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Public Perceptions of the Ocean: Lessons for Marine Conservation From a Global Research Review

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Insights into how public audiences perceive and relate to the ocean are pivotal to successful societal engagement and integration of human dimensions in marine conservation. Perceptions research explores how people understand, value or engage with an environment, issue or management response, and in the context of marine conservation, provides crucial insights for the development, delivery and evaluation of effective conservation interventions. This review of 349 peer reviewed studies explores the current state of research into public perceptions of the ocean. Using an extensive data extraction process, the review examined the geographical spread of ocean perceptions research, the topics of research focus, and the methods used. The review identifies gaps in current research activity, and opportunities for maximizing the impact of ocean perceptions research in current and future marine conservation. Key findings of the review include evidence that the rate of research is growing, with 59% of studies published between 2013–2017. However, a clear geographical skew is evident, with the majority of studies being undertaken in higher income countries. Furthermore, there has been a tendency to focus on charismatic species, or issues and spaces of clear human-ocean interaction (e.g., beaches), highlighting significant gaps in the topics and themes currently covered by ocean perceptions research. An additional gap identified is the underutilization of available methods to explore the complexity of marine perceptions. In a bid to address these gaps, the paper concludes with a series of recommendations designed to stimulate and support ocean perceptions research as being fundamental to the success of marine conservation efforts. While ocean perceptions research may be young, the growing research effort evidenced in this review gives optimism for realizing its potential and continuing to improve the integration of ocean perceptions research effectively into marine conservation.

Keywords: public perceptions, marine conservation, research, global review, policy, marine social sciences, society

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INTRODUCTION

Ocean ecosystems are under intense and increasing pressure from human activities (O'Hara et al., 2021). Climate change, pollution and biodiversity loss undermine benefits to people which are essential for human survival (Worm et al., 2006; Pascual et al., 2017). Natural sciences have long provided the tools to assess and monitor ocean biodiversity and have been the dominant

sciences applied to conservation (Mascia et al., 2003). However, there is now recognition that natural sciences alone are not sufficient to achieve marine conservation goals (Fletcher and Potts, 2007; Bennett, 2019). Marine conservation depends upon a clear understanding of the complex relationships between society and the ocean. The need to better understand these relationships has been recognized by both the marine research and policy communities (ISSC/UNESCO, 2013; Jefferson et al., 2015; Bennett, 2019; Bavinck and Verrips, 2020; McKinley et al., 2020a; Claudet, 2021). This shift has been echoed in the UN Decade of Ocean Science for Sustainable Development (2021–2031) which sets out the necessity of improved integration between natural and social sciences to tackle global ocean challenges (Ryabinin et al., 2019), and positions the Decade as a potential opportunity to forge a new and transformational relationship between society and the ocean.

Calls for a better understanding of the relationships between society and the ocean are not new. In the last two decades, various concepts have been proposed that envisage large scale societal changes to address the challenges facing the ocean, including, marine citizenship (Fletcher and Potts, 2007; McKinley and Fletcher, 2010, 2012), a focus on engagement with shallow seas and our "neighborhood ocean" (Vincent, 2011), and ocean literacy (Steel et al., 2005; Brennan et al., 2019; McKinley and Burdon, 2020; Kelly et al., 2021; Glithero and Zandvilet, 2021). While each of these comes with its own definitions, terminology, and frameworks, a common thread is the recognition that catalyzing a shift to an improved societal relationship with the ocean requires more than merely enhancing or improving society's knowledge of the ocean (Kollmuss and Agyeman, 2002; McKinley et al., 2020a). There has been a corresponding acknowledgment that social sciences, and more specifically, an understanding of public perceptions of the ocean (which, for the purposes of this study has been taken to mean seas, coasts, and the wider ocean) is essential to the success of pro-conservation actions within governments, industries and wider society (Schultz, 2011; Lotze et al., 2018; Stoll-Kleemann, 2019; McKinley and Burdon, 2020).

Perceptions are defined as "the way an individual observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome" (Bennett, 2016, p4). Perceptions research recognizes that society is not homogeneous and that perceptions of the ocean vary between individuals and groups. The variation in ocean perceptions within society is influenced by multiple contextual factors, including (but not limited to) socio-demographics, personality variables, access and experience of the ocean, coasts, or seas (Jefferson et al., 2015; Bennett, 2016). Historically, perceptions research has, to some extent, been dismissed as "anecdotal," and therefore, potentially "less reliable" than other forms of evidence [as discussed by Bennett (2016)]. However, it is now recognized that understanding how people perceive the ocean is fundamental to the design and implementation of marine conservation and other management interventions to maximize their impact (Gelcich et al., 2014; Jefferson et al., 2015; Potts et al., 2016; Bennett, 2019). This is confirmed by a growing literature illustrating the benefits of including public perceptions research in marine conservation practice (Jefferson et al., 2015; Bennett, 2016; Gelcich and O'Keeffe, 2016), including:

- Developing an understanding of the diverse societal attitudes, views and values held toward different components of the ocean and its management. This can provide crucial insights to support policy development, foster improved ocean literacy or marine citizenship, and catalyze behavior change (e.g., Potts et al., 2016);
- Supporting assessments of the social acceptability, effectiveness and impacts of conservation interventions, initiatives and policies [e.g., the introduction of a new marine protected area (MPA)] and developing insights into how these perceptions may influence their implementation (e.g., Lotze et al., 2018; Brueckner-Irwin et al., 2019; Rasheed, 2020);
- Informing the design of effective and meaningful mechanisms for stakeholder engagement, which can in turn support the legitimacy, equity and inclusivity of marine conservation activities and governance approaches (e.g., Burdon et al., 2019; Bennett et al., 2021);
- Fostering public sensitization to marine conservation activities through appropriate communication, awareness raising and engagement initiatives (e.g., Chambers et al., 2019; Kolandai-Matchett et al., 2021).
- In a policy context, public perceptions research provides valuable tools to monitor and measure success against a range of policy targets [e.g., Aichi Target 1; Sustainable Development Goal 14, see Haward and Haas (2021)].

Ocean perceptions research is currently fragmented and conducted across multiple disciplines and in a range of geographical and societal contexts (Jefferson et al., 2015). This results in the research being difficult to synthesize, challenging to interpret as a single body of work, and harder to access for practitioners or other researchers wishing to use the findings. To make a more impactful contribution to marine conservation outcomes, ocean perceptions research needs to be collated into a coherent body of literature. This will provide focus for those working in this field and establish a knowledge base for enhanced practice, to push forward the development of new ideas and insights, and to develop new methods and approaches (Jefferson et al., 2015).

Ocean perceptions research draws on the broad spectrum of marine social sciences approaches and methods to explore different research questions and evidence needs, using both qualitative and quantitative methods [See Newing (2011) and Bennett (2016) for more detail]. Quantitative methods are those which gather numerical data (e.g., often collected using questionnaires), whilst qualitative methods gather non-numerical data usually as text or images, such as that collected through interviews (Newing, 2011). While questionnaires and interviews are some of the more commonly used methods, social science approaches are diverse and include, for example; photostudies, in which photographs taken by respondents are used as interview prompts (e.g., Tonge et al., 2013); Q methodology, which is used to explore polarizing subjects and

requires the respondent to sort a series of statements based on their agreement or disagreement (e.g., Gall and Rodwell, 2016); Community Voice Method which uses video interviews to explore a research question, then presents the findings of the research through a video report for further discussion by community and stakeholder groups (e.g., Ainsworth et al., 2019), while focus groups and community workshops allows the views of multiple participants to be collected (Newing, 2011). In addition, recent years have seen an emergence of methods which draw on arts and humanities disciplines to explore public perceptions of the ocean. These approaches provide a creative lens through which the complex connections between society and the sea can be explored (Bennett and Roth, 2019). Examples within the literature include the use of poetry to explore indigenous marine conservation knowledge (Kosgei, 2021) and Brennan's (2018) exploration of marine space through an arts/science collaboration.

An important consideration in any perceptions research is to explore the heterogeneity of perceptions within audiences as it is unlikely that all individuals within one audience will hold the same view of a particular issue. To assess heterogeneity of perceptions, researchers measure variables such as socio-demographics (e.g., age, gender) or engagement with a subject (e.g., visiting the coast). Further, a person's values are responsible for shaping intrinsic motivation and can influence perceptions and behaviors (Kollmuss and Agyeman, 2002; Manfredo et al., 2017). Social values are therefore a potentially powerful variable for exploring heterogeneity of perceptions. They can be measured through scales such as Schwartz Value Index (Schwartz, 2012), or integrating values typologies such as Kellert's typology of values (Kellert, 1997).

Given the complexity of relationships between society and the ocean it is reasonable to assume that there will be a corresponding diversity and variation in perceptions (Bennett, 2016). Therefore, adopting the full diversity of research methods is critical to enable a full exploration of public perceptions of the ocean.

Despite the increased recognition of the importance of public perceptions research in understanding human-ocean connections and the insight this provides to policy and management, challenges remain in translating these opportunities into meaningful action and impact. This paper presents an assessment of the existing ocean public perceptions research landscape, with a view to understanding knowledge gaps and identifying opportunities where this research can be better applied to marine conservation challenges. The paper delivers a "stock take" of ocean perceptions research, including the spatial and thematic focus of the research, the methods used to conduct the research, and the ways in which the research is funded. Furthermore, the paper presents a gap analysis that identifies research priorities to benefit marine conservation and public engagement with the ocean.

MATERIALS AND METHODS

To identify relevant studies for inclusion in this review, a suite of 126 search terms was used, divided into three categories of "public," "perceptions," and "marine" (**Table 1**). The review focused on peer-reviewed studies published in the English language, and therefore does not include studies published in the gray literature or those published in a language other than English. To maximize the opportunity to include relevant studies, two search engines were used: ScienceDirect and Google Scholar. Standard search protocols were used to conduct the searches, with each category of terms separated by "AND" and the individual terms within each category separated by "OR." In addition, the authors used their expert knowledge to include additional studies not identified through the searches.

Studies were only included in the review if they met three additional criteria: (1) the study had an ocean focus (in total or part); (2) it presented primary perceptions data (i.e., it was not a review); and (3) its survey population was the public. In this review, "public" is defined as those audiences not making an income from their engagement with the ocean. Thus, for example, studies of special interest groups such as recreational divers or anglers were included but studies with commercial divers and fishers were excluded. While ocean perceptions research with non-public audiences such as fishers, coastal managers and scientists is clearly an important part of responding to certain elements of marine conservation (Gall and Rodwell, 2016), these groups were beyond the scope of this review.

A total of 349 studies met all search criteria up to and including those published in May 2017 and were included in the review. Each study was reviewed by the author team to extract key data relating to a number of parameters (overview in **Table 2**, further details in SM1). The data extraction process was pilot tested in four iterations using a subset of 10–20 studies to ensure the extracted data met the research question requirements. Paper reviewing was carried out by all authors, with a subset of 5% of the studies re-reviewed by different authors to ensure inter-reviewer consistency.

The data extracted from each study is presented in **Table 2** (with further details about the extraction and analytical processes presented in **Supplementary Table 1**). Qualitative data was coded using a manual thematic coding and data reduction process (Bryman, 2016). Coding categories were defined through identification of the emergent themes and agreement of hierarchies of categories as required, with analysis and coding checked between the authors (see **Supplementary Table 1** for more).

RESULTS

This section describes the key research topics of the included studies, when and where the 349 studies were conducted, and the methods used (see **Supplementary Material 2** for a list of all 349 studies).

The Ocean Perceptions Research Landscape: When and Where Were the Studies Completed?

The review demonstrated the field of ocean perceptions research to be relatively nascent. The first study of public perceptions

TABLE 1 | Search terms used to identify research on public perceptions of the ocean.

Public terms	Perception terms	Marine terms		
Children	Attachment	Acidification	Fish farming	Pacific
Citizen	Attitude	Algae	Fisheries	Plankton
Communit*	Awareness	Antarctic	Fishing	Planning
Gender	Behavior	Aquaculture	Flooding	Plastic
International	Belief	Arctic	Gas	Pollution
National	Citizenship	Atlantic	Habitat	Reclamation
Public	Concern	Bathing	High seas	Recreation
Resident	Connection	Beach	Indian	Renewable energy
School	Emotion	Biodiversity	Invasive	Runoff
Senior citizen	Experience	Bycatch	Invertebrate	Saltmarsh
Society	Feeling	Cetacean	Litter	Sea
Student	Idea	Climate change	Littoral	Sea level rise
Tourist	Interest	Coast	Mangrove	Seabird
Visitor	Knowledge	Coastal management	Marine animal	Seafood
Young	Memory	Coastal protection	Marine environment	Seagrass
Youth	Opinion	Coral	Marine governance	Seascape
	Perceive	Crustacean	Marine industry	Seaside
	Perception	Deep sea	Marine life	Seaweed
	Perspective	Defense	Marine mammal	Sewage
	Relationship	Disease	Marine protected area	Shark
	Responsibility	Diving	Marine reptile	Shellfish
	Thought	Dredging	Marine reserve	Shipping
	Value	Echinoderm	Mining	Southern
	Viewpoint	Ecosystem services	Mollusk	Swimming
	Vision	Engineering	Ocean	Temperature
		Erosion	Ocean management	Tourism
		Estuary	Offshore	Water quality
		Eutrophication	Oil	Wetland
		Fish		

of the ocean was published in 1988 with 10 or fewer studies published per year until the late 2000s. 2009 marks the beginning of a considerable increase in the rate of publication to around 50 studies per year from 2015 onward (**Figure 1** and **Supplementary Table 3**). 59% of all the studies in this review were published between 2013–2017.

TABLE 2 | Research questions and details of extracted data (see SM1 for more information, codes link to relevant section of SM1).

Research question	Data extracted from papers
When and where were the studies conducted?	• Year of publication (Ai) • Journal (Aii) • Number of countries in which data was collected (Aiii) • List of countries in which data was collected (Aiv) • Scale of study (Av) • Funding source (Avi)
What did the study research?	• Target population (Bi) • Thematic focus (Bii_ • Non-marine element to study (Biii) • Public perceptions dimensions (see Jefferson et al., 2015) (Biv)
How was the study conducted?	• Method of data collection (Ci) • Model used (Cii) • Sample size (Ciii) • Socio-demographic variables measured (Civ) • Social values measured (Cv) • Ocean experience measured (Cvi)

The review found ocean perceptions research conducted on populations in Europe (31%), North America (27%), Oceania (17%), Asia (11%), Africa (6%), South America (4%), Caribbean (3%), and Central America (2%; **Figure 2**). The United States and Australia were the countries with the most studies with 24% (94) and 14% (56) studies, respectively. All other countries had 15 or fewer studies, with 57 countries having fewer than five studies (**Figure 2**; **Supplementary Table 4**). In terms of scale, the majority of studies (84%) assessed public perceptions at a sub-national scale (e.g., Piriyapada and Wang, 2014), with 12% at the national scale (e.g., Goldberg et al., 2016), and only 5% assessed perceptions in more than one country. The largest study assessed ocean perceptions in ten countries (Gelcich et al., 2014).

The 349 studies reviewed were published in 109 different journals (see **Supplementary Table 5** for detailed information). The journals Ocean and Coastal Management and Marine Policy together account for a third of the studies reviewed (19 and 13%, respectively). A further third of studies are shared across 16 titles with Tourism Management (4%), Ecological Economics (4%) and Environmental Management (3%) the next most common journals. The remaining studies are published across 91 titles.

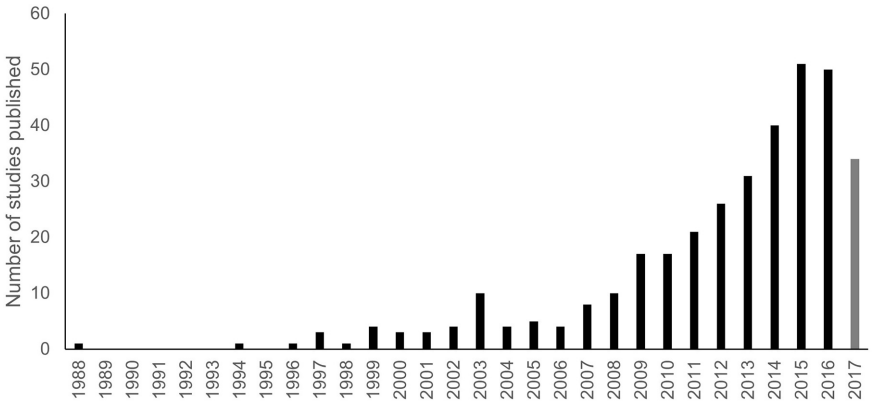

FIGURE 1 | Number of ocean perceptions studies published each year. Note 2017 count to May 2017 (n = 349).

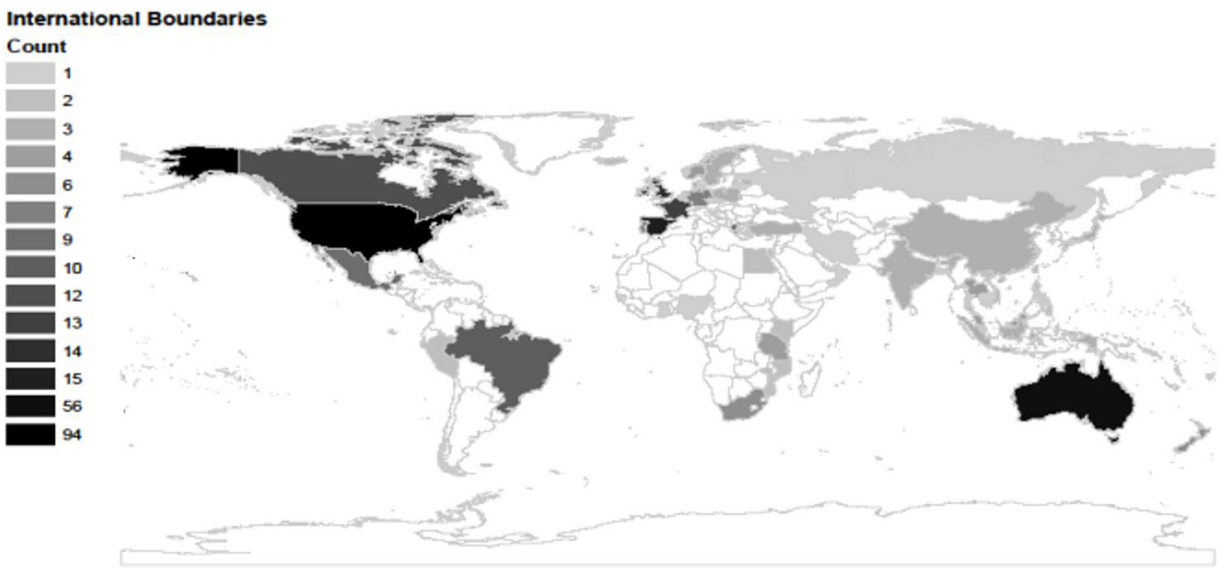

FIGURE 2 | Map showing number of ocean perceptions studies per country (n = 349).

While many of the journal titles have a marine or coastal focus, the range of disciplines represented by the journal titles is diverse, including conservation, tourism, recreation and sport, whole environment, social science, energy, geography, economics, health, agriculture, education, communication, psychology, sustainable development, amongst others. This suggests that researchers from a wide diversity of disciplines are contributing to ocean perceptions research.

Funding information was provided for only 250 (72%) of the 349 studies reviewed, with funding sources falling into seven categories (**Table 3**). National government bodies (including ministries, departments, and executive agencies) were the most common funders of ocean perceptions research, contributing to 60% of the 250 studies and being the sole funder of 86 studies. Universities, through bursaries, travel funds, and internal grants, contributed to 30% of the studies, although it is probable that the costs of many of the 99 studies with no funding information described may have been underwritten by universities. National research councils contributed to 19% of studies. The European Commission and philanthropic bodies each contributed to 11% of the studies (usually through funding of larger projects), while NGOs and commercial organizations each contributed to 4% of studies. Of the 250 studies with funding information, two thirds (67%) were supported by one category of funders, with the remaining third (33%) supported by two or more funder categories, usually including at least one university.

The Thematic Focus of Ocean Perceptions Research: What Did the Studies Research?

The target populations of the reviewed studies were most often residents or tourists/visitors (48 and 20%, respectively) (**Table 4**). A further 11 categories of "public" were identified, of which

TABLE 3 | Funders supporting marine public perceptions studies (*n* = 250).

Funding source	Number of studies	%
National government body	151	60
University	74	30
National Research Councils	48	19
European Commission	28	11
Philanthropic Foundations	28	11
NGOs	11	4
Commercial	10	4

Some studies were funded from more than one source.

TABLE 4 | Target population of studies (*n* = 349).

Target population	%
Residents	48
Tourists/visitors	20
Public	10
Beach/coastal users	10
Divers/snorkelers	7
Indigenous/traditional community residents	5
Recreational fishers	5
Students (any age) and teachers	3
Nature based tourism	3
Recreational boaters	3
Watersports (incl. surfers, kayak and kite surfers)	2
Marine/ocean users	1
Museum/aquarium visitors	1

Author definitions of their target population were used to categorize data.

eight were different types of recreational groups (**Table 4**). Most studies (84%) assessed perceptions of one population [e.g., residents; Perry et al. (2014)]; 14% of two [e.g., general public and tourists; Moscardo et al. (2001)], 1% of three [e.g., residents, tourists and indigenous/traditional communities; Brown et al. (2016)], and 0.6% of four (e.g., Strickland-Munro et al., 2016; Moore et al., 2017).

The most studied ocean topic was perceptions related to MPAs (15% of all studies; **Figure 3**) including for example, reactions of local communities to a no-take MPA in South Africa (Faasen and Watts, 2007), exploration of international tourists' willingness to pay to visit marine parks in the Seychelles (Mwebaze and MacLeod, 2013) and comparisons between public and expert views of threats to the ocean and proportion of New Zealand waters which are currently and should ideally be protected (Eddy, 2014). Studies exploring perceptions of biota included habitats (13%), single species or species groups (9%) and marine biodiversity (3%). Blue economy studies were dominated by research on perceptions of marine renewables, so this was split into two categories: blue economy (5%) including fisheries, aquaculture, desalination and mining; and marine renewables (7%). Threats explored through the studies include climate change (6%), pollution (5%), and environmental degradation (2%). 12% of studies explored perceptions of the marine environment or the coast without linking to a particular location or issue, categorized as broad scale marine and coastal. For example Chen and Tsai (2016) investigated ocean environmental awareness in Taiwanese students and Pakalniete et al. (2017) explored the preferences of Latvian citizens for improved marine waters.

Tourists and marine recreation populations were a large component of the target respondents (**Table 4**; 20%) and studies investigating public perceptions of tourism and recreation accounted for 11% of studies. 7% of studies focused on perceptions of management, including, for example, Alves et al. (2017) and de la Torre-Castro et al. (2017), while a further 2% of studies focused on understanding perceptions of marine cultural ecosystem services. Finally, studies included in the "other" category (4%) included perceptions of abiotic ocean features, citizen science and stewardship.

Perceptions of biotic components of the ocean environment accounted for 25% of all studies. 31 of the 86 biotic studies assessed perceptions of single species or species groups. **Table 5** presents a summary of the particular species and species groups explored, of which 90% studied perceptions of vertebrate species. Habitats were investigated in 45 studies including reefs (38% of habitat studies), beaches (31%), mangroves (13%), deep sea (9%), wetlands (7%), intertidal (2%), and seagrass (2%). One study investigated public perceptions of mangroves, reefs and seagrass meaning the total percent for habitat studies exceeds 100%.

It was also noted that 15% of studies included a non-marine component. These studies represent those spaces, issues or communities which span the land-sea boundary. For example, studies taking a geographically defined focus such as a National Park (e.g., De Lopez, 2003), exploring a ubiquitous issue such as climate change (McComas et al., 2015) or where the connection of the effects of land-based activities on marine environments is explored, e.g., Roca et al. (2009) who study perceptions of the impacts of run-off on beach quality. Relatively few studies explicitly compared marine and non-marine related perceptions, rather those including both took an integrated approach to their research.

Figure 4 shows the distribution of studies against dimensions of public perceptions research (Jefferson et al., 2015), which include dimensions of knowledge, values, and concern among others (for more information see **Supplementary Material 6**). We found that 84% of studies measured more than one component (e.g., Faasen and Watts (2007) who explore knowledge, human-ecosystem interactions, and behaviors). Knowledge was the most commonly measured dimension of perceptions (61%), while concern was found to be the second most frequently measured dimension (40%) of studies, with marine experiences, human-system interactions and economic values the next most frequently measured, found in over 30% of studies (see **Figure 4**). The least frequently measured dimensions were human health and wellbeing, and positive connections at 10 and 9%, respectively.

Research Methods Used: How Were the Studies Conducted?

The description of methods used are based on how methods were described by the author/s of the studies reviewed. The most

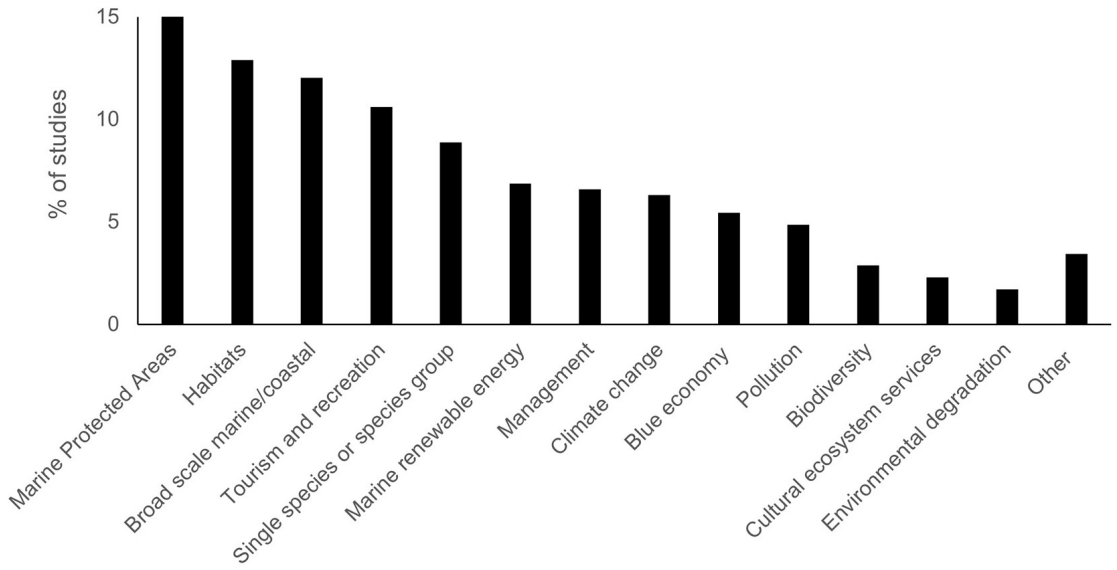

FIGURE 3 | Percentage of ocean perceptions studies investigating each theme; studies were allocated to a single category (n = 349).

commonly used method was questionnaires (70% of studies) followed by interviews (40%) and focus groups (9%). However, there was inconsistency in the use of the terms "questionnaire" and "interview" within some of the studies reviewed, leading to difficulties in clearly identifying the methods used. Multiple methods were used by 26% of studies and 12% used other methods, including participant observations, e.g., of diver's damaging behavior which was compared to self-reported damage (Hammerton, 2017), mapping such as participatory GIS mapping (Aswani et al., 2015), advanced interview techniques such as Q methodology (Brownlee and Verbos, 2015) or photo elicitation studies (Coleman and Kearns, 2015).

Around 30% of studies included economic assessment. This was usually to provide a metric of the scale, extent or direction of a perception, using a range of approaches, such as a contingent valuation method, or willingness to pay. For example, Barry et al. (2011) use willingness to pay to determine financial values to represent the scale of perception around the recreational value of Ireland's coastal resources, while Ariza et al. (2012) used travel cost methodologies to explore perceptions about the relationship between economic values and beach quality in Spain. 10% of studies used a psychology-based approach at some point in the study. These studies usually used a psychology-based approach to either classify the sample or to provide explanation of the observed perceptions. For example, Johnson et al. (2015) used the stakeholder characterization framework to classify perceptions of tidal energy, while Jefferson et al. (2014) used Maslow's Hierarchy of Needs to understand different values held by respondents about the marine environment in the United Kingdom.

TABLE 5 | Details of species studied (one study included two species).

Species group	Number of studies	Species if named
Fish	10	7 sharks, 2 salmon, 1 goliath grouper
Mammals	9	3 dolphins, 2 manatees, 1 monk seal, 1 gray seal
Reptiles	8	sea turtles (two of which loggerhead)
Inverts	3	2 jellyfish, 1 oyster
Birds	2	1 hooded plover

Sample sizes ranged from 8 to 23,788 respondents (**Figure 5**). Seven studies gave imprecise sample sizes (e.g., "approximately 550," "over 47" and were included as the given number (e.g., 550, 47), 12 studies did not report a sample size but an approximate result could be calculated from other details given in the paper (e.g., an n number given alongside presentation of results) and two studies did not report a sample size and were not included in this analysis. The remaining 328 studies gave precise sample sizes.

Many studies reported measuring socio-demographic variables but not all reported whether these variables explained any heterogeneity in the perceptions being measured. The studies were assessed for the inclusion of 12 commonly used socio-demographic variables (see **Supplementary Table 7** and **Figure 8**). An average of 4 socio-demographic variables were measured per study. 83% (290) of studies measured at least one socio-demographic variable (**Figure 6**; **Supplementary Figure 8**) with the most measured variables being age (88% of the 290 studies), gender (87%), education (59%) and place of residence (46%). 66% of studies which measured socio-demographic variables reported an influence of at least one variable on perceptions. However, this may be an underestimate as 32% of studies did not report at all whether the measured variables influenced perceptions, nor did they report whether they had tested and received a null result, adding to the ambiguity of this finding (**Figure 6**; **Supplementary Table 7** and **Figure 8**). It appears that many of those studies used their collected socio-demographic data only to describe the respondent profile, and not as a means of exploring heterogeneity of the perceptions

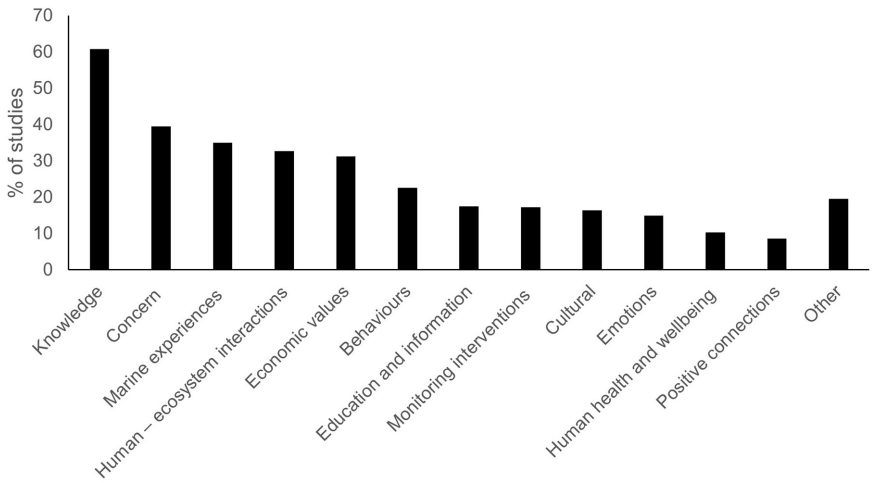

FIGURE 4 | Percentage of ocean perceptions studies measuring dimension of public perceptions research; studies could be in one or more categories (n = 349).

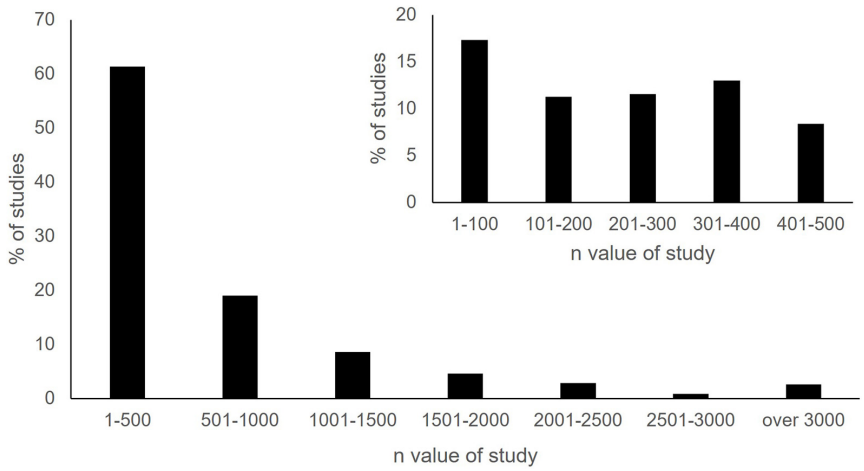

FIGURE 5 | Percent of ocean perceptions studies within each sample size category. Inset presents sample sizes for studies with fewer than 500 respondents (n = 347).

being measured. Around 10 studies did not clearly detail what variables they had measured, rather stating that they had collected "demographic characteristics."

Social values are the *trans*-situational goals and principles that guide human behavior (Manfredo et al., 2017). Analysis found that only 10% of studies measured social values. Of these 35 studies, 77% found an effect of social values on perceptions, 6% reported no effect of social values and 17% did not report their findings (**Figure 6**). A range of frameworks and models were used across these studies to measure social values, including established methods such as the New Environmental Paradigm or NEP (Alessa et al., 2003) or application of Kellert's typology of values, whilst other studies applied a bespoke set of questions on a narrower range of values, e.g., Grafeld et al. (2016) which used "a series of Likert questions to measure use, indirect use, bequest and existence values." Finally, 39% of all studies reviewed measured some element of interaction with the marine environment, of which 71% found an effect on perceptions, 4% reported no effect and 25% did not report on the analysis.

DISCUSSION

The aim of this review was to assess the existing ocean perceptions research landscape in order to identify gaps and set out recommendations to support improved contribution of public perceptions research to marine conservation. Through bringing attention to this subject area, and revealing current research gaps, the review aims to enhance the role of ocean perceptions research in marine conservation and cement its position within the UN Decade of Ocean Science for Sustainable Development 2021–2030, and beyond. The review found a growing rate of studies in ocean perceptions research which may infer increasing research effort, journals giving greater attention to conservation

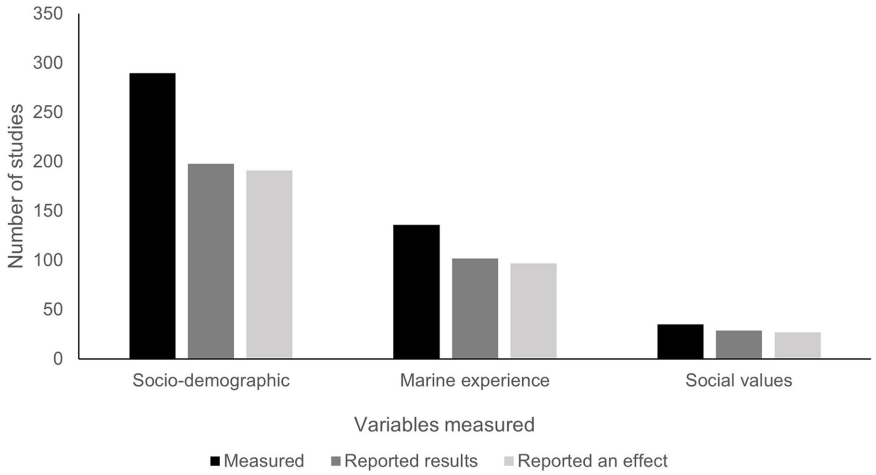

FIGURE 6 | Number of ocean perceptions studies which measured, reported results, and reported effects of socio-demographic variables, ocean experience and social values (n = 349).

social sciences, greater funding availability, or a combination of these. Despite this growth, the review highlighted a number of gaps including: (1) a skewed global distribution of studies; (2) a bias toward charismatic species and habitats, and a focus on spaces and issues where humans most obviously interact with the ocean (e.g., beaches) or are most contentious (e.g., MPAs); and (3) an apparent underutilization of available perceptions research methods. Each of these gaps will be explored in turn, followed by a discussion of how to strengthen the appreciation of ocean perceptions research to support marine conservation.

