frontiers in Marine Science

TYPE Original Research
PUBLISHED 04 March 2026
DOI 10.3389/fmars.2026.1764846

OPEN ACCESS

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RECEIVED 10 December 2025
REVISED 30 January 2026
ACCEPTED 09 February 2026
PUBLISHED 04 March 2026

CITATION
McKinley E, Pagès JF, Lockhart H and Mann-Lang J (2026) Understanding and exploring ocean literacy in South Africa: an initial assessment.
Front. Mar. Sci. 13:1764846.
doi: 10.3389/fmars.2026.1764846

Understanding and exploring ocean literacy in South Africa: an initial assessment

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Recent years have witnessed increased interest in human-ocean relationships and the role that understanding these can play in ensuring sustainable ocean futures. Once a concept on the periphery of ocean governance, ocean literacy has become an integral component of ocean discourse and governance. Historically grounded in marine education, ocean literacy has undergone a significant evolution moving beyond its educational roots and individual knowledge development to an effort that seeks ocean literacy as a societal outcome. While interest in ocean literacy has increased, knowledge and research gaps remain, including a tendency for most research being carried out in the Global North. This paper recognises this gap and seeks to address the geographical biases inherent within ocean literacy research, presenting the first assessment of ocean literacy across South Africa. Using an online questionnaire (n=549), this study explored multiple dimensions of ocean literacy, gathering crucial insights into human-ocean relationships in a South African context. Analysis found there to be high levels of concern for the marine environment, with plastic pollution/litter (73%) and overfishing (72%) identified as the leading threats facing South Africa's ocean, while over 98% of respondents indicated that protecting the marine environment was important to them personally. Through the paper, we explore each of the ocean literacy dimensions, including 'emoceans' and emotional responses to the ocean, access and experience, trust, and more. While this study cannot be considered an exhaustive, whole of society, evaluation of ocean literacy in South Africa, and recognising ongoing discourse around the suitability of the concept outside of its Global North origins, the paper presented here contributes valuable insights, adding to the global evidence and understanding of ocean literacy and addressing evidence and knowledge gaps.

KEYWORDS
challenge 10, human-ocean relationships, marine education, ocean stewardship, UN ocean decade

1 Introduction

The last two decades have experienced a growing interest in the complexities of human-ocean relationships, with the global ocean community increasingly recognising the importance of integrating human dimensions into the governance of these 'peopled' seas (Claudet et al., 2020; Bennett, 2019). Central to this shift has been the rise of the concept of

ocean literacy (OL). Positioned as a mechanism for change within the UN Decade of Ocean Science for Sustainable Development (hereafter, the UN Ocean Decade), launched in January 2021, OL is now firmly embedded in ocean governance discourse, both in relation to the ten decadal challenges, and to sustainable ocean development more broadly (UNESCO-IOC, 2021).

Defined as 'having an understanding of your influence on the ocean, and the ocean's influence on you' (Cava et al., 2005), the momentum around OL research and the concept more generally has grown exponentially in recent years (McRuer et al., 2024; Shellock et al., 2024; McKinley et al., 2023). Although not a new concept and originally rooted in formal ocean education (Payne et al., 2022), OL has evolved into a framework that encompasses the complexities of human-ocean relationships across contexts and is increasingly recognised not only as a driver of individual action but also as a societal outcome (Glithero et al., 2024; McKinley et al., 2023; Paredes-Coral et al., 2021; Brennan et al., 2019; Stoll-Kleemann, 2019). This broadening reflects growing calls for a better understanding of the relationships, values and connections held by society *toward*, *with* and *for* the ocean (McKinley et al., 2020; Bennett, 2019), emphasised recently in the 2024 Barcelona Statement, following the UN Ocean Decade conference (UNESCO-IOC, 2024).

Early work on OL had a dominant focus on dimensions of knowledge, communication and responsibility. More recent work, however, has suggested that OL comprises multiple dimensions, including knowledge, communication, responsibility, behaviour, awareness, activism, attitudes, emotional connections or 'emoceans', access and experience, trust and transparency and adaptive capacity (Fauville et al., 2024; McKinley et al., 2023). These dimensions provide a flexible framework for exploring the diversity and complexity of human-ocean relationships, although OL as a concept is likely to continue evolving as its role in ocean governance continues to be reshaped. Despite its evolution and the current momentum around OL, most recently evidenced through the inclusion of OL within the Nice Declaration following the 3rd United Nations Ocean Conference in June 2025, recent reviews have illustrated geographical, methodological and conceptual gaps across the existing research landscