about the social situation of dockworkers and seamen in seaports. Another endeavor is anthropologist Bronislaw Malinowski's Pacific island studies titled "Argonauts of Western Pacific" on the religious and long-distance Melanesian Kula published in 1922. These are just two studies among many more in various other social science disciplines.

While having its roots in the study of fisheries, the field of marine social sciences has evolved over time to encompass a wider range of disciplines, topics, and approaches (Urquhart et al., 2014; Arbo et al., 2018). In addition to sociology and anthropology, the disciplines of geography, political science, economics, history, and psychology all impart insights into the marine social science field. More "applied science" disciplines, such as education, communication studies, development studies, and law, also contribute to the marine social sciences (Bennett, 2019). The methods are as diverse as the disciplines, ranging from quantitative and qualitative to participatory (ibid.) and from theoretical to applied research (McKinley et al., 2022).

Against the backdrop of ever-growing anthropogenic pressures on marine and coastal ecosystems (Longo and Clark, 2016; Jouffray et al., 2020), the interwovenness of oceans and societies is now clearer than ever. Such anthropogenic pressures can be direct (e.g. fishing, sea-use change, and climate change) and indirect (human population growth, per capita income, and technological advances). These anthropogenic drivers not only threaten the health of marine and coastal ecosystems (Moullec et al., 2021; Setter et al., 2022), but also put at risk the people who depend on oceans for food, recreation, transport, and commerce, underscoring the vital role in sustaining livelihoods. To add to the situation, previous findings underestimated the effects of anthropogenic pressures on ocean health (Hermes et al., 2022) and the pressures are likely to intensify in the future (Halpern et al., 2019; Moullec et al., 2021).

Considering the anthropogenic influence on the world's oceans and the role of oceans in human wellbeing, the urgency for societal knowledge related to marine and coastal ecosystems can no longer be ignored. It comes as no surprise that the call for societal knowledge related to marine and coastal ecosystems among the research community (e.g. Bennett, 2019, p. 246) and international agendas (e.g. UN Ocean Decade) has recently grown more strident. In this vein, the marine social sciences, dealing with ocean-human relations, are considered a major beacon of hope for providing such knowledge for a sustainable future of marine and coastal ecosystems (McKinley et al., 2019). Now is a crucial moment to strengthen the role of marine social sciences and contribute to "the science we need for the ocean we want", the UN Ocean Decade's vision (Bennett, 2019). Supplementary Material 1 reflects on anticipated outcomes that mirror the "ocean we want". As the UN Ocean Decade "is concerned with data and information, as much as it is with human values and wellbeing in protecting the oceans" (Franke et al., 2022), Bennett's hope might not be too far-fetched.

On that premise, the marine social scientist community as well as marine natural scientists call for the inclusion of the marine social sciences in the wider marine science field (Martin, 2019; Moon et al., 2021). At the same time marine social scientists urge that marine social sciences' "identity as a valuable and valid discipline in its own right" should be ensured and strengthened (McKinley et al., 2020, p. 87).

2.2 Previous marine social sciences studies

The marine social sciences have gained significant attention in recent years, with several studies accentuating its contribution to sustainability. In some of the first marine social science overviews, Arbo and colleagues (2018) identified five topics related to blue growth that marine social scientists should critically engage with, including governance frameworks and knowledge production. Bennett (2019) highlighted four pillars to which the marine social sciences can contribute valuable perspectives, such as examining the effectiveness of governance and management approaches and gauging the effects of conservation and management interventions on human wellbeing.

The first manifesto for the marine social sciences, gaining extensive reach, was developed during the MARE 2019 conference, with urgent topics, suggestions for governance research, and new methodologies and approaches (Bavinck and Verrips, 2020) that were discussed intensively in 12 comments from the marine social sciences community. In line with the manifesto, McKinley and colleagues (2020) drew on qualitative analysis of this conference's discussions to indicate priorities for the ongoing development of the marine social science community, such as developing an interdisciplinary research agenda. In contrast, McKinley and colleagues (2022) later conducted a survey to emphasize future marine social sciences priorities, including marine and coastal governance and management, fisheries and fishing communities, and adaptation and climate change. The study also identified challenges and barriers, such as the lack of visibility and recognition of the marine social sciences. The role of the social sciences to provide fresh thinking and interdisciplinary research that enables societal transformations toward sustainability and an "ocean we need for the future we want" (Bleischwitz et al., 2022) was also recently re-emphasized.

These works demonstrate the growing importance of the marine social sciences in promoting sustainability in marine and coastal ecosystems.

3 Materials and methods

After this brief introduction to the marine social sciences, we now turn to the material and methods of our analysis. A significant difference between the abovementioned marine social sciences reviews and ours pertains to methodology. Many of the described studies reviewed literature in a qualitative manner or provided insights based on quantitative surveys. Complementing the above, we hope to shed additional light on sustainability-related marine social sciences research, its structure and features with this bibliometric analysis. This kind of analysis is useful to evaluate

scientific research, outline the characteristics of scientific disciplines (Zhang et al., 2015), and trace the development of research in particular fields. With the bibliometric approach our study does not aim to offer an in-depth qualitative analysis of content other studies might be able to provide. The multiple steps involved in our analysis are displayed in Figure 1 and will be described below.

3.1 Data retrieval

The metadata for this analysis was obtained from the Web of Science (WoS) database. We used Boolean operators[2] to search for sustainability-related marine social sciences peer-reviewed articles. For the sake of retrieving metadata for our analysis, the search term, displayed in Figure 1, was applied using the topic search (TS) in the Social Sciences Citation Index (SSCI) WoS Core Collection. To obtain an approximate solution for the reflection of the research field using such a comprehensive database is important. Additionally, using broad search terms to account for the diversification of marine social sciences research (Urquhart et al., 2014; Arbo et al., 2018) was crucial for our analysis. As mirrored in our search term, studies were included in our analysis if they (1) had a focus on ocean or coastal ecosystems; (2) included ocean-human relationships; (3) were situated within social sciences disciplines; and (4) were framed in sustainability-related[3] discourses. The term "socio-ecological" was applied in our search term to account for processes such as socio-ecological change and socio-ecological transformation and at the same time for considering the relationship between society and oceanic ecosystems. Although this term is not necessarily intertwined with sustainability issues, we checked the use in our database, in which it appears to be highly connected to the notion of sustainability.

Despite WoS covering a broad range of journals, it is worth noting that no single database can cover all relevant journals in a field. Hence, a few journals in the field, such as *Maritime Studies* are not covered in our data. Additionally, while we did not limit our search to English articles, it is possible that articles written in other languages may be underrepresented in the WoS database, as Pranckutė (2021) as well as Mongeon and Paul-Hus (2015) reported. This could have affected the representation of non-English language articles in our study. We decided not to filter the search results by year, since older articles (the first one appeared in 1991) might be potentially valuable to trace back the intellectual foundations of marine social science research. The initial sample consisted of 1,240 articles which were extracted on November 30, 2022.

3.2 Preprocessing

While the metadata of an article has informed the analyses of the scientific production and the contribution of journals, countries and institutions, the baseline for the keyword and network analyses of our study was keyword co-occurrence. We decided to merge keywords chosen by authors (author keywords) and indexed terms that are automatically generated from the titles of cited articles (keywords plus) to get a comprehensive idea of the content of the articles in our database.

Author keywords represent carefully selected topic-specific words that authors use to describe their articles' issues (Lu et al., 2020). These keywords are typically chosen to offer a general understanding of an article's topics under investigation. Because author keywords can impact publication success, attract potential readers, and determine dissemination to particular fields, authors tend to use informative, relevant, and refined words with a standardized academic expression as their keywords (Uddin and Khan, 2016). As significant entities of metadata, author keywords play a vital role in bibliographic analysis, helping to clarify scientific knowledge structures, identify subject hotspots, and detect research trends (Lu et al., 2020). Zhang and colleagues (2015) show that keywords plus might offer a broader description of an article's content, while being as effective as author keywords to conduct bibliometric analysis. Merging author keywords and keywords plus therefore seems promising if the goal is to get a complete set of units of analysis.

After merging author keywords and keywords plus, a list of keyword synonyms was created using the software KHCoder and Excel. Words with similar meanings were summarized under one concept using the Excel output of the KHCoder frequency distribution list of keywords. Considering synonyms is important to account for the fact that authors often use different keywords or abbreviations to describe the same research topic (e.g. "MPA," "marine protected areas," "marine protected area"). Each "concept" therefore contains synonym keywords for the same underlying construct. An example of a concept would be "marine protected areas" for the synonyms listed in the parenthesis above.

The abstracts of all articles that showed up in our initial sample, which were assigned exclusively on the basis of keywords listed in keywords plus, were manually screened. Articles that were mistakenly placed in our database were manually eliminated, whereafter 1,215 articles remained for analysis. Those articles contained 3,698 keywords with 21,994 mentions.

Aiming to include only the most representative concepts in the analysis, we only considered concepts mentioned at least 25 times. Eliminating stopwords was an important step in preprocessing the data. Stopwords are words that are considered irrelevant because they appeared in our search term and could therefore yield trivial results (Block and Fisch, 2020, p. 311). Hence, 144 keywords representing 44.43% of all mentions were included in the final sample for further analysis.

2 Boolean operators are used to connect search words to narrow or broaden search terms. "AND", "OR", and "NOT" are the three basic Boolean operators.

3 As terms such as "sustainability" and "Anthropocene" are controversial and definitions vary among scholars, we have refrained from providing a definition that studies must meet. Instead, we assume that the use of such terms serves as an indication that these studies contribute to ocean sustainability discourses and solutions from a social scientist's lens.

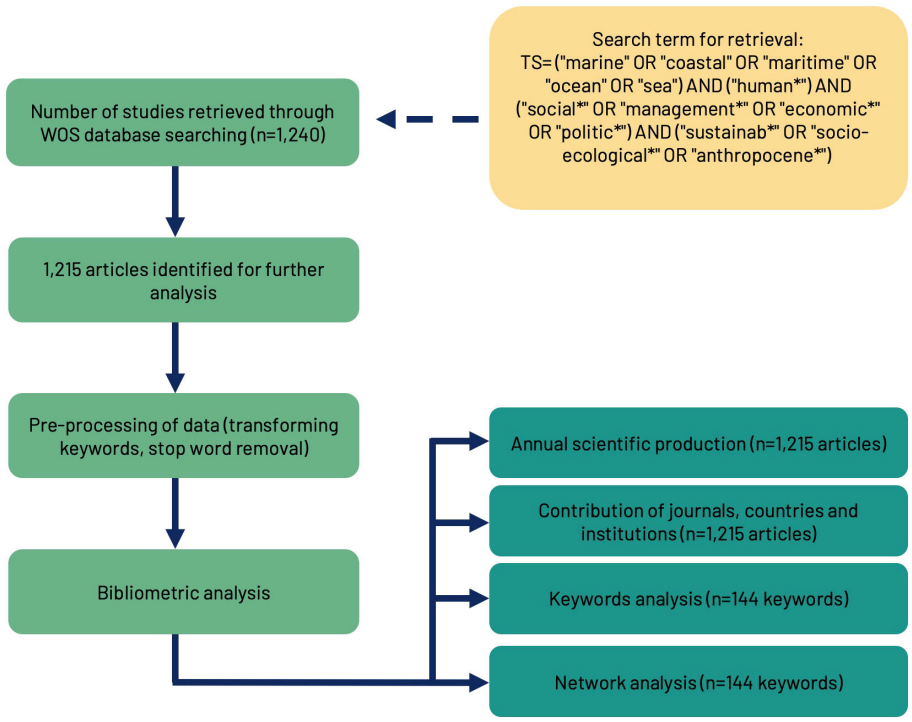

FIGURE 1
Flow of analysis.

3.3 Analysis methods

On the basis of the final sample, a binary keyword occurrence matrix was created with KHCoder, providing an overview of the occurrence of the chosen 144 keywords in the merged keywords of the 1,215 identified articles. The binary keyword occurrence matrix was analyzed with the software UCINET 6.636 (Borgatti et al., 2002). First, a keyword co-occurrence matrix was created, displaying the number of co-occurrences of each keyword of the final sample. A core-periphery analysis of the keyword co-occurrence matrix revealed keywords central to the research field, with a strong connection to each other (Borgatti and Everett, 2000).

To identify different research streams, factor analysis was conducted with IBM SPSS Statistics 28 (IBM Corp, 2021). By grouping the keywords, based on the co-occurrence frequency, into factors, factor analysis identifies keywords that represent a shared research stream (Kuntner and Teichert, 2016). The factor loadings display the representativeness of keywords for a research stream (Wörfel, 2021; Sun and Teichert, 2022). We used a principal component analysis and a Varimax rotation with Kaiser normalization to extract the research streams. The software Gephi (version 0.10.1) was used to visualize the research (Bastian et al., 2009). To provide a more detailed picture of the research network, density scores were calculated using UCINET software. This method involves dividing the number of existing ties between nodes (keywords) by the sum of all possible ties, as described by Hanneman and Riddle (2005). For a dichotomized network matrix, a density score of one indicates that all keywords are connected, whereas a density score of zero means that the keywords are not connected to each other (Zuschke, 2020).

4 Results and discussion

4.1 Main information about article collection

As displayed in Table 1, a total of 1,215 relevant articles in the sustainability-related marine social sciences is published in 312 sources. The first article in the sustainability-related marine social sciences field appeared in 1991. This appearance may be linked to Agenda 21, a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment that was established in June 1992 at the Earth Summit in Rio de Janeiro, Brazil. Agenda 21 includes a dedicated chapter on the conservation and sustainable use of oceans, seas, and coastal areas (Chapter 17).

The annual growth rate for the years 1991 to 2023 reaches 2,19% (Table 1), with its peak and a total number of 184 published articles in 2021 (Figure 2). The average age of documents in our database illustrates that the (sustainability-related) marine social sciences is a young and emerging field, as some scholars stated (McKinley et al., 2022).

TABLE 1 Summary statistics of collected articles.

Description	Result
Timespan	1991-2023
Sources (number of journals)	312
Documents (number of articles)	1,215
Annual growth rate	2.19%
Authors	5,172
Authors of single-authored documents	150
International co-authorship	43.29%
Co-authors per document	5.09
Author keywords (DE)	3,848
References	71,011
Document average age	4.86
Average citations per document	26.06

4.2 Trends in publication

As illustrated in Figure 2, the total number of articles as a proxy for productivity (Donthu et al., 2021) steadily increased over time. The exponential growth in marine social science research (McKinley et al., 2020; Jefferson et al., 2021) also proves to be true for sustainability-related articles in the field. This growth is reflected in the curve in Figure 2. The scientific production acquired additional momentum in 2015. It is possible that significant developments in multilateralism and international policymaking in 2015 contributed to the sharp growth of article numbers from that year onward. The 2030 Agenda for Sustainable Development with its 17 sustainable development goals (SDGs), specifically SDG 14 dedicated to the oceans, seas and marine resources (life below water), and the Paris Agreement on Climate Change are two major agreements among several others that were set in motion in 2015. In addition, the Assembly of the Intergovernmental Oceanographic Commission started discussing concepts and the potential benefits of a UN Ocean Decade in 2016/2017. Finally, December 5, 2017 marks the date when the UN General Assembly decided to establish the UN Ocean Decade for 2021 to 2030.

Whereas research concerning the Covid-19 pandemic was boosted from 2020, qualitative empirical research was "seriously hampered" due to regulations and restrictions (Otto and Haase, 2022). With this in mind, the drop in article publications since 2020 perhaps indicates that marine social science research is often empirically grounded research and involves "being out there" in the field, pointing to what Bavinck and Verrips called "marine empiricism" (2020, p. 123).

Table 2 depicts the ten most relevant sources in our database as expressed by the number of publications between 1991-2023. The 1215 articles in our study were published in 312 journals. Among the sustainability-related marine social science sources are *Marine Policy* (132), *Sustainability* (121), and *Ocean & Coastal Management* (79). Given that our data collection encompasses 1,215 articles and the number of articles published in the most relevant journals appears to be relatively limited, it suggests that the field is fragmented in terms of where articles are published. Additionally, it is worth mentioning that many of the most relevant journals in the field are inter- and transdisciplinary. Only two journals, *Marine Policy* and *Frontiers in Marine Science*, are dominated by either social or natural scientists. The desire of the marine social science community to integrate into wider marine science, as described in Section 2, may be reflected by the high number of interdisciplinary journals in our database. The journal landscape in our data points to the development toward the integration of social and natural research, that the manifesto for the marine social sciences wishes to see (Bavinck and Verrips, 2020).

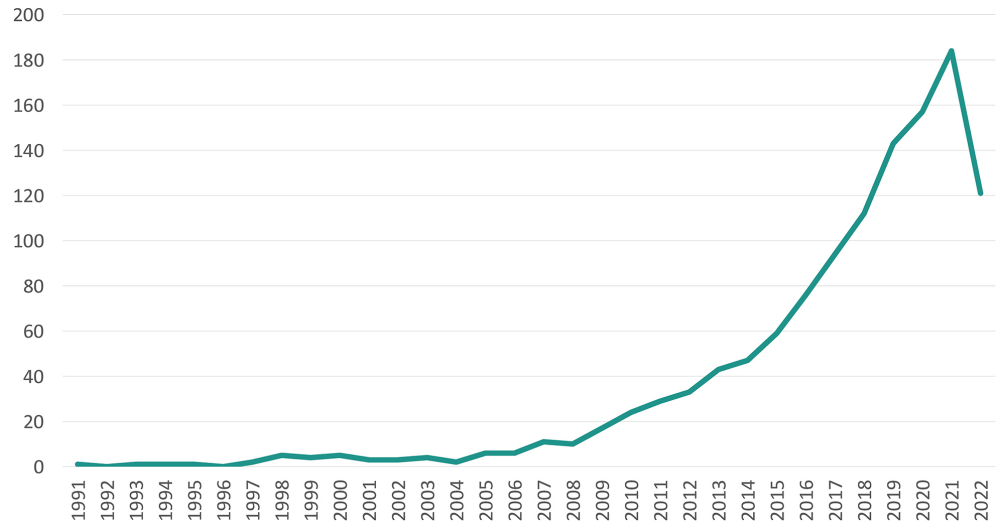

FIGURE 2
Annual scientific production (1991-2022).

TABLE 2 Ten most relevant journals.

Journal	Number of articles
Marine Policy	132
Sustainability	121
Ocean & Coastal Management	79
Ecology and Society	49
Frontiers in Marine Science	29
Coastal Management	20
Ecological Economics	20
Fish and Fisheries	19
Regional Environmental Change	19
Science of Total Environment	19

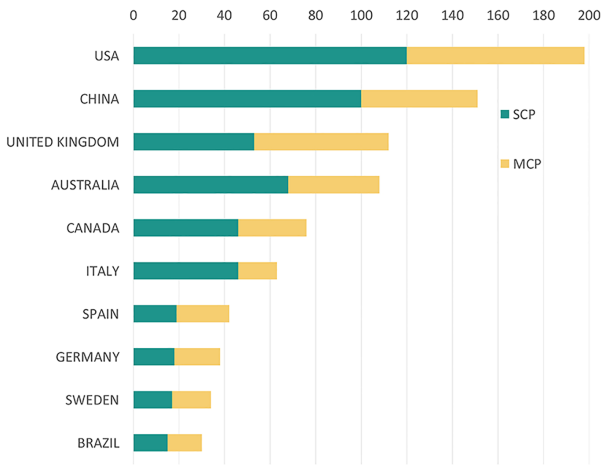

FIGURE 3
Top 10 author countries.

4.3 Geographical distribution

A total of 71 countries[4] have contributed to publishing about sustainability-related marine social science. The USA is the most active country in the field, leading with the highest proportion of publications (n=198; 16,3%), followed by China (n=151; 12,4%) and the United Kingdom (n=112; 9,2%). The absence of certain countries with vibrant marine social science communities from Figure 3, such as Poland (Kołodziej and Kołodziej-Durnaś, 2022) and the Netherlands, being the home of the Center for Maritime Research (MARE), could have several explanations. This absence could potentially be attributed to variations in publication cultures and practices across different countries. Another explanation could be the absence of the *Maritime Studies* journal from our database. In light of the 10 top publishing countries, displayed in Figure 3, it altogether seems appropriate to criticize the marine (social) sciences field for being dominated by "Western" countries (Ahmadia et al., 2021; Shellock et al., 2022).

Of the total publications, 57% were single-country publications (SCP) and a smaller proportion (43%) were multiple-country publications (MCP). MCP are created by authors affiliated with institutions from different countries, pointing to existing international cooperation. Considering the cross-border nature of oceanic matters, these numbers indicate that there might be a lot of potential in terms of joint international efforts. Such a global effort, as Bennett argues, could also contribute to building a "community of practice and catalyze insights from marine social sciences to guide marine and coastal policy (2019, p. 250)".

4.4 Influential institutions

We identified institutions that have been most productive and influential in sustainability-related marine social sciences over the course of time, focusing on three time slices (1998-2010, 2011-2016, and 2017-2022). Those three time slices were selected to account for the expansion of the research field between 2017 and 2022 (i.e. number of publications 1998 – 2010: 100; number of publications in 2017 alone: 96) (Supplementary Material 2). Generally, a strong relationship can be seen among regions and institutions. From 1998 to 2010, Anglo-American institutes dominated sustainability-related marine social sciences with a commitment to publishing in peer-reviewed journals. Still, even the most productive institutes had a limited number of publications, correlating with the low scientific production during that period.

From 2011 to 2016, a diversification of productive institutes can be observed, with more European universities entering the field. This trend intensified from 2017 to 2022. A surprising finding is the absence of Chinese institutes, as the country is the second most productive in terms of article output. This might show that marine social science research is dispersed across many institutes in China.

At the same time, institutions from Portugal and the Netherlands appeared among the list of most productive and influential institutions (Supplementary Material 2), hinting at a concentration of sustainability-related marine social sciences in very influential institutions. Altogether, the sustainability-related marine social sciences field attracts more and more researchers from various institutes in the world, which could explain the rapid growth in recent years.

4.5 Concept frequency distribution

In our analysis, word frequencies of concepts were used as a descriptive tool to get a preliminary understanding of relevant themes in the sustainability-related marine social sciences. The more frequently the concepts were mentioned in the articles, the larger their size in Figure 4. The most used concepts are "conservation"(n=338) "climate change"(n=281), "fisheries"(n=279), "impact"(n=271) and "system"(n=215), pointing to popular themes in our data. In terms of the spatial component, "community"(n=126) and "islands"(n=106)

4 A country is represented by the country of the institution where authors are affiliated.

FIGURE 4
Word cloud of keywords.

appear as prominent concepts. A speculative explanation of the high frequency of such concepts is that sustainability-related marine social sciences focus on small regions or social microstructures. A comprehensive overview of the concept's frequencies is displayed in Supplementary Material 3. Section 4.8 in this study is dedicated to the detailed explanation of how the keywords relate and which research stream they form.

4.6 Evolution of concepts (2012-2022)

To study the evolution of concepts, we analyzed several features. We focused on the last ten years (2012-2022), since publication output encompassed at least two publications with every concept in each of those years. The frequency of certain keywords over a specific period reveals the evolution of sustainability-related marine social science studies and brings to light recent research trends. Figure 5 and Supplementary Material 4 display how the 10 most popular concepts evolved overtime. In addition, Supplementary Material 5 reveals other detail,such as when certain concepts began to appear in our data or howlong the relevant concepts' burst status lasts.

Figure 5 displays the five most popular concepts in the decadebetween 2012 and 2022. The point where the curve peaks on Figure 5's y-axis represents when conceptswere mentioned the most. Due to limited space, we focus on illustrating the temporal evolution of an exemplary concept. The concept "conservation" (dark blue) is one of the most prominent topics, as the word cloud (Figure 4) displayed. "Conservation" shows an overall increase from 2012 to 2020, with some upward and downward trends. There are two sharp increases in keyword usage — the first one between 2012 and 2013 and the second one from 2018 to 2020.

The first incline could potentially reflect debates on international conservation goals, which intensified from 2010 onwards. The Convention on Biological Diversity in 2010 (CBD) (United Nations, 1992) introduced Aichi Target 11 to encourage countries to preserve coastal and marine areas using protected areas and other effective conservation tools, with the goal of conserving a minimum of 10% of such regions by 2020 (UNEP, 2010). This goal gained further support in 2012 at the UN Conference on Sustainable Development (Rio+20), the year that reported a sharp increase in the keyword usage of "conservation."

The second incline and the highest usage of "conservation" in 2019 might be linked to 2020 being the target year for which parties agreed to conserve 10% of marine and coastal areas under both the CBD (United Nations, 1992) and the SDGs.

4.7 Research streams retrieved from factor analysis

Up to this stage, our results offered a general overview of sustainability-related marine social sciences output regarding article number developments, dominant journals, institutions, and countries as well as regular themes and their evolution. This subsection provides insights into how specific topics in the field have been discussed and which research streams those topics form.

Our analysis revealed six factors through a principal component factor analysis. The factors explain 62.86% of the total variance in our dataset.

We qualitatively analyzed articles to determine each stream's key attributes. Articles with a high number of keywords allocated to an attributed factor served as references to describe the stream's research paradigm, theoretical background, and popular methods. In view of the focus on the top representative articles, the intention is not to provide a complete recap of the research streams. Instead, we provide a description of the research streams in an illustrative manner. Supplementary Material 6 contains an overview of each research stream's top ten keywords and most representative articles, including information on the applied research methodologies. As the identified research streams vary regarding article numbers, the following descriptions also vary in length.

4.7.1 "Perceptions and benefits of marine conservation" research stream

The first research stream deals with perceptions and benefits of marine conservation and covers the most articles (n= 477).