Gaps in Geographic Distribution of Ocean Perceptions Research

Recent decades have seen calls to increase the integration of social science research into all aspects of environmental conservation (e.g., Mascia et al., 2003; Bennett, 2019). The growth in publication rate of ocean perceptions research identified in this review fits the pattern of a response to these calls, and wider increases in publication rates in other subjects [e.g., spatial human dimensions research (Koehn et al., 2013); and qualitative conservation social science (Moon et al., 2016)]. However, this rate of publication is not equally distributed, with publications from the United States, Australia, and Europe dominating the research literature. This echoes the distribution of published research into public perceptions of climate change (Capstick et al., 2015), ecological biodiversity (Titley et al., 2017) and conservation (Di Marco et al., 2017). This could be influenced by our focus on English language publications. Despite the majority of scientific papers being published in English (Ramírez-Castañeda, 2020), it is recognized that whilst multilanguage research is challenging, it provides a richer insight for conservation action (Salager-Meyer, 2008; Angulo et al., 2021). This is an area which could be explored in future perceptions reviews. These findings suggest that benefits of ocean perceptions research are not yet being felt across all marine conservation efforts and, as a result, may in fact indirectly contribute to ongoing biodiversity loss and/or social inequity in under-represented study areas (Bennett et al., 2021).

Gaps in the Ocean Themes Explored

Habitats and Species

The review found that existing ocean perceptions research is skewed toward charismatic species and habitats, echoing the documented bias in marine ecological research. For example, Duarte et al. (2008) describe a bias in ecological marine habitat research effort toward coral reefs over seagrass and mangroves (all threatened habitats). This pattern appears to be replicated in this review with coral reef perceptions studies dominating habitat-specific studies (15 coral reef studies, 6 studies on mangroves and 4 studies on the deep sea). Beaches are also frequently researched (10 studies), predominantly around themes of tourism, beach quality, use and management, while species-specific ocean perceptions research is dominated by vertebrates (90%; **Table 5**). Marine invertebrates are ecologically critical and can be an important part of the experience of marine biodiversity for many people, however, this review found that they appear to be relatively unexplored by ocean perceptions research. This under exploration of these species and spaces (and other similarly neglected topics) may limit our understanding about the connections people make with marine environments. Identifying these biases at this early stage of ocean perceptions research is perhaps not surprising, given similar trends identified in other fields. However, as we look to recommendations to improve the application of ocean perceptions research, addressing these biases will be important.

Human Activities and Management

The review found that the ocean perceptions studies with an emphasis on human activities tended to focus on MPAs, tourism and recreation, and renewable energy generation. It is possible that ocean perceptions research is being conducted on a greater diversity of activities but remains in the gray literature and was

therefore not detected in this review. The topics highlighted in this review reflect important and often contentious interactions between people and the ocean. For example, the designation of an MPA can create tensions and competing narratives within and between affected communities. As such, understanding community-held perceptions of MPAs is potentially very useful when considering a designation or determining management measures. For instance, a public perceptions study would provide valuable insight to inform approaches that resolve matters of rivalry or disagreement (Voyer et al., 2015).

Although MPA focused perceptions studies were the greatest single group of studies (15%), this is a relatively small collection of 53 studies. Given that, at present, there are over 18,500 MPAs covering almost 28 million km^2 (UNEP-WCMC and IUCN, 2021), the ocean perceptions research literature is extremely limited. This reflects the assertion by Mascia et al. (2010) that there is a "scarcity of rigorous research on the social impacts of marine protected areas" (p.1428). The same observation can be made for ocean perceptions studies of marine renewable energy, in which the total number of studies (24) does not adequately reflect the scale of the offshore renewable energy sector, which in mid-2019 included 5,500 offshore wind turbines across 17 countries (International Energy Agency, 2019). This indicates that perceptions studies and the application of social sciences more generally does not currently reflect the role of society in developments of marine renewable energy or its potential impact on coastal communities (Kerr et al., 2014).

The limited focus on key ocean challenges has several possible explanations. It could be explained by a lack of recognition for the potential role of perceptions research in contributing to research into key global challenges. It could also reflect a legacy, or continuing, undervaluation of the "social voice" in ocean and coastal policy and management. For example, Gruby et al. (2016), in a perception study of large MPAs reported that a number of interviewees "were puzzled by our questions about the human dimensions of large MPAs. . . [and struggled] to recognize the relevance of social science concerning spaces where there are "no people." Regardless, it is clear that there is a major research opportunity *and* policy need to examine the public perceptions of key ocean crises, such as ocean climate impacts, plastic pollution, or how to transition to a circular ocean economy. Perhaps more fundamentally, the limited emphasis on understanding human attitudes toward key ocean challenges runs contrary to the core principle of the ecosystem approach that "management objectives are a matter of societal choice" (CBD, 2000), which is not being supported with the current level of ocean perceptions research effort.

The review confirms the veracity of calls from authors and practitioners that much greater emphasis is needed on understanding the social aspects of coastal and ocean systems. For example, Unsworth et al. (2019) describe one of the conservation challenges of seagrass conservation as a lack of societal awareness; Romañach et al. (2018) argue that mangrove conservation would benefit from understanding the complex interrelationships between social and natural systems; while McKinley et al. (2020b) assert the need for integrating social sciences into saltmarsh management. These testimonies illustrate the importance of ocean perceptions research (and marine social sciences more widely) in confronting conservation challenges, but that at present the research literature is inadequate to support these needs. Given the assertions that certain conservation outcomes are enhanced by the inclusion of ocean perceptions research, it may be appropriate to consider the development of a research agenda that enables the limited ocean perceptions capacity to be focused on the most urgent locations or topics.

Diversifying Marine Perceptions Research Methods

The ways in which ocean perceptions research can inform and support marine conservations are varied and rich (Jefferson et al., 2015; Bennett, 2016; Gelcich and O'Keeffe, 2016). The diversity of methods used to conduct perceptions studies are both qualitative and quantitative, from the familiar such as questionnaires, interviews and workshops to the less familiar such as digital storytelling, forum theater, and other creative and arts-based approaches (Bennett et al., 2017a). Despite this, our results indicate that current ocean perceptions research does not fully reflect the full range of methods and approaches available, with the majority of studies included in this review found to depend on the traditional social science methods of questionnaires and interviews. This review found there to be three main weaknesses of the current suite of methods used to undertake ocean perceptions studies including: (1) a focus on measuring societal knowledge and concern of marine topics, which is only one of many possible drivers shaping public ocean perceptions (**Figure 4**); (2) a lack of exploration of the heterogeneity of audience perceptions (**Figure 6**); and (3) the predominance of questionnaires and interviews as the dominant research methods employed.

Diversifying the Dimensions of Ocean Perceptions Research

Behavior change is at the heart of conservation (Schultz, 2011), with behavioral sciences such as environmental psychology exploring the complex process of catalyzing behavior changes. Behavior change is influenced by internal factors, such as an individual's emotions and values, and external factors such as the prevailing culture and social norms (Kollmuss and Agyeman, 2002). The idea that "people care about what they know" (Balmford et al., 2002) is persuasive, yet raising awareness or knowledge of marine conservation issues on its own rarely results in a behavior change (Stoll-Kleemann, 2019). Yet almost two-thirds of ocean perceptions research studies measured respondent knowledge (**Figure 4**). This suggests an underappreciation of factors such as emotions, culture, positive connections, or behaviors themselves in ocean perceptions research (Jefferson et al., 2015; McKinley and Burdon, 2020).

A high proportion of studies measure respondent worry or concern about specific ocean issues (40%) with only 9% of studies exploring positive connections with the ocean, which perhaps hints at a focus on the doom and gloom narrative frequently used to frame environmental issues (Vanderheiden, 2011) and feels disconnected from wider aspirations of social

engagement for and with marine conservation. It is known that fear-based messaging can disengage, increasing feelings of apathy and disengagement (O'Neill and Nicholson-Cole, 2009; Gifford, 2011). Enhancing and understanding positive emotional connections, such as awe, wonder and fascination, with the ocean underpins the concepts of marine citizenship and ocean literacy and the wider connection to nature movement (McKinley and Burdon, 2020; McKinley et al., 2020a). These concepts aspire to use society-nature connections to encourage large scale societal shifts to protect and restore ocean health or biodiversity. Ocean perceptions research which explores a more diverse suite of connections between society and the sea is needed to provide the evidence base to underpin current ambitions to catalyze large scale societal change (Kearns and Collins, 2012; McKinley and Burdon, 2020).

The three dimensions least represented in the reviewed studies were emotions, human health and wellbeing and positive connections (**Figure 4**). Since the census end-date of this review in 2017, research related to these dimensions has continued to grow in prominence. "Blue health" (the connections between aquatic ecosystems and human wellbeing) has been the focus of major projects (e.g., the EU funded SOPHIE and Blue Health projects) and publications such as the Blue Health Agenda (Borja et al., 2020), the restorative value of blue spaces in response to the Covid-19 pandemic (Pouso et al., 2021) and the equigenic benefits of blue spaces (Fleming et al., 2019; Short et al., 2021). Eco-anxiety is gathering increasing attention as the scale of the biodiversity and climate crises appear to be more widely recognized by society (Cunsolo et al., 2020). The Blue Health Agenda (Borja et al., 2020) highlights the importance of "understanding the complex relationships existing between oceans and human health, in multiple knowledge areas and across sectors" and cite research gaps which would be filled through ocean perceptions research. Therefore, these dimensions of ocean perceptions research are likely to receive greater attention in the coming years as these issues gain further prominence.

The imbalances in the dimensions studied (**Figure 4**) may be due to a lack of awareness of methods for measuring dimensions, such as emotions, or may be due a lack of understanding of the importance of those dimensions within a conservation context. Ocean perceptions studies were found to rarely use psychology-based approaches as part of their methods, with economic valuation methods, or no existing approach used at all, more common. While it is difficult to interpret this pattern without knowing the disciplinary background of the lead researchers, Martin (2020) describes challenges which arise when social science research is conducted by those from non-social science disciplines. These challenges include (a) a lack of use of the literature to inform the development of social science research undertaken by natural scientists, and (b) the development of methods which do not build on the work of others indicating that perhaps some of the gaps in use of models arise from a lack of capacity for interdisciplinary working. Whilst knowledge and concern are not necessarily simple to measure [see for example Fischer and Young (2007) for a discussion of measuring knowledge of biodiversity], these lesser explored aspects of human relationships with the ocean require specialist disciplinary knowledge and method. Further work may be required to fully understand why this gap exists. Given the growing focus on emotional connection, wellbeing, and other topics, increased inclusion of conservation psychology methods and applications within ocean perceptions research is likely to be a positive trend.

Explore Heterogeneity of Audiences

In the context of ocean perceptions research, audience heterogeneity describes the variation in perceptions held within the target population. Understanding audience heterogeneity is fundamental to a thorough exploration of public perceptions of a subject (Kanagavel et al., 2014). As shown in **Figure 6**, ocean perceptions research to date has left this subject relatively unexplored, even when data on potential explanatory variables had been collected. The lack of effort to explore audience heterogeneity through socio-demographic variables, social values or marine interaction revealed in this review is concerning and shows a lack of appreciation for how these variables can influence perceptions. This perhaps fits with the pattern of considering "the public" as a single, homogenous audience (Kanagavel et al., 2014). Whilst it is certainly vital that variables are used to describe the respondent profile, the opportunity to fully explore perceptions were often not realized, even when data was available.

Socio-demographic variables were widely measured in the studies (particularly age and gender) with 83% of studies measuring at least one socio-demographic variable. This shows an awareness of the need to understand the sample being studied. However, 32% of these studies did not report whether they had tested for any influence of the socio-demographic variables measured on perceptions. Many studies appear to have used their socio-demographic data to describe the sample which engaged with the research, usually presented as a respondent profile. The high proportion of studies measuring these variables (83%) suggests researchers are familiar with the variables, and the need to understand who they are researching. However, there may also be a need to increase researcher awareness of the wider applicability of socio-demographic variables.

Engagement with the ocean was the primary focus of a number of studies, for example Ong and Musa (2012) explored the influence of experience and personality on diver behavior in Malaysia. However, engagement with the ocean stands alone as a potential explanatory variable, due to its influence on a person's perceptions, experiences and values of the ocean. Research into connection with nature, of which engagement with the ocean is an example, is increasingly showing the role it has with pro-environmental behaviors (Chawla, 2020). Despite this, 61% of studies did not include engagement with the ocean as a variable. There is real potential that greater assessment of engagement with the ocean could add considerable value to marine conservation through better understanding the impacts of visiting and experiencing marine spaces.

Social values are a complex but important subject which can inform innovative conversation strategies (Manfredo et al., 2017). However, only 10% of the reviewed studies measured social values, leaving this essential component of ocean perceptions research relatively unexplored. Their measurement requires

an understanding of social sciences literature and methods which may be unexplored or unconsidered by many outside of environmental psychology disciplines. Where variables such as age or gender may be considered relatively simple to include in a questionnaire, researchers unfamiliar with social values methods may struggle to investigate their potential effects on ocean perceptions. Increasing the extent to which ocean perceptions research explores social values is an example of the recommendations by the World Social Sciences Review (ISSC/UNESCO, 2013) which calls for natural scientists to engage social scientists early in projects to identify the greatest impact of social science concept, such as the exploration of social values within projects. In parallel, the review also recommends social scientists take the lead in promoting the application of social sciences methods which can enhance the understanding of global environmental challenges (ISSC/UNESCO, 2013).