Among the important *topics* in this stream is the link between the success of conservation efforts and how individuals perceive conservation policies and practices (Badola et al., 2012; Lewis et al., 2018). In this regard, biodiversity conservation is at the forefront of discussions. While most studies refer to the wider biodiversity discourse, some studies pay particular attention to certain biodiversity hotspots, such as mangroves (Badola et al., 2012; Lewis et al., 2018). In this stream, marine spatial planning (MSP) is discussed as an important framework to manage marine usage across different temporal and spatial dimensions in line with diverse

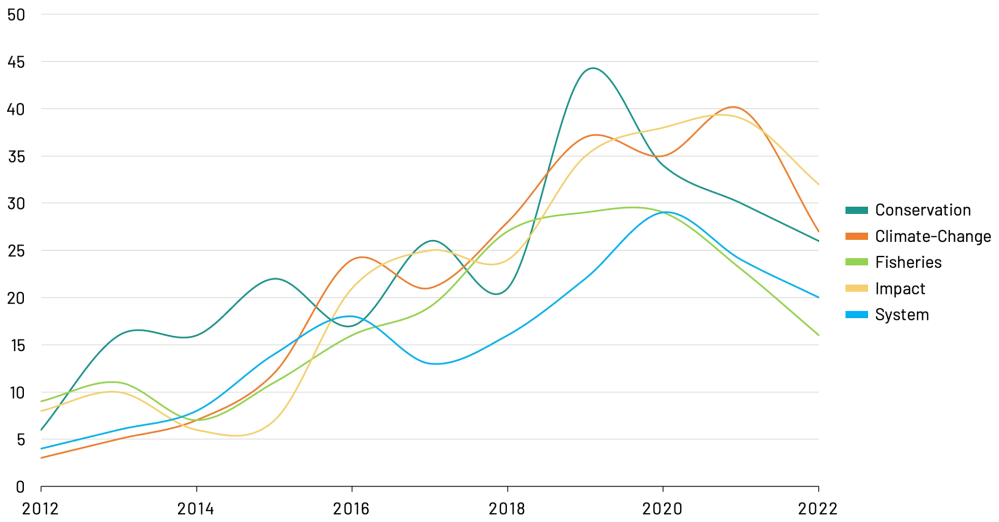

FIGURE 5
Most popular concepts from 2012-2022 (top five).

stakeholder needs (Ban et al., 2014; Bryhn et al., 2020; Friedrich et al., 2020). MSP is also commonly linked with the blue economy agenda (e.g. Bennett, 2018). Playing an important role in MSP, marine protected areas (MPAs) are widely examined in this stream. MPAs are not only discussed in terms of people's perceptions and attitudes towards this conservation tool or policy solution (Nicoll et al., 2016; Tonin and Lucaroni, 2017; Di Franco et al., 2020), but also regarding the benefits derived from it (Rees et al., 2013; Lopes et al., 2015; Rees et al., 2020; Buonocore et al., 2021; Harker et al., 2022). Reflecting current trends in general marine social sciences (McKinley et al., 2022, p. 5), research in this stream discusses stakeholder engagement as a *topic* (Lewis et al., 2018; Di Franco et al., 2020; Friedrich et al., 2020; Fajardo et al., 2021).

Among other things, studies in this research stream find that attitudes toward conservation and its tools are mostly positive (Badola et al., 2012) and the anticipated benefits exceed the possible disadvantages (Harker et al., 2022). The evidence asserts that involving stakeholders and local communities through collaboration and co-production could benefit the effectiveness of conservation efforts through enhanced support (e.g. Lewis et al., 2018; Di Franco et al., 2020; Fajardo et al., 2021). Stakeholder engagement can, among other things, help "natural resource managers to better understand what they are protecting, why and for whom", as scholars have pointed out (Marshall et al., 2019).

The dominant *theoretical framework* for the perceptions and benefits of marine conservation research stream is the ecosystem-based management approach. Applying such an approach, as argued in one article in reference to the CBD, could help to "reach a balance between conservation, sustainable use, and fair and equitable sharing of benefits provided by the use of natural goods and services" (Guilhon et al., 2021). This includes ensuring "broad stakeholder consultation and participatory adaptive management" (Cook et al., 2019). The ecosystem services approach informs "marine spatial planning decisions" (Friedrich et al., 2020) and offers insights into the values of coastal and marine ecosystems (Ghermandi et al., 2019; Sangha et al., 2019).

Case studies, including qualitative and quantitative questionnaires, as well as stakeholder and focus groups are among the prevalent *methods* used. Those case studies in this stream span the globe and range from applications in South-American, Southeast Asian, East-African, and European countries over oceanic countries to studies in North America (Supplementary Material 6).

Future topics to address in this research stream might be perceptions or social acceptability of conservation tools that could complement MPAs and marine spatial planning. One example of a tool for the sustainable conservation of coastal and marine ecosystems would be other area-based conservation measures (OECMs) since they are seen as a significant contributor toward achieving Aichi Target 11 (United Nations, 1992) and our data suggests that perceptions or social acceptability of OECMs are understudied by marine social scientists. While most of the studies in this stream focus on case studies in certain areas, multi-country studies may reveal additional insights, as oceanic matters do not stop at national borders. From a methodological perspective, studies that combine different methods, including observations, as opposed to mere questionnaire studies that could provoke social desirability, could be sensible. In other words, conservation scholars could be more "adventurous or brave with the methods" (Jefferson et al., 2021, p.12) they use.

This research stream contributes to the UN Ocean Decade's Outcome 2 — enhancing knowledge to pave the way to "a **healthy and resilient ocean** where marine ecosystems are understood, protected, restored and managed" (UNESCO-IOC, 2021).

4.7.2 "Fisheries, aquaculture, and food security" research stream

The roots of marine social science can be traced back to fishery community studies (Arbo et al., 2018; Bavinck and Verrips, 2020;

Steins et al., 2020). It therefore comes as no surprise that fisheries (management), aquaculture, and food security appears as an important research stream in our analysis, covering 162 articles.

One of the prevailing *topics* in this research stream is the role of fisheries in food security. An abundance of studies in this stream stress the importance of fisheries for food security, livelihoods, and the social and economic wellbeing of coastal communities (Clark and Longo, 2019; Vianna et al., 2020; Giron-Nava et al., 2021). Some studies pay special attention to the role of small-scale fisheries (Teh and Pauly, 2018; Jimenez et al., 2021; Wallner-Hahn et al., 2022). For instance, drawing on marine fish catch statistics from various Southeastern Asian countries, Teh and Pauly (2018) show the relative contribution of small-scale and industrial fisheries to national food security. Scholars in this stream have also investigated the contribution of aquaculture as a resource for food security and livelihoods (Anderson et al., 2019; Stead, 2019; Harohau et al., 2020). Overfishing and its causes are also discussed in this stream. Some scholars have criticized the idea of ascribing the cause of overfishing merely to too many fishers catching declining numbers of fish, referred to as Malthusian overfishing (Finkbeiner et al., 2017; Giron-Nava et al., 2021).

Altogether, albeit not exclusively, researchers found that the relative contribution of the small-scale fisheries sector was underestimated by an average of approximately two times (Teh and Pauly, 2018) and that adequately managed aquaculture could provide a sustainable source of fish to sustain current and increased per capita fish consumption rates (Merino et al., 2012). To ensure the wellbeing of local communities, there is a need to diversify livelihoods (Wallner-Hahn et al., 2022) and to adequately address the underlying factors of poverty and equity in fisheries (Giron-Nava et al., 2021). The need to enhance interdisciplinary collaboration to develop practical solutions to the core problems of managing tropical coastal and marine social-ecological systems (Ferrol-Schulte et al., 2013) was also underscored.

Concerning the *theoretical framework*, the sustainable livelihoods approach represents the predominant lens of many studies in this stream (Ferrol-Schulte et al., 2013; Harohau et al., 2020; Tilot et al., 2021). In simplified terms, the sustainable livelihoods approach structures variables that limit or boost livelihood opportunities and describes how they are linked (Serrat, 2017). Yet, some scholars argue that such an approach does not accurately account for relevant issues, for instance assigning rights and access, corrupt practices, and lack of local financial, intellectual and innovative capacities (Ferrol-Schulte et al., 2013). Another theoretical angle in this stream is reflected by the ecosystem services approach (Bax et al., 2022).

Method-wise, case studies are the baseline for many of the studies in this stream. Among the methods applied in this case studies are questionnaires, literature reviews and statistical analysis. The case studies are mostly conducted in the Global South, with a focus on Pacific regions, especially in Southeast Asia and Oceania (Supplementary Material 6). While most studies focus on a single country or region, a few studies in this research stream have used global comparative approaches (Zeller et al., 2018; Bax et al., 2022). Furthermore, there are theoretical contributions in the form of historical analyses (Gros, 2014; Nayak, 2014) or the discussion of natural resource economics in evaluating aquaculture policy and regulation (Anderson et al., 2019).

Among *future topics* that authors in this stream find important are best practice fisheries management in "remote or wilderness locations" (McClanahan et al., 2022), the ecological and economical significance of seagrass (Wallner-Hahn et al., 2022), and the impact of recreational fishing on marine ecosystems (Pita et al., 2018). Referring to future marine social sciences priorities, as discussed by McKinley and colleagues, we suggest that further studies could improve the understanding of aspects such as human rights in the fisheries industry (2022, p. 13). An abundance of research announcing the role of small-scale fisheries in this research stream could serve as a starting point for more supportive research for small-scale fisheries, as called for in the marine social sciences manifesto (Bavinck and Verrips, 2020) and further studies (McKinley et al., 2022).

Studies in this stream contribute to the UN Ocean Decade's Outcome 3 — "[a] **productive** ocean supporting sustainable food supply and a sustainable ocean economy" (UNESCO-IOC, 2021).

4.7.3 "Climate change and climate change responses" research stream

The third research stream in our analysis refers to 164 articles that address climate change and climate change responses.

This stream tackles various *topics*, pointing to the complex dynamics of climate change issues. Among the most discussed topics in this stream are vulnerability dynamics connected to climate change processes in coastal areas and communities. Some scholars tackle particular consequences of climate change, such as coastal erosion (Gomez et al., 2020), rising sea levels (Omann et al., 2009; Student et al., 2020; Fernandez et al., 2022), floods (Bhattacharjee and Behera, 2018), and typhoons (Nguyen et al., 2019), while others aim to understand vulnerability regarding a broader range of climate change impacts (Kebede et al., 2018; Ng et al., 2019; Bagheri et al., 2021) and risks (Kim and Lee, 2016; Murshed et al., 2021).

Closely linked to the vulnerability discourse, resilience, as the ability to resist or recover from climate change impacts, is another important *topic* in this stream. Studies cover factors such as resilience challenges associated with tourism (Semeoshenkova et al., 2017; Tzoraki et al., 2018), and variables that impact fishers' ability to cope with changes in their socio-ecological resilience (Silva et al., 2021). The responses and ability to cope with climate change effects, both at an individual/community (Rampengan et al., 2014; Nicholls et al., 2016; Van Dolah et al., 2020; Larsen et al., 2021; Olowoporoku et al., 2021) and policy/management level (Bergillos and Ortega-Sánchez, 2017; Hafezi et al., 2020; Orchard et al., 2020), are discussed in this research stream, together with participatory and interdisciplinary approaches (Dada et al., 2021; Larsen et al., 2021; Allan et al., 2022).

An abundance of research in this stream warns that coastal (and deltaic) areas are especially sensitive and vulnerable to change (Kebede et al., 2018; Gomez et al., 2020; Armenio et al., 2021; Silva et al., 2021). Among the identified drivers of vulnerability are the limited adaptation capacity (e.g. Zacarias, 2019; Gomez et al., 2020) and economic implications (Arto et al., 2019; Kubo et al.,

2020; Lázár et al., 2020). As important adaptation strategies to climate-related impact on the individual/community level, aspects such as the diversification of livelihoods (Bhattacharjee and Behera, 2018; Gomez et al., 2020), existing fisheries business and species diversification (Hossain et al., 2018) and migration (Bhattacharjee and Behera, 2018; Hossain et al., 2018) were found. On the level of coastal management and policies, studies pointed out "delaying urbanization and preserving unexploited coastal wetlands" (Chang et al., 2018), enhancing inclusive hazard management approaches (Orchard et al., 2020), integrating coastal protection measure into climate change adaptation and mitigation policy (Gomez et al., 2020) as adaptation strategies to climate change, among several others. Altogether, many of the studies in this stream offer suggestions for policymakers and management.

The sustainable livelihoods approach and (socio-ecological-) system approaches are among the prominent *theoretical frameworks* in this stream.

In terms of *methods*, this research stream is dominated by studies that apply or develop models, indices, or scenarios to assess vulnerability and risks associated with climate change (Ng et al., 2019; Nguyen et al., 2019; Silva et al., 2021; Fernandez et al., 2022; Dada et al., 2021; Allan et al., 2022). A combination of different aspects by merging indices or applying integrated frameworks to get a more comprehensive overview/understanding of vulnerability and resilience components is common among scholars (e.g. Kebede et al., 2018; Fernandez et al., 2022). Case studies are often applied to test those models. Furthermore, literature reviews (Armenio et al., 2021; Larsen et al., 2021) and questionnaire studies (Wu et al., 2016; Bagheri et al., 2021; Olowoporoku et al., 2021) are applied in this research stream. Many of the case studies are conducted in Southeastern and Southern Asia. Notably, several studies cover Bangladesh, probably because it is among the most climate-sensitive countries in the world. For the same reason, small-island studies are also among the well represented regions in this research stream. Further areas of studies include cases in African, Oceanic and North American countries, as well as a few studies covering Europe (Supplementary Material 6).

Because ocean-human interactions involve complex dynamics, especially regarding climate change processes, dynamic approaches in addition to models that are probabilistic and static could provide further *future* insights. A study by Student and colleagues (2020), analyzing tourism-related rising sea levels, is an example of adding value to the understanding of different facets of vulnerability by drawing on dynamic vulnerability assessment. Although studies already elaborate livelihood strategies, focusing on how to strengthen such strategies in the long run could be of even greater importance, as suggested in a study by McKinley and colleagues (2022). Since most of the studies aim to inform policymakers, it remains unclear how the marine social sciences contribute to the understanding of civil society. More studies and initiatives with an ocean literacy agenda, especially with a sustainability focus, could enhance such an understanding.