Ocean Perceptions Research Methods and Approaches

The findings of this review show a bias toward the use of questionnaire and interview methods in ocean perceptions research, and very limited application of more innovative methods, particularly of a qualitative nature (e.g., Community Voice Method). Given the complexities of the relationships between society and the sea, application of more diverse methods would be valuable to fully explore and expose the intricacies of this relationship (Bennett et al., 2017b; Bennett and Roth, 2019; Moon et al., 2019b). It is possible that this historical dependence on traditional methods and approaches reflects an existing trend in conservation social science, where researchers without a grounding in social sciences (e.g., natural or physical scientists) recognize the need for social evidence and therefore attempt research using unfamiliar methods (Martin, 2020). This is further explored by Martin (2020) who describes questionnaires as being perceived as "quick and easy" and often used by natural scientists to explore social components of otherwise familiar ecosystems. Understanding the source of the methods gaps, and the other gaps identified in the review, is important to identifying the best ways to diversify ocean perceptions research.

It is difficult to be sure how these disciplinary and methodology gaps in marine conservation developed. Marine conservation has historically been driven by natural sciences, and it is possible that training in conservation historically, and continues to, lack adequate social science content and the development of interdisciplinary skills and awareness needed to respond to the challenges facing the global ocean (Gardner, 2021). By continuing this trend, there is a risk that this disciplinary blind spot will continue, thus dramatically limiting the potential for effective marine conservation. Indeed, by the end of the UN Ocean Decade, if the patterns seen by Gardner (2021) continue, the conservation sector will continue to face a shortage of social science skills, and it is likely that these gaps will persist.

The growing recognition of the role of qualitative and creative methods is an opportunity to overcome some of the gaps to inform marine conservation by providing deeper insights into the connections between society and the ocean. Achieving this will require ocean perceptions research which: (1) integrates a greater extent and diversity of available models, concepts and approaches to deliver a broader suite of the types of ocean perceptions research through, for example, exploring behaviors, positive connections, cultural importance of the sea, human health and wellbeing; (2) appreciates that public perceptions of the ocean vary across populations, i.e., that there is more than one "public," and explores audience heterogeneity through the analysis of explanatory variables such as social values and socio-demographic characteristics; and (3) embraces a broader suite of methods and the opportunities this brings to be innovative about ways to engage different audiences and better understand the diversity of connections between society and the sea.

This review finds that overall, the ocean perceptions research community is currently not being adventurous or brave with the methods and analyses it uses, and as suggested by Overland and Sovacool (2020) needs to deliver more rigorous social science moving beyond the familiar methods and embracing the opportunities of a more diverse suite of social science methods. This call echoes those from other authors, including Moon et al. (2019a; p 427) state "by limiting how we see, experience or understand social sciences approaches, we limit the diversity of ways through which we can explore socio-ecological worlds. Furthermore, Bennett and Roth (2019) describe the need for exponential expansion of the topics examined by conservation social science, and the potential for social sciences, arts and the humanities to have a transformative effect on conservation paradigms, programs, policies and practices. Examples of where approaches like this are being adopted include the One Ocean Hub's innovative "Empatheatre" approach[1], as well as the recent work from the Wetland Life project[2], which used photonarratives and creative writing as a way to elucidate public perceptions of the benefits and disbenefits of wetland environments. Embracing the whole suite of approaches and interdisciplinary thinking in the formative development of ocean perceptions research would ensure diversification of the methods, dimensions and analyses it conducts.

CONCLUSIONS AND RECOMMENDATIONS

The paper presents the findings of an in-depth review of existing public perceptions research relating to the marine environment, cementing the field of ocean perceptions research as a growing discipline with increasing and valued applications to marine conservation. Understanding public perceptions of the ocean is critically important to ensuring that marine conservation efforts engage and resonate with target audiences, and that social impacts of conservation actions are captured. While ocean perceptions research is a relatively young field, it is clear that it is growing and is likely to continue to grow given increasing interest in marine social sciences (McKinley et al., 2020a). However, the review also highlights gaps in the current research which show it is not utilizing the full potential to

[1] www.empatheatre.com

[2] www.wetlandlife.org

impact marine conservation efforts. For example, even subjects which appear relatively well studied within ocean perceptions research, such as public perceptions of MPAs, are still calling out for social science evidence to support more equitable and socially sensitive interventions (Gruby et al., 2017). Despite the seemingly rapid growth in this field, gaps in knowledge and understanding remain. Addressing these and delivering ocean perceptions research in more countries, exploring more marine issues and exploiting a greater diversity of social sciences methods would deliver considerable insights into public perceptions of the ocean and therefore greater impact for marine conservation.

In order to achieve enhanced marine conservation impact, we recommend the following:

- Undertake a strategic transdisciplinary assessment to identify marine conservation priorities to which ocean perceptions research can leverage maximum impact;
- Expand the geographical reach of ocean perceptions research to reflect marine conservation efforts in a broader range of countries;
- Build global capacity to deliver, commission, interpret and apply ocean perceptions research;
- Inspire and enhance transdisciplinarity through the involvement of research, policy and practitioner actors in the development, delivery and application of ocean perceptions research;
- Promote ocean perceptions research and its value to those delivering, commissioning, interpreting and applying ocean perceptions research;
- Further investigate the gaps identified in this review in order to shape capacity building efforts, starting with exploration of the disciplines delivering ocean perceptions research;
- Undertake thematic meta-analyses of the ocean perceptions research literature to synthesize existing evidence for particular issues, including multi-language reviews and exploration of gray literature where possible;
- Incorporate social science content and specialist staff into undergraduate and postgraduate conservation training [for further details see Gardner (2021)];
- Ensure effective, two-way communication channels between researchers and marine conservation policy and practice for the development and application of ocean perceptions research;
- Intensify existing efforts to integrate social science and social scientists into marine conservation activities including network building, enhancing awareness of the diversity of social sciences methods and growth in interdisciplinary funding mechanisms (see McKinley et al., 2020a; Overland and Sovacool, 2020).

While some of the recommendations presented here are perhaps not novel or unexpected, they serve to further highlight the need for continued efforts to better integrate social sciences research, including ocean perceptions research, into the broader marine conservation landscape. Whilst it is encouraging to see the upward trajectory of ocean perceptions research, which can undoubtedly deliver impact for marine conservation, it is important that this is complemented by, and grounded in, appropriate training, capacity building and high-quality research. Given the urgency of the current challenges facing the ocean, all available methods to support effective and equitable responses to the biodiversity and climate crises should be used to their fullest capacity. We believe ocean perceptions research is an essential contribution to marine conservation and look forward to seeing the impacts this field will have in the coming decade and beyond.

AUTHOR CONTRIBUTIONS

RJ conceived the study, co-designed and contributed to data collection, undertook analysis, and led the drafting of the manuscript. EM co-designed and contributed to data collection, undertook analysis, and contributed to the drafting of the manuscript. HG and AN contributed to data collection. SF contributed to data collection, data analysis, and writing of the manuscript. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2021.711245/full#supplementary-material

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