Studies in this stream aid in informing policymakers and therefore add to the UN Ocean Decade's Outcome 5 — "[a] safe ocean **where life and livelihoods are protected from ocean-related hazards**" (UNESCO-IOC, 2021). Additionally, studies that draw on scenarios might be able to provide knowledge that could pave the way to Outcome 4 — "[a] predicted ocean **where society understands and can respond to changing ocean conditions**" (UNESCO-IOC, 2021).

4.7.4 "Coastal landscape and land use change" research stream

The fourth research stream, coastal landscape and land use change, comprises 120 articles.

In this stream, changes in land use, the drivers, and the impact of land use change on sustainability, mostly in coastal regions, are among the prevailing *topics*. Such analyses offer a valuable reference for making informed decisions regarding regional land development policies (Liang et al., 2022a; Tito et al., 2022).

Studies in this stream present a continuous expansion of construction land in coastal areas in different regions (e.g. Bellot et al., 2007; Serra et al., 2014; Bian et al., 2021; Liang et al., 2022a). In addition, a growing number of areas with middle and high landscape vulnerability can be detected (Zhou et al., 2020). In their study, Liang and co-authors (2022a) identified foreign direct investment, the industrialization index, and population as the main drivers of land use change. Altogether, studies suggest that developing sustainable coastal and landscape management is necessary for the future (Yi et al., 2018; Zhou et al., 2020). Notably, the relationship between intensifying land use and ecological protection shows some ambiguity. While some studies accentuate that land use negatively affects landscape vulnerability (Zhou et al., 2020), public green spaces, air and water pollution in coastal areas (Bian et al., 2021), others claim that land exploitation can positively impact "regional economic development and ecological protection" (Zhou et al., 2020).

Studies in this research stream are strongly empirically grounded, testing previous findings regarding landscape management or developing experimental hypotheses. As far as the representative studies are concerned, no *theoretical* baseline patterns could be found. Many of the studies in this stream have a regional focus on China. Further studies tackle countries in South America and Mediterranean Europe (Supplementary Material 6).

Regarding *methods*, most of the analyses in this stream are based on quantitative assessments. Land use change, landscape vulnerability and landscape interference indices (Yi et al., 2018; Zhou et al., 2020; Liang et al., 2022a), emergy analysis (Lee and Huang, 2018), as well as models, such as the random forest model (Liang et al., 2022a), and remote sensing images (Yi et al., 2018) are some of the approaches (Supplementary Material 6).

Future studies about the relationship between intensifying land use and ecological protection in the same and other regions could shed light on the ambiguity of the findings concerning this relationship.

4.7.5 "Coastal and marine management" research stream

This research stream highlights coastal and marine management and consists of 178 articles.

While the other research streams identified in our study also include management issues, this one pays particular attention to coastal

and marine management processes and appears as a cross-cutting theme. Among the main *topics* prevalent in this stream are the enhancement of ecosystem-based management and assessments as well as the further development of the socio-ecological system (SES) framework in light of management and governance issues. The SES framework, developed by Elinor Ostrom (2007), aims to assess the sustainability of complex social ecological systems and comprises four core subsystems. Furthermore, challenges in developing MSP are discussed.

Various studies emphasize the importance of mingling variables and principles into marine management processes. This includes incorporating the social or human dimension into marine management processes (Koehn et al., 2013; Lillebø et al., 2019). In addition to the need to integrate such aspects into an SES framework approach (Link et al., 2017), Sousa and Alves (2020) put forward the need for ecosystem-based services and spatial planning processes to be comprehensive, adaptive, inclusive, and integrative. From the perspective of ecosystem-based management, some studies point out a discrepancy between identifying pathways for sustainable management and integrating such findings into planning processes (e.g. Wamsler et al., 2014; Leenhardt et al., 2015). In line with findings in the above research streams, stakeholder engagement has been found to have positive effects both on improving ecosystem-based management and assessments (Adams et al., 2014; Dutra et al., 2015; Lockerbie et al., 2020) and on MSP processes (Frazão Santos et al., 2021). This ranges from engaging managers and policymakers (Dutra et al., 2015) to academic communities (Adams et al., 2014) and accounting for expert knowledge (Lockerbie et al., 2020).

As mentioned, an important *theoretical* underpinning for this research stream is the SES framework — its application as well as further development. Thereby, and deviating slightly from the streams already discussed, this stream pays attention to *theory* development, as the marine social sciences manifesto suggests (Bavinck and Verrips, 2020, p. 123).

In light of showing pathways for future development strategies and integrated solutions to challenges in ocean management, concerning *methods* many scholars suggest applying scenarios, models, and other quantitative frameworks (e.g. Axelrod et al., 2015; Lockerbie et al., 2020; Sajjad et al., 2020). Literature reviews (Koehn et al., 2013; Sousa and Alves, 2020; Frazão Santos et al., 2021), participatory approaches (Adams et al., 2014; Rakotomahazo et al., 2019) and social network analysis (Obregón et al., 2020; Salazar-De La Cruz et al., 2020) also form part of the methodological tools in this research stream.

One *future* avenue for research in this stream could be the question of how to better integrate study suggestions into management and policy implementation processes.

As this research stream represents a cross-sectional topic that will be discussed in subsection 4.9, it could contribute to the UN Ocean Decade outcomes mentioned in the five other research streams.

4.7.6 "Development and ocean-human health" research stream

The sixth research stream features in 87 articles and was named development and ocean-human health. It is the smallest stream in terms of article numbers.

In this research stream, several studies explore the interrelation between various development processes and marine ecosystem health. These studies examine *topics* such as the connection between urban development, agricultural development, and marine pollution (Li et al., 2020; Willis et al., 2022; Xu and Zhang, 2022), as well as sustainability levels in coastal urban areas (Yuan et al., 2022). Nature-based solutions are also evaluated as a means of promoting sustainability (Meerow, 2019; Sebastiani et al., 2021). In addition to these topics, the studies in this stream address the relationship between human wellbeing and ocean health (Delany-Crowe et al., 2019; Pittman et al., 2019; Hooyberg et al., 2020; Nash et al., 2022) and evaluate the access to human health services in small-island developing states (Craig et al., 2022).

Studies in this stream point to an increase in ocean pollution (Xu and Zhang, 2022) and the amount of potential pollution (Willis et al., 2022). Generally, strategies to reduce ocean pollution appear to be lacking (Willis et al., 2022). Research shows that ocean and human health are positively correlated (Hooyberg et al., 2020) and that more robust regulations addressing both are needed (Nash et al., 2022). Researchers urge policymakers to sustainably manage coastal regions to preserve the public health benefits connected to these areas for future generations (Hooyberg et al., 2020; Shen et al., 2022).

The dominant *methods* applied in this stream are quantitative assessments (e.g. Gürlük, 2009; Hooyberg et al., 2020; Xu and Zhang, 2022) and qualitative questionnaire studies (e.g. Li et al., 2020; Shen et al., 2022) (Supplementary Material 6).

In accordance with studies in the fourth research stream, studies in the development and ocean-human health stream are strongly empirically grounded and no *theoretical* baseline patterns could be found.

Future research topics to address in this research stream's fields of expertise could be assessing strategies to reduce ocean pollution. By providing insights about the links between human and ocean health, research in this stream hints at the "societal and individual connection with the marine and coastal environment," a future marine social sciences priority McKinley and colleagues (2022) pointed out. Such research could serve as a starting point to further explore how individuals and society value and connect with oceans.

Altogether, studies in this stream could help to promote knowledge generation for the UN Ocean Decade's Outcome 1 — "[a] **clean ocean** where sources of pollution are identified and reduced or removed" (UNESCO-IOC, 2021).

4.8 Keyword co-occurrence network

The network illustration (Figure 6) depicts how keywords and research streams are related to each other. The number of co-occurrences as a proxy for keyword prevalence is reflected in the size of a node, while a co-occurrence is represented by a tie between keywords. The positioning of nodes in the network is based on the connections between nodes (Jacomy et al., 2014). Consequently, keywords in the core of the network have a stronger connection to keywords of their own research stream, as well as to other research streams. The network consists of three larger research streams

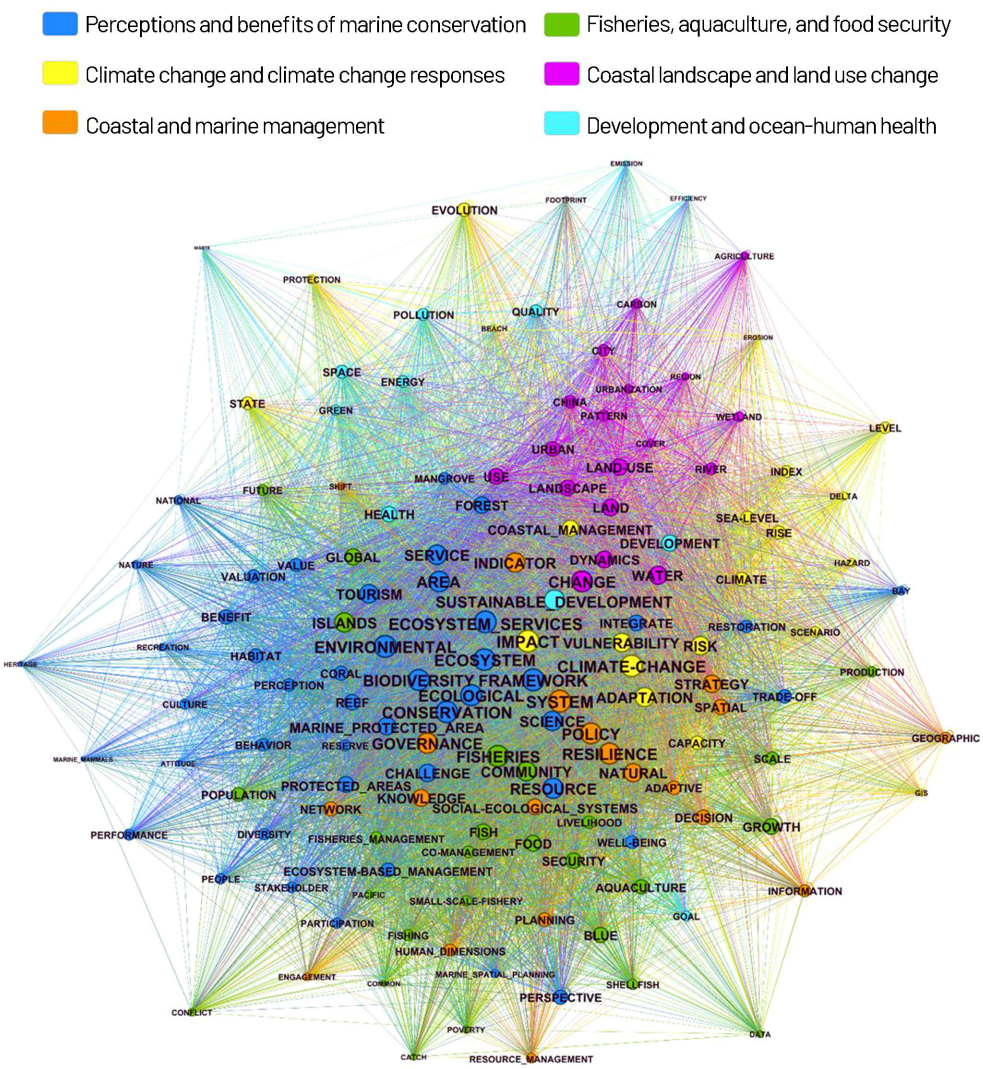

FIGURE 6
Keyword co-occurrence network illustration.

(perceptions and benefits of marine conservation; fisheries, aquaculture, and food security; and climate change and climate change responses) and three smaller subordinate research streams (coastal and marine management; coastal land use change; and development and ocean-human health). Density scores provide additional information on the knowledge exchange in and between research streams. High scores indicate extensive knowledge sharing, while low scores hint at little intellectual connection (Kuntner and Teichert, 2016). The intellectual connection is reflected in the use of similar concepts in the articles' respective keywords.

Overall, all research streams display a medium to high knowledge exchange in the network, with values ranging from 0.83 and 0.95 in research streams and values from 0.59 to 0.81 between streams (Supplementary Material 7). The strongest within-knowledge exchange was found in the coastal land use change research stream. Despite a high interconnectedness with the climate change and climate change responses research stream, it also exhibited the lowest interconnectedness, i.e. with the fisheries, aquaculture, and food security research stream. Apparent from the network illustration as well as the density scores, the coastal and marine management research stream acts as a cohesive element of the whole research field.

5 Summary and recommendations for future sustainability-related marine social sciences avenues based on bibliometric analyses

The development of scientific production in the sustainability-related marine social sciences field mirrors the rapid development of the wider marine social sciences research (McKinley et al., 2022). Especially from 2015, our results showed a sharp increase in article output, pointing to the role of international agenda settings that might have boosted the attention to topics in the marine realm.

Against the backdrop of the UN Ocean Decade's start in 2021, which specifically stresses the important role of social sciences in providing knowledge for the "ocean we want," it could be assumed that the marine social sciences will gain even more momentum in the upcoming years.

In this light, the question of how to best support the marine social sciences community (McKinley et al., 2020) becomes even more apparent. The results of our bibliometric analysis might not be able to answer such a question. However, drawing on our results, we propose four selected future research avenues or directions for discussion the marine social sciences community could potentially build on.

5.1 Strengthen sustainability-related marine social sciences capacity

Our results identified a diversification of aspects of sustainability-related marine social science research over time. Varying countries and institutes involved in publishing in the field, as well as diverse research topics, echoed by increased keywords in recent years, are among such aspects. Despite a perception of marine social scientists as being a mere helping hand to natural scientists (McKinley et al., 2022), the identified research streams indicate a broad expertise in its own right.

This expertise of sustainability-related marine social sciences is also illustrated in the research streams' contributions to the UN Ocean Decade and its various anticipated outcomes. For instance, stakeholder participation and its positive effects are discussed throughout various research streams. In providing knowledge about stakeholder participation processes, sustainability-related marine social science research could help prevent scientific findings about coastal and marine ecosystems entering society as "fixed truth" (Bogusz and Holtappels, 2021, p. 279). It can furthermore help pave the way to UN Ocean Decade's Outcome 7 — "[an] inspiring and engaging ocean where society understands and values the ocean in relation to human wellbeing and sustainable development" (UNESCO-IOC, 2021, highlights in original).

Despite its vast contributions to possible sustainable pathways, scholars argue that there remains a lack of "visibility and recognition" of marine social sciences in and outside academia (McKinley et al., 2022). This is also reflected in the fact that social scientists represent a minority among international environmental expert organizations. To foster the outreach of (sustainability-related) marine social sciences, developing more extensive research on questions of how to strengthen the visibility of social scientists' value in shaping sustainable futures of coastal and marine ecosystems may be crucial. In addition, it could be important to explore how to better enroll social scientists into expert organizations.

Our results indicated an unbalanced approach to knowledge production in terms of spatial distribution. While case studies are conducted worldwide, recognizing regional focus areas in some research streams, the vast majority of peer-reviewed articles are written by researchers based at institutes in the Global North. This discrepancy is particularly concerning given the location of several significant marine ecosystems in the Global South. As Partelow and colleagues (2020) noted in their literature review, scientists from such regions are not at the forefront of knowledge production. This disparity could potentially contribute to the "intellectual dominance" of the Global North, as scholars like Chakrabarty (2000) have argued. This trend echoes concerns about the risks associated with "parachute science" (Stefanoudis et al., 2021) and it may result in a less suitable viewpoint and further strengthen one-sided dependencies in the knowledge production about marine ecosystems (Partelow et al., 2020). Borrowing from Hornidge and colleagues (2023), an important question for the future would be: How can "eye-level science systems with valued contributions built on robust cooperative networks within and between Global North and Global South science systems" (p. 31) be enhanced?

5.2 Cultivate cross-country studies and collaboration for cross-country oceanic concerns

Our study demonstrates that single-country case studies are among the most prominent research methods in some research streams of the sustainability-related marine social sciences. Such case studies highlight the contribution of sustainability-related marine social sciences in understanding the complexity of transformation processes in different regions and could enhance "local and regional ocean knowledge systems," as the UN Ocean Decade proposes (Hornidge et al., 2023, p. 28). Yet, marine ecosystems are often summarized under the term "world ocean" (in the singular) for a reason, which is to present the cross-border character of oceanic concerns. Facing the global ocean crisis, putting such knowledge systems into dialogue appears to be equally important (ibid.).

A point of departure to enhance such a dialogue could be the development of cross-country studies or reviews that draw on country comparisons in the marine social science realm. Such studies could foster the understanding of marine ecosystems and solutions to the climate and biodiversity crisis on a global level. In addition, cross-country studies could promote author collaborations worldwide, where we found some room for improvement regarding multiple country publications.

The value of scientific collaboration is not only revealed by the UN Ocean Decade and under Article 242 of the United Nations Convention on the Law of the Sea (UNCLOS) but was recently reaffirmed by the approval of the UN High Seas Treaty on March 4, 2023. The treaty aims to safeguard the diversity of marine biodiversity and exercise supervision over the open ocean at a global level. In such an endeavor, "research capacity building among nations" plays a pivotal role (Jones, 2023). The extensive expertise in the "perceptions and benefits of marine conservation" as well as the "fisheries,

aquaculture, and food security" research streams could be a point of departure to build on regarding questions on offshore conservation in the light of the UN High Seas Treaty.

5.3 Bring natural and social scientists into dialogue

Our study has identified the diverse ways in which the marine social sciences provide knowledge to support the sustainability of marine and coastal ecosystems, as well as the livelihoods of people who rely on them. Notably, our analysis of the journal landscape suggests that there is a growing trend toward integrating social and natural sciences research, which is in line with the goals of the marine social sciences manifesto (Bavinck and Verrips, 2020). This trend is evident in interdisciplinary and marine science journals that regularly publish sustainability-related marine social science studies. Such developments indicate that there is substantial potential for knowledge exchange between these disciplines.

There is however still a need to facilitate the integration of natural and social sciences knowledge to better understand ocean-human relations, in line with the UN Ocean Decade (UNESCO-IOC, 2021). It is essential to explore ways to bring natural and social scientists who are working on coastal and marine ecosystems into dialogue, as Bogusz and Holtappels (2021) stressed. To identify research topics for collaboration more precisely, it may be useful to conduct a more detailed study of the contributions of different disciplines to specific research topics. In addition, exploring the challenges of bringing natural and social scientists together could provide insights into important levers for interdisciplinary cooperation. While McKinley and colleagues (2022) have made a promising start in identifying such challenges and barriers, more research is needed to advance this important agenda. Furthermore, funding mechanisms that promote persistent interdisciplinary networks and projects are much needed.

5.4 Make (more) sense of marine social science epistemic diversity

The decline in article publications since 2020 is associated with Covid-19 restrictions and marine social sciences' focus on empirical work. Paired with the lack of theoretical contributions in some research streams, this might point to potential for situating and framing where marine social sciences stand in terms of theoretical approaches. Consequently, Bavinck and Verrips urgeded to develop "social science theory based on coastal, marine empiricism from all over the world" (2020, p. 123).

While our analysis provided insights into research topics, methodological and theoretical approaches, it remained elusive in terms of providing more detail about disciplinary approaches and regional variances of approaching ocean-human relations. Because "how we know the ocean varies substantially around the world" (Hornidge et al., 2023), future bibliometric analysis could focus on such aspects and provide additional insights as well as a more nuanced understanding of the regional and disciplinary variances of approaching marine and coastal ecosystems. Studies about the epistemic diversity of marine social sciences could also help to avoid the regular misconceptions in the field (McKinley et al., 2022, p. 7). Above all, disentangling the epistemic diversity could provide a strong baseline to foster dialogue between natural and social scientists who deal with coastal and marine ecosystems. A comprehensive overview could enhance the understanding of who speaks from which angle.

5.5 Study limitations

Although providing a first broad overview of sustainability-related marine social sciences articles, our analysis is limited in scope. Because our study was based on WoS as a single database, our analysis is not a complete rundown of the field. A supplementary analysis using Scopus as metadata or the *Maritime Studies* journal could further the understanding of the sustainability-related marine social science research field.

An in-depth content analysis of the 1,215 studies in our sample is clearly beyond the scope of our analysis. While such a review is desirable, given the vast and intricate nature of the field, it will probably require a narrower scope that concentrates on specific themes.

While marine social sciences are generally intertwined with sustainability issues, our search term put forth only studies that explicitly mentioned sustainability-related terms (Figure 1). Because such terms are contested and authors define the terms differently, there might be relevant studies in the field that are not listed in our data. Relatedly, the topic of blue growth might be underrepresented in our study, as sustainability is already implicitly included in this term (for an overview of blue growth, see Liang et al., 2022b). As inherent to any bibliometric analysis, the search term might have skewed the results, pointing to the fact that our study represents an approximate solution reflecting sustainability-related marine social sciences research. While the majority of the studies can clearly be assigned to the domain of the social sciences, there might be a few that can be located at the intersection between social and natural sciences. This reflects the many touchpoints of the marine social sciences. Overall, verification with other sources could check the "completeness" of our results.

Despite these limitations, our study enriches the understanding of sustainability-related marine social science peer-reviewed research and proposes future avenues to discuss. As the field is continuously evolving and a single bibliometric study cannot grasp such a diverse field entirely, this article will hopefully encourage future research on the marine social science landscape and its role in contributing to the "ocean we want" (UNESCO-IOC, 2021).

6 Final remarks

There is a critical need for sustainable solutions that prioritize the wellbeing of coastal and marine ecosystems and their responsible utilization (Bleischwitz et al., 2022). Finding pathways to new sustainable waters is a collective task and one that requires

pooling together all available methods (e.g. Jefferson et al., 2021) and (inter-)disciplinary strengths, including marine social sciences research. In order to unleash the full potential of the marine social sciences, we suggest the following recommendations based on the bibliometric analysis of 1,215 peer-reviewed articles:

- Explore ways and build on existing efforts that enhance the outreach of the vast contributions of marine social sciences research;
- Enhance ocean knowledge systems, that inspire eye-level dialogue between natural and social sciences disciplines, as well as cross-country collaboration, including Global North and Global South;
- Inspire more meta-studies that boost the understanding of marine social sciences epistemic and methodological diversity to uncover thematic and methodological points of connection for interdisciplinary and cross-country collaborations.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: Web of Science.

Author contributions

NP and FS: Conceptualized the study, analyzed and interpreted the data. NP: Wrote the manuscript. FS: Reviewed the manuscript and wrote individual paragraphs on the methods sections. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2023.1210133/full#supplementary-material

References

Adams, M. S., Carpenter, J., Housty, J. A., Neasloss, D., Paquet, P. C., Service, C., et al. (2014). Toward increased engagement between academic and indigenous community partners in ecological research. *Ecol. Soc.* 19 (3). doi: 10.5751/es-06569-190305

Ahmadia, G. N., Cheng, S. H., Andradi-Brown, D. A., Baez, S. K., Barnes, M. D., Bennett, N. J., et al. (2021). Limited progress in improving gender and geographic representation in coral reef science. *Front. Mar. Sci.* 8. doi: 10.3389/fmars.2021.731037

Allan, A., Barbour, E., Nicholls, R. J., Hutton, C., Lim, M., Salehin, M., et al. (2022). Developing socio-ecological scenarios: A participatory process for engaging stakeholders. *Sci. Total Environ.* 807, 150512. doi: 10.1016/j.scitotenv.2021.150512

Anderson, J. L., Asche, F., and Garlock, T. (2019). Economics of aquaculture policy and regulation. *Annu. Rev. Resource Economics* 11 (1), 101–123. doi: 10.1146/annurev-resource-100518-093750

Arbo, P., Knol, M., Linke, S., and St. Martin, K. (2018). The transformation of the oceans and the future of marine social science. *Maritime Stud.* 17 (3), 295–304. doi: 10.1007/s40152-018-0117-5

Armenio, E., Mossa, M., and Petrillo, A. F. (2021). Coastal vulnerability analysis to support strategies for tackling COVID-19 infection. *Ocean Coast. Manage.* 211, 105731. doi: 10.1016/j.ocecoaman.2021.105731

Arto, I., García-Muros, X., Cazcarro, I., González-Eguino, M., Markandya, A., and Hazra, S. (2019). The socioeconomic future of deltas in a changing environment. *Sci. Total Environ.* 648, 1284–1296. doi: 10.1016/j.scitotenv.2018.08.139

Axelrod, M., Roth, B., Kramer, D. B., Salim, S. S., Novak, J. M., Sathianandan, T. V., et al. (2015). Cascading globalization and local response. *J. Environ. Dev.* 24 (3), 315–344. doi: 10.1177/1070496515591577

Badola, R., Barthwal, S., and Hussain, S. A. (2012). Attitudes of local communities towards conservation of mangrove forests: A case study from the east coast of India. *Estuarine Coast. Shelf Sci.* 96, 188–196. doi: 10.1016/j.ecss.2011.11.016

Bagheri, M., Zaiton Ibrahim, Z., Akhir, M. F., Talaat, W. I. A. W., Oryani, B., Rezania, S., et al. (2021). Developing a climate change vulnerability index for coastal city sustainability, mitigation, and adaptation: A case study of Kuala Terengganu, Malaysia. *Land* 10 (11), 1271. doi: 10.3390/land10111271

Ban, N. C., Maxwell, S. M., Dunn, D. C., Hobday, A. J., Bax, N. J., Ardron, J., et al. (2014). Better integration of sectoral planning and management approaches for the interlinked ecology of the open oceans. *Mar. Policy* 49, 127–136. doi: 10.1016/j.marpol.2013.11.024

Bastian, M., Heymann, S., and Jacomy, M. (2009). Gephi: an open source software for exploring and manipulating networks. *Proc. Int. AAAI Conf. Web. Soc. Media* 3 (1), 361–362. doi: 10.1609/icwsm.v3i1.13937

Bavinck, M., and Verrips, J. (2020). Manifesto for the marine social sciences. *Maritime Stud.* 19 (2), 121–123. doi: 10.1007/s40152-020-00179-x

Bax, N., Novaglio, C., Maxwell, K. H., Meyers, K., McCann, J., Jennings, S., et al. (2022). Ocean resource use: Building the coastal blue economy. *Rev. Fish Biol. Fisheries* 32, 189-207. doi: 10.1007/s11160-021-09636-0

Bellot, J., Bonet, A., Peña, J., and Sánchez, J. R. (2007). Human impacts on land cover and water balances in a coastal Mediterranean county. *Environ. Manage.* 39 (3), 412–422. doi: 10.1007/s00267-005-0317-9

Bennett, N. J. (2018). Navigating a just and inclusive path towards sustainable oceans. *Mar. Policy* 97, 139–146. doi: 10.1016/j.marpol.2018.06.001

Bennett, N. J. (2019). Marine social science for the peopled seas. *Coast. Manage.* 47 (2), 244–252. doi: 10.1080/08920753.2019.1564958

Bergillos, R. J., and Ortega-Sánchez, M. (2017). Assessing and mitigating the landscape effects of river damming on the Guadalfeo River delta, southern Spain. *Landscape Urban Plann.* 165, 117–129. doi: 10.1016/j.landurbplan.2017.05.002

Bhattacharjee, K., and Behera, B. (2018). Determinants of household vulnerability and adaptation to floods: Empirical evidence from the Indian state of West Bengal. *Int. J. Disaster Risk Reduction* 31, 758–769. doi: 10.1016/j.ijdrr.2018.07.017

Bian, H., Gao, J., Wu, J., Sun, X., and Du, Y. (2021). Hierarchical analysis of landscape urbanization and its impacts on regional sustainability: A case study of the Yangtze River economic belt of China. *J. Cleaner Production* 279, 123267. doi: 10.1016/j.jclepro.2020.123267

Bleischwitz, R., Schlueter, A., Fujitani, M., Breckwoldt, A., Kriegl, M., Portman, M., et al. (2022). *Marine social sciences for the ocean we want* (Springer Nature Sustainability Community). Available at: https://sustainabilitycommunity.springernature.com/posts/marine-social-sciences-for-the-ocean-we-want?user_id=202035-raimund-bleischwitz (Accessed March 15, 2023).

Block, J. H., and Fisch, C. (2020). Eight tips and questions for your bibliographic study in business and management research. *Manage. Rev. Q.* 70, 307–312. doi: 10.1007/s11301-020-00188-4

Bogusz, T., and Holtappels, M. (2021). Third knowledge spaces between nature and society: A dialogue. *Historical Soc. Res.* 46 (2), 264–286. doi: 10.12759/hsr.46.2021.2.264-286

Bonaccorsi, A. (2018). *The evaluation of research in social sciences and humanities: Lessons from the Italian experience* (Cham: Springer).

Borgatti, S. P., and Everett, M. G. (2000). Models of core/periphery structures. *Soc. Networks* 21 (4), 375–395. doi: 10.1016/S0378-8733(99)00019-2

Borgatti, S. P., Everett, M. G., and Freeman, L. C. (2002). *Ucinet 6 for Windows: Software for social network analysis* (Harvard, MA: Analytic Technologies).

Bryhn, A., Kraufvelin, P., Bergström, U., Vretborn, M., and Bergström, L. (2020). A model for disentangling dependencies and impacts among human activities and marine ecosystem services. *Environ. Manage.* 65 (5), 575–586. doi: 10.1007/s00267-020-01260-1

Buonocore, E., Buia, M. C., Russo, G. F., and Franzese, P. P. (2021). Exploring the convergence of natural flows for the generation of natural capital stocks in marine ecosystems. *Ecol. Complexity* 46, 100928. doi: 10.1016/j.ecocom.2021.100928

Chakrabarty, D. (2000). *Provincializing Europe: Postcolonial thought and historical difference* (Princeton: Princeton University Press).

Chang, Y., Chu, K., and Chuang, L. Z.-H. (2018). Sustainable coastal zone planning based on historical coastline changes: A model from a case study in Tainan, Taiwan. *Landscape Urban Plann.* 174, 24–32. doi: 10.1016/j.landurbplan.2018.02.012

Clark, T. P., and Longo, S. B. (2019). Examining the effect of economic development, region, and time period on the fisheries footprints of nations, (1961-2010). *Int. J. Comp. Sociology* 60 (4), 225–248. doi: 10.1177/0020715219869976

Cook, D., Malinauskaite, L., ROman, J., Daviðsdóttir, B., and Ögmundardóttir, H. (2019). Whale sanctuaries – an analysis of their contribution to marine ecosystem-based management. *Ocean Coast. Manage.* 182, 104987. doi: 10.1016/j.ocecoaman.2019.104987

Craig, A. T., Beek, K., Gilbert, K., Soakai, T. S., Liaw, S.-T., and Hall, J. J. (2022). Universal health coverage and the Pacific Islands: An overview of senior leaders' discussions, challenges, priorities and solutions 2015-2020. *Int. J. Environ. Res. Public Health* 19 (7), 4108. doi: 10.3390/ijerph19074108

Dada, O., Almar, R., Morand, P., and Menard, F. (2021). Towards West African coastal social-ecosystems sustainability: Interdisciplinary approaches. *Ocean Coast. Manage.* 211, 105746. doi: 10.1016/j.ocecoaman.2021.105746

Delany-Crowe, T., Marinova, D., Fisher, M., McGreevy, M., and Baum, F. (2019). Australian policies on water management and climate change: Are they supporting the sustainable development goals and improved health and well-being? *Globalization Health* 15 (68). doi: 10.1186/s12992-019-0509-3

Di Franco, A., Hogg, K. E., Calò, A., Bennett, N. J., Sévin-Allouet, M.-A., Esparza Alaminos, O., et al. (2020). Improving marine protected area governance through collaboration and co-production. *J. Environ. Manage.* 269, 110757. doi: 10.1016/j.jenvman.2020.110757

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., and Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *J. Business Res.* 133, 285–296. doi: 10.1016/j.jbusres.2021.04.070

Dutra, L. X. C., Bustamante, R. H., Sporne, I., van Putten, I., Dichmont, C. M., and Ligtermoet, E. (2015). Organizational drivers that strengthen adaptive capacity in the coastal zone of Australia. *Ocean Coast. Manage.* 109, 64–76. doi: 10.1016/j.ocecoaman.2015.02.008

Engels, T. C. E., Istenič Starčič, A., Kulczycki, E., Pölönen, J., and Sivertsen, G. (2018). Are book publications disappearing from scholarly communication in the social sciences and humanities? *Aslib J. Inf. Manage.* 70 (6), 592–607. doi: 10.1108/ajim-05-2018-0127

Fajardo, P., Beauchesne, D., Carbajal-López, A., Daigle, R. M., Fierro-Arcos, L. D., Goldsmit, J., et al. (2021). Aichi target 18 beyond 2020: Mainstreaming traditional biodiversity knowledge in the conservation and sustainable use of marine and coastal ecosystems. *PeerJ* 9, e9616. doi: 10.7717/peerj.9616

Fernandez, M. A., Golubiewski, N. E., Joynt, J. L. R., and Rhodes, L. A. (2022). Hot or not? Developing a spectrum of indicator-based assessments in approaching vulnerability to climate change. *Australas. J. Environ. Manage.* 29 (1), 24–45. doi: 10.1080/14486563.2022.2034672

Ferrol-Schulte, D., Wolff, M., Ferse, S., and Glaser, M. (2013). Sustainable livelihoods approach in tropical coastal and marine social-ecological systems: A review. *Mar. Policy* 42, 253–258. doi: 10.1016/j.marpol.2013.03.007

Finkbeiner, E. M., Bennett, N. J., Frawley, T. H., Mason, J. G., Briscoe, D. K., Brooks, C. M., et al. (2017). Reconstructing overfishing: Moving beyond Malthus for effective and equitable solutions. *Fish Fisheries* 18 (6), 1180–1191. doi: 10.1111/faf.12245

Franke, A., Peters, K., Hinkel, J., Hornidge, A., Schlüter, A., Zielinski, O., et al. (2022). Making the UN Ocean Decade work? The potential for, and challenges of, transdisciplinary research and real-world laboratories for building towards ocean solutions. *People Nat* 5 (1), 21-33. doi: 10.1002/pan3.10412

Frazão Santos, C., Agardy, T., Andrade, F., Crowder, L. B., Ehler, C. N., and Orbach, M. K. (2021). Major challenges in developing marine spatial planning. *Mar. Policy* 132. doi: 10.1016/j.marpol.2018.08.032

Friedrich, L. A., Glegg, G., Fletcher, S., Dodds, W., Philippe, M., Bailly, D., et al. (2020). Using ecosystem service assessments to support participatory marine spatial planning. *Ocean Coast. Manage.* 188, 105121. doi: 10.1016/j.ocecoaman.2020.105121

Ghermandi, A., Obura, D., Knudsen, C., and Nunes, P. A. L. D. (2019). Marine ecosystem services in the northern Mozambique channel: A geospatial and socio-economic analysis for policy support. *Ecosystem Serv.* 35, 1–12. doi: 10.1016/j.ecoser.2018.10.009

Giron-Nava, A., Lam, V. W. Y., Aburto-Oropeza, O., Cheung, W. W. L., Halpern, B. S., Sumaila, U. R., et al. (2021). Sustainable fisheries are essential but not enough to ensure well-being for the world's fishers. *Fish Fisheries* 22 (4), 812-821. doi: 10.1111/faf.12552

Gomez, M. L. A., Adelegan, O. J., Ntajal, J., and Trawally, D. (2020). Vulnerability to coastal erosion in the Gambia: Empirical experience from Gunjur. *Int. J. Disaster Risk Reduction* 45, 101439. doi: 10.1016/j.ijdrr.2019.101439

Gros, P. (2014). Fishing: A very ancient practice undergoing major change. *Cahiers Agricultures* 23 (1), 4–17. doi: 10.1684/agr.2014.0678

Guilhon, M., Montserrat, F., and Turra, A. (2021). Recognition of ecosystem-based management principles in key documents of the seabed mining regime: Implications and further recommendations. *ICES J. Mar. Sci.* 78 (3), 884–899. doi: 10.1093/icesjms/fsaa229

Gürlük, S. (2009). Economic growth, industrial pollution and human development in the Mediterranean Region. *Ecol. Economics* 68 (8-9), 2327–2335. doi: 10.1016/j.ecolecon.2009.03.001

Hafezi, M., Sahin, O., Stewart, R. A., Connolly, R. M., Mackey, B., and Ware, D. (2020). Adaptation strategies for coral reef ecosystems in small island developing states: Integrated modelling of local pressures and long-term climate changes. *J. Cleaner Production* 253, 119864. doi: 10.1016/j.jclepro.2019.119864

Halpern, B. S., Frazier, M., Afflerbach, J., Lowndes, J. S., Micheli, F., O'Hara, C., et al. (2019). Recent pace of change in human impact on the world's ocean. *Sci. Rep.* 9 (1). doi: 10.1038/s41598-019-47201-9

Hanneman, R. A., and Riddle, M. (2005). Introduction to social network methods. (Riverside, CA: University of California, Riverside).

Hannigan, J. (2017). Toward a sociology of oceans. *Can. Rev. Sociology/Revue Can. sociologie* 54 (1), 8–27. doi: 10.1111/cars.12136

Harker, A. L., Stojanovic, T. A., Majalia, A. M., Jackson, C., Baya, S., and Tsiganyiu, K. D. (2022). Relationships between livelihoods, well-being, and marine protected areas: Evidence from a community survey, Watamu Marine National Park and Reserve, Kenya. *Coast. Manage.* 50 (6), 490–513. doi: 10.1080/08920753.2022.2126266

Harohau, D., Blythe, J., Sheaves, M., and Diedrich, A. (2020). Limits of Tilapia aquaculture for rural livelihoods in Solomon Islands. *Sustainability* 12 (11), 4592. doi: 10.3390/su12114592

Hermes, J., Venkatesen, R., Morris, T., Heslop, E., Narayanaswamy, V., Aucan, J., et al. (2022). The role of sustained ocean observations to the society and blue economy, in Blue Economy. Eds. E.R. Urban Jr. and V. Ittekkot (Singapore: Springer), 417–465. doi: 10.1007/978-981-19-5065-0_14

Hooyberg, A., Roose, H., Grellier, J., Elliott, L. R., Lonneville, B., White, M. P., et al. (2020). General health and residential proximity to the coast in Belgium: Results from a cross-sectional health survey. *Environ. Res.* 184, 109225. doi: 10.1016/j.envres.2020.109225

Hornidge, A.-K., Partelow, S., and Knopf, K. (2023). "Knowing the ocean: Epistemic inequalities in patterns of science collaboration," in *Ocean Governance*. Eds. S. Partelow, M. Hadjimichael and A. K. Hornidge, (MARE Publication Series, Springer: Cham) 25, 25–45. doi: 10.1007/978-3-031-20740-2_2

Hossain, M. A. R., Ahmed, M., Ojea, E., and Fernandes, J. A. (2018). Impacts and responses to environmental change in coastal livelihoods of south-west Bangladesh. *Sci. Total Environ.* 637-638, 954–970. doi: 10.1016/j.scitotenv.2018.04.328

IBM Corp (2021). *IBM SPSS statistics for windows, version 28.0* (Armonk, NY: IBM Corp).

Jacomy, M., Venturini, T., Heymann, S., and Bastian, M. (2014). ForceAtlas2, a continuous graph layout algorithm for handy network visualization designed for the Gephi software. *PloS One* 9 (6), e98679. doi: 10.1371/journal.pone.0098679

Jefferson, R., McKinley, E., Griffin, H., Nimmo, A., and Fletcher, S. (2021). Public perceptions of the ocean: Lessons for marine conservation from a global research review. *Front. Mar. Sci.* 8. doi: 10.3389/fmars.2021.711245

Jimenez, É.A., Gonzalez, J. G., Amaral, M. T., and Lucena Frédou, F. (2021). Sustainability indicators for the integrated assessment of coastal small-scale fisheries in the Brazilian Amazon. *Ecol. Economics* 181, 106910. doi: 10.1016/j.ecolecon.2020.106910

Jones, N. (2023). UN forges historic deal to protect ocean life: What researchers think. *Nature*. doi: 10.1038/d41586-023-00684-z

Jouffray, J.-B., Blasiak, R., Norström, A. V., Österblom, H., and Nyström, M. (2020). The blue acceleration: The trajectory of human expansion into the ocean. *One Earth* 2 (1), 43–54. doi: 10.1016/j.oneear.2019.12.016

Kebede, A., Nicholls, R., Allan, A., Arto, I., Cazcarro, I., Fernandes, J., et al. (2018). Applying the global RCP–SSP–SPA scenario framework at sub-national scale: A multi-scale and participatory scenario approach. *Sci. Total Environ.* 635, 659–672. doi: 10.1016/j.scitotenv.2018.03.368

Kim, D., and Lee, J. (2016). Development of a web-based tool for climate change risk assessment in the business sector. *Sustainability* 8 (10), 1013. doi: 10.3390/su8101013

Koehn, J. Z., Reineman, D. R., and Kittinger, J. N. (2013). Progress and promise in spatial human dimensions research for ecosystem-based ocean planning. *Mar. Policy* 42, 31–38. doi: 10.1016/j.marpol.2013.01.015

Kołodziej, A., and Kołodziej-Durnaś, A. (2022). Chapter 1 Maritime sociology in the making. In *Maritime Spaces and Society*. Brill, Leiden, 3–24. doi: 10.1163/9789004503410_002

Kubo, T., Uryu, S., Yamano, H., Tsuge, T., Yamakita, T., and Shirayama, Y. (2020). Mobile phone network data reveal nationwide economic value of coastal tourism under climate change. *Tourism Manage.* 77, 104010. doi: 10.1016/j.tourman.2019.104010

Kuntner, T., and Teichert, T. (2016). The scope of price promotion research: An informetric study. *J. Business Res.* 69 (8), 2687–2696. doi: 10.1016/j.jbusres.2015.11.004

Larsen, J. N., Schweitzer, P., Abass, K., Doloisio, N., Gartler, S., Ingeman-Nielsen, T., et al. (2021). Thawing permafrost in arctic coastal communities: A framework for studying risks from climate change. *Sustainability* 13 (5), 2651. doi: 10.3390/su13052651

Lázár, A. N., Nicholls, R. J., Hall, J. W., Barbour, E. J., and Haque, A. (2020). Contrasting development trajectories for coastal Bangladesh to the end of century. *Regional Environ. Change* 20 (93). doi: 10.1007/s10113-020-01681-y

Lee, Y.-C., and Huang, S.-L. (2018). Spatial emergy analysis of agricultural landscape change: Does fragmentation matter? *Ecol. Indic.* 93, 975–985. doi: 10.1016/j.ecolind.2018.05.067

Leenhardt, P., Teneva, L., Kininmonth, S., Darling, E., Cooley, S., and Claudet, J. (2015). Challenges, insights and perspectives associated with using social-ecological science for marine conservation. *Ocean Coast. Manage.* 115, 49–60. doi: 10.1016/j.ocecoaman.2015.04.018

Lewis, C. L., Granek, E. F., and Nielsen-Pincus, M. (2018). Assessing local attitudes and perceptions of non-native species to inform management of novel ecosystems. *Biol. Invasions* 21 (3), 961–982. doi: 10.1007/s10530-018-1875-0

Li, J., Xu, X., and Liu, L. (2020). Attribution and causal mechanism of farmers' willingness to prevent pollution from livestock and poultry breeding in coastal areas. *Environment Dev. Sustainability* 23 (5), 7193–7211. doi: 10.1007/s10668-020-00911-x

Liang, J., Yin, Z., Yang, J., Li, Y., Xu, M., Li, J., et al. (2022b). Bibliometrics and visualization analysis of research in the field of sustainable development of the blue economy, (2006-2021). *Front. Mar. Sci.* 9. doi: 10.3389/fmars.2022.936612

Liang, Y., Zeng, J., and Li, S. (2022a). Examining the spatial variations of land use change and its impact factors in a coastal area in Vietnam. *Land* 11 (10), 1751. doi: 10.3390/land11101751

Lillebø, A. I., Teixeira, H., Morgado, M., Martínez-López, J., Marhubi, A., Delacámara, G., et al. (2019). Ecosystem-based management planning across aquatic realms at the Ria de Aveiro Natura 2000 territory. *Sci. Total Environ.* 650, 1898–1912. doi: 10.1016/j.scitotenv.2018.09.317

Link, J. S., Thébaud, O., Smith, D. C., Smith, A. D. M., Schmidt, J., Rice, J., et al. (2017). Keeping humans in the ecosystem. *ICES J. Mar. Sci.* 74 (7), 1947–1956. doi: 10.1093/icesjms/fsx130

Lockerbie, E. M., Shannon, L., Lynam, C. P., Coll, M., and Jarre, A. (2020). A comparative framework to support an ecosystem approach to fisheries in a global context. *Ecol. Soc.* 25 (2). doi: 10.5751/es-11508-250216

Longo, S. B., and Clark, B. (2016). An ocean of troubles: Advancing marine sociology. *Soc. Problems* 63 (4), 463–479. doi: 10.1093/socpro/spw023

Lopes, P. F. M., Pacheco, S., Clauzet, M., Silvano, R. A. M., and Begossi, A. (2015). Fisheries, tourism, and marine protected areas: Conflicting or synergistic interactions? *Ecosystem Serv.* 16, 333–340. doi: 10.1016/j.ecoser.2014.12.003

Lu, W., Liu, Z., Huang, Y., Bu, Y., Li, X., and Cheng, Q. (2020). How do authors select keywords? A preliminary study of author keyword selection behavior. *J. Informetrics* 14 (4), 101066. doi: 10.1016/j.joi.2020.101066

Marshall, N. A., Dunstan, P., Pert, P., and Thiault, L. (2019). How people value different ecosystems within the Great Barrier Reef. *J. Environ. Manage.* 243, 39–44. doi: 10.1016/j.jenvman.2019.05.024

Martin, V. Y. (2019). Four common problems in environmental social research undertaken by natural scientists. *BioScience* 70 (1), 13–16. doi: 10.1093/biosci/biz128

McClanahan, T. R., Friedlander, A. M., Wantiez, L., Nicholas, A. J., Bruggemann, J. H., Chabanet, P., et al. (2022). Best-practice fisheries management associated with reduced stocks and changes in life histories. *Fish Fisheries* 23 (2), 422–444. doi: 10.1111/faf.12625

McKinley, E., Acott, T., and Stojanovic, T. (2019). "Socio-cultural dimensions of marine spatial planning," in *Maritime spatial planning*. Eds. J. Zaucha and K. Gee (Cham: Palgrave Macmillan). doi: 10.1007/978-3-319-98696-8_7

McKinley, E., Acott, T., and Yates, K. L. (2020). Marine social sciences: Looking towards a sustainable future. *Environ. Sci. Policy* 108, 85–92. doi: 10.1016/j.envsci.2020.03.015

McKinley, E., Kelly, R., Mackay, M., Shellock, R., Cvitanovic, C., Van Putten, I., et al. (2022). Development and expansion in the marine social sciences: Insights from the global community. *iScience* 25 (8), 104735. doi: 10.1016/j.isci.2022.104735

Meerow, S. (2019). A green infrastructure spatial planning model for evaluating ecosystem service tradeoffs and synergies across three coastal megacities. *Environ. Res. Lett.* 14 (12), 125011. doi: 10.1088/1748-9326/ab502c

Merino, G., Barange, M., Blanchard, J. L., Harle, J., Holmes, R., Allen, I., et al. (2012). Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? *Global Environ. Change* 22 (4), 795–806. doi: 10.1016/j.gloenvcha.2012.03.003

Mongeon, P., and Paul-Hus, A. (2015). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics* 106 (1), 213–228. doi: 10.1007/s11192-015-1765-5

Moon, K., Cvitanovic, C., Blackman, D. A., Scales, I. R., and Browne, N. K. (2021). Five questions to understand epistemology and its influence on integrative marine research. *Front. Mar. Sci.* 8. doi: 10.3389/fmars.2021.574158

Moullec, F., Asselot, R., Auch, D., Blöcker, A. M., Börner, G., Färber, L., et al. (2021). Identifying and addressing the anthropogenic drivers of global change in the North Sea: A systematic map protocol. *Environ. Evidence* 10 (19). doi: 10.1186/s13750-021-00234-y

Murshed, S., Paull, D. J., Griffin, A. L., and Islam, M. A. (2021). A parsimonious approach to mapping climate-change-related composite disaster risk at the local scale in coastal Bangladesh. *Int. J. Disaster Risk Reduction* 55, 102049. doi: 10.1016/j.ijdrr.2021.102049

Nash, K. L., Van Putten, I., Alexander, K. A., Bettiol, S., Cvitanovic, C., Farmery, A. K., et al. (2022). Oceans and society: Feedbacks between ocean and human health. *Rev. Fish Biol. Fisheries* 32 (1), 161–187. doi: 10.1007/s11160-021-09669-5

Nayak, P. K. (2014). The Chilika Lagoon social-ecological system: An historical analysis. *Ecol. Soc.* 19 (1). doi: 10.5751/es-05978-190101

Ng, K., Borges, P., Phillips, M. R., Medeiros, A., and Calado, H. (2019). An integrated coastal vulnerability approach to small islands: The Azores case. *Sci. Total Environ.* 690, 1218–1227. doi: 10.1016/j.scitotenv.2019.07.013

Nguyen, K.-A., Liou, Y.-A., and Terry, J. P. (2019). Vulnerability of Vietnam to typhoons: A spatial assessment based on hazards, exposure and adaptive capacity. *Sci. Total Environ.* 682, 31–46. doi: 10.1016/j.scitotenv.2019.04.069

Nicholls, R. J., Hutton, C. W., Lázár, A. N., Allan, A., Adger, W. N., Adams, H., et al. (2016). Integrated assessment of social and environmental sustainability dynamics in the Ganges-Brahmaputra-Meghna delta, Bangladesh. *Estuarine Coast. Shelf Sci.* 183, 370–381. doi: 10.1016/j.ecss.2016.08.017

Nicoll, R., Vick, C., Laffoley, D., Hajduk, T., Zuccarino-Crowe, C., Bianco, M., et al. (2016). MPAs, aquatic conservation and connecting people to nature. *Aquat. Conservation: Mar. Freshw. Ecosyst.* 26, 142–164. doi: 10.1002/aqc.2678

Obregón, C., Admiraal, R., van Putten, I., Hughes, M., Tweedley, J. R., and Loneragan, N. R. (2020). Who you speak to matters: Information sharing and the management of a small-scale fishery. *Front. Mar. Sci.* 7. doi: 10.3389/fmars.2020.578014

Olowoporoku, O., Daramola, O., and Odunsi, O. (2021). Determinants of residents' perceived environmental hazards and risks in coastal towns of Delta State, Nigeria. *Int. J. Disaster Risk Reduction* 56, 102094. doi: 10.1016/j.ijdrr.2021.102094

Omann, I., Stocker, A., and Jäger, J. (2009). Climate change as a threat to biodiversity: An application of the DPSIR approach. *Ecol. Economics* 69 (1), 24–31. doi: 10.1016/j.ecolecon.2009.01.003

Orchard, S., Hughey, K. F. D., Measures, R., and Schiel, D. R. (2020). Coastal tectonics and habitat squeeze: Response of a tidal lagoon to co-seismic sea-level change. *Natural Hazards* 103 (3), 3609–3631. doi: 10.1007/s11069-020-04147-w

Ostrom, E. (2007). A diagnostic approach for going beyond panaceas. *Proc. Natl. Acad. Sci.* 104 (39), 15181–15187. doi: 10.1073/pnas.0702288104

Otto, D., and Haase, A. (2022). How the COVID-19 pandemic impacts social scientific research on sustainability: Questions of methodology, ethics and justice — comment on Santana et al. *Sustainability Sci* 17 (1), 315-318. doi: 10.1007/s11625-021-01066-y

Partelow, S., Hornidge, A.-K., Senff, P., Stäbler, M., and Schlüter, A. (2020). Tropical marine sciences: Knowledge production in a web of path dependencies. *PloS One* 15 (2), e0228613. doi: 10.1371/journal.pone.0228613

Pita, P., Hyder, K., Gomes, P., Pita, C., Rangel, M., Veiga, P., et al. (2018). Economic, social and ecological attributes of marine recreational fisheries in Galicia, Spain. *Fisheries Res.* 208, 58–69. doi: 10.1016/j.fishres.2018.07.014

Pittman, S. J., Rodwell, L. D., Shellock, R. J., Williams, M., Attrill, M. J., Bedford, J., et al. (2019). Marine parks for coastal cities: A concept for enhanced community well-being, prosperity and sustainable city living. *Mar. Policy* 103, 160–171. doi: 10.1016/j.marpol.2019.02.012

Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world. *Publications* 9 (1), 12. doi: 10.3390/publications9010012

Rakotomahazo, C., Ravaoarinorotsihoarana, L. A., Randrianandrasaziky, D., Glass, L., Gough, C., Boleslas Todinanahary, G. G., et al. (2019). Participatory planning of a community-based payments for ecosystem services initiative in Madagascar's mangroves. *Ocean Coast. Manage.* 175, 43–52. doi: 10.1016/j.ocecoaman.2019.03.014

Rampengan, M. M. F., Boedhihartono, A. K., Law, L., Gaillard, J. C., and Sayer, J. (2014). Capacities in facing natural hazards: A small island perspective. *Int. J. Disaster Risk Sci.* 5 (4), 247–264. doi: 10.1007/s13753-014-0031-4

Rees, S. E., Attrill, M. J., Austen, M. C., Mangi, S. C., and Rodwell, L. D. (2013). A thematic cost-benefit analysis of a marine protected area. *J. Environ. Manage.* 114, 476–485. doi: 10.1016/j.jenvman.2012.10.048

Rees, S. E., Sheehan, E. V., Stewart, B. D., Clark, R., Appleby, T., Attrill, M. J., et al. (2020). Emerging themes to support ambitious UK marine biodiversity conservation. *Mar. Policy* 117, 103864. doi: 10.1016/j.marpol.2020.103864

Sajjad, M., Chan, J. C. L., and Lin, N. (2020). Incorporating natural habitats into coastal risk assessment frameworks. *Environ. Sci. Policy* 106, 99–110. doi: 10.1016/j.envsci.2020.01.004

Salazar-De La Cruz, C.C.S.-D., Alberto Zepeda-Domínguez, J., Espinoza-Tenorio, A., and E Ramos-Muñoz, D. (2020). Governance networks in marine spaces where fisheries and oil coexist: Tabasco, México. *Extractive Industries Soc.* 7 (2), 676–685. doi: 10.1016/j.exis.2020.03.012

Sangha, K. K., Stoeckl, N., Crossman, N., and Costanza, R. (2019). A state-wide economic assessment of coastal and marine ecosystem services to inform sustainable development policies in the Northern Territory, Australia. *Mar. Policy* 107, 103595. doi: 10.1016/j.marpol.2019.103595

Sebastiani, A., Buonocore, E., Franzese, P. P., Riccio, A., Chianese, E., and Nardella, L. (2021). Modeling air quality regulation by green infrastructure in a Mediterranean coastal urban area: The removal of PM10 in the Metropolitan city of Naples (Italy). *Ecol. Model.* 440, 109383. doi: 10.1016/j.ecolmodel.2020.109383

Semeoshenkova, V., Newton, A., Contin, A., and Greggio, N. (2017). Development and application of an integrated beach quality index (BQI). *Ocean Coast. Manage.* 143, 74–86. doi: 10.1016/j.ocecoaman.2016.08.013

Serra, P., Vera, A., Tulla, A. F., and Salvati, L. (2014). Beyond urban–rural dichotomy: Exploring socioeconomic and land-use processes of change in Spain, (1991–2011). *Appl. Geogr.* 55, 71–81. doi: 10.1016/j.apgeog.2014.09.005

Serrat, O. (2017). "The sustainable livelihoods approach," in *Knowledge solutions: Tools, methods, and approaches to drive organizational performance* (Singapore: Springer Singapore).

Setter, R. O., Franklin, E. C., and Mora, C. (2022). Co-occurring anthropogenic stressors reduce the timeframe of environmental viability for the world's coral reefs. *PloS Biol.* 20 (10), e3001821. doi: 10.1371/journal.pbio.3001821

Shellock, R. J., Cvitanovic, C., Mackay, M., McKinnon, M. C., Blythe, J., Kelly, R., et al. (2022). Breaking down barriers: The identification of actions to promote gender equality in interdisciplinary marine research institutions. *One Earth* 5 (6), 687–708. doi: 10.1016/j.oneear.2022.05.006

Shen, L., Li, Y., Lan, S., and Yao, M. (2022). Social benefits evaluation of rural micro-landscapes in southeastern coastal towns of China — the case of Jinjiang, Fujian. *Sustainability* 14 (13), 8036. doi: 10.3390/su14138036

Silva, R., Oumeraci, H., Martínez, M. L., Chávez, V., Lithgow, D., Van Tussenbroek, B. I., et al. (2021). Ten commandments for sustainable, safe, and w/healthy sandy coasts facing global change. *Front. Mar. Sci.* 8. doi: 10.3389/fmars.2021.616321

Sousa, L. P., and Alves, F. L. (2020). A model to integrate ecosystem services into spatial planning: Ria de Aveiro coastal lagoon study. *Ocean Coast. Manage.* 195, 105280. doi: 10.1016/j.ocecoaman.2020.105280

Sowa, F., and Kołodziej-Durnaś, A. (2015). A short introductory note on maritime sociology. Routinen der Krise — Krise der Routinen — 37. *Kongress der Deutschen Gesellschaft für Soziologie* 37, 1564–1570.

Stead, S. M. (2019). Using systems thinking and open innovation to strengthen aquaculture policy for the United Nations Sustainable Development Goals. *J. Fish Biol* 94 (6), 837-844. doi: 10.1111/jfb.13970

Stefanoudis, P. V., Licuanan, W. Y., Morrison, T. H., Talma, S., Veitayaki, J., and Woodall, L. C. (2021). Turning the tide of parachute science. *Curr. Biol.* 31 (4), R184–R185. doi: 10.1016/j.cub.2021.01.029

Steins, N. A., Toonen, H. M., and Delaney, A. (2020). Commentary 1 to the manifesto for the marine social sciences: fisheries. *Maritime Studies* 19, 125–127. doi: 10.1007/s40152-020-00181-3

Student, J., Lamers, M., and Amelung, B. (2020). A dynamic vulnerability approach for tourism destinations. *J. Sustain. Tourism*, 1–22. doi: 10.1080/09669582.2019.1682593

Sun, H., and Teichert, T. (2022). Scarcity in today's consumer markets: Scoping the research landscape by author keywords. *Manage. Rev. Q.*, 1–28. doi: 10.1007/s11301-022-00295-4

Teh, L. C. L., and Pauly, D. (2018). Who brings in the fish? The relative contribution of small-scale and industrial fisheries to food security in Southeast Asia. *Front. Mar. Sci.* 5. doi: 10.3389/fmars.2018.00044

Tilot, V. C., Guilloux, B., Willaert, K., Mulalap, C. Y., Bambridge, T., D'Arcy, P., et al. (2021). The concept of Oceanian sovereignty in the context of deep sea mining in the Pacific region. *Frontiers in Marine Science* 8. doi: 10.3389/fmars.2021.756072

Tito, R., Salinas, N., Cosio, E. G., Boza Espinoza, T. E., Muñiz, J. G., Aragón, S., et al. (2022). Secondary forests in Peru: Differential provision of ecosystem services compared to other post-deforestation forest transitions. *Ecol. Soc.* 27 (3). doi: 10.5751/es-13446-270312

Toledo, E. G. (2020). Why books are important in the scholarly communication system in social sciences and humanities. *Scholarly Assess. Rep.* 2 (1). doi: 10.29024/sar.14

Tonin, S., and Lucaroni, G. (2017). Understanding social knowledge, attitudes and perceptions towards marine biodiversity: The case of tegnùe in Italy. *Ocean Coast. Manage.* 140, 68–78. doi: 10.1016/j.ocecoaman.2017.02.019

Tönnies, F. (2010). *Schriften zum Hamburger Hafenarbeiterstreik* (München: Profil Verlag).

Tzoraki, O., Monioudi, I. N., Velegrakis, A. F., Moutafis, N., Pavlogeorgatos, G., and Kitsiou, D. (2018). Resilience of touristic island beaches under sea level rise: A methodological framework. *Coast. Manage.* 46 (2), 78–102. doi: 10.1080/08920753.2018.1426376

Uddin, S., and Khan, A. (2016). The impact of author-selected keywords on citation counts. *J. Informetrics* 10 (4), 1166–1177. doi: 10.1016/j.joi.2016.10.004

UNEP (2010). *Decision adopted by the conference of the parties to the convention on biological diversity at its tenth meeting X/2. The Strategic Plan for Biodiversity 2011-2020 and the Aichi biodiversity targets*. Available at: https://www.cbd.int/doc/decisions/cop-10/cop-10-dec-02-en.pdf.

UNESCO-IOC (2021). *The United Nations Decade of Ocean Science for Sustainable Development, (2021-2030) Implementation plan – summary* (Paris: UNESCO). (IOC Ocean Decade Series, 19.).

United Nations (1992). *Convention on biological diversity — United Nations 1992*. Available at: https://www.cbd.int/doc/legal/cbd-en.pdf.

United Nations Environment Programme, & International Resource Panel (2021). *Governing Coastal Resources: Implications for a Sustainable Blue Economy*. Available at: https://wedocs.unep.org/20.500.11822/36325 (Accessed June 14, 2023).

Urquhart, J., Acott, T. G., Symes, D., and Zhao, M. (2014). *Social issues in sustainable fisheries management* (Netherlands: Dordrecht Springer).

Van Dolah, E. R., Miller Hesed, C. D., and Paolisso, M. J. (2020). Marsh migration, climate change, and coastal resilience: Human dimensions considerations for a fair path forward. *Wetlands* 40 (6), 1751–1764. doi: 10.1007/s13157-020-01388-0

Verleysen, F. T., and Ossenblok, T. L. B. (2017). Profiles of monograph authors in the social sciences and humanities: An analysis of productivity, career stage, co-authorship, disciplinary affiliation and gender, based on a regional bibliographic database. *Scientometrics* 111 (3), 1673–1686. doi: 10.1007/s11192-017-2312-3

Vianna, G. M. S., Zeller, D., and Pauly, D. (2020). Fisheries and policy implications for human nutrition. *Curr. Environ. Health Rep.* 7 (3), 161–169. doi: 10.1007/s40572-020-00286-1

Wallner-Hahn, S., Dahlgren, M., and de la Torre-Castro, M. (2022). Linking seagrass ecosystem services to food security: The example of southwestern Madagascar's small-scale fisheries. *Ecosystem Serv.* 53, 101381. doi: 10.1016/j.ecoser.2021.101381

Wamsler, C., Luederitz, C., and Brink, E. (2014). Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environ. Change* 29, 189–201. doi: 10.1016/j.gloenvcha.2014.09.008

Willis, K. A., Serra-Gonçalves, C., Richardson, K., Schuyler, Q. A., Pedersen, H., Anderson, K., et al. (2022). Cleaner seas: Reducing marine pollution. *Fish Biol. Fisheries* 32 (1), 1–16. doi: 10.1007/s11160-021-09674-8

Wörfel, P. (2021). Unravelling the intellectual discourse of implicit consumer cognition: A bibliometric review. *J. Retailing Consumer Serv.* 61, 101960. doi: 10.1016/j.jretconser.2019.101960

Wu, C.-C., Jhan, H.-T., Ting, K.-H., Tsai, H.-C., Lee, M.-T., Hsu, T.-W., et al. (2016). Application of social vulnerability indicators to climate change for the southwest coastal areas of Taiwan. *Sustainability* 8 (12), 1270. doi: 10.3390/su8121270

Xu, W., and Zhang, Z. (2022). Impact of coastal urbanization on marine pollution: Evidence from China. *Int. J. Environ. Res. Public Health* 19 (17), 10718. doi: 10.3390/ijerph191710718

Yi, L., Chen, J., Jin, Z., Quan, Y., Han, P., Guan, S., et al. (2018). Impacts of human activities on coastal ecological environment during the rapid urbanization process in Shenzhen, China. *Ocean Coast. Management [online]* 154, 121–132. doi: 10.1016/j.ocecoaman.2018.01.005

Yuan, X., Chen, L., Sheng, X., Li, Y., Liu, M., Zhang, Y., et al. (2022). Evaluation of regional sustainability through emergy analysis: A case study of nine cities in the Yellow River basin of China. *Environ. Sci. Pollut. Res.* 29 (26), 40213–40225. doi: 10.1007/s11356-022-18916-6

Zacarias, D. A. (2019). Understanding community vulnerability to climate change and variability at a coastal municipality in southern Mozambique. *Int. J. Climate Change Strategies Manage.* 11 (1), 154–176. doi: 10.1108/ijccsm-07-2017-0145

Zeller, D., Cashion, T., Palomares, M., and Pauly, D. (2018). Global marine fisheries discards: A synthesis of reconstructed data. *Fish Fisheries* 19 (1), 30–39. doi: 10.1111/faf.12233

Zhang, J., Yu, Q., Zheng, F., Long, C., Lu, Z., and Duan, Z. (2015). Comparing keywords plus of WoS and author keywords: A case study of patient adherence research. *J. Assoc. Inf. Sci. Technol.* 67 (4), 967–972. doi: 10.1002/asi.23437

Zhou, Y., Pu, L., and Zhu, M. (2020). Coastal landscape vulnerability analysis in Eastern China — based on land use change in Jiangsu Province. *Int. J. Environ. Res. Public Health* 17 (5), 1702. doi: 10.3390/ijerph17051702

Zuschke, N. (2020). An analysis of process-tracing research on consumer decision-making. *J. Business Res.* 111, 305–320. doi: 10.1016/j.jbusres.2019.01.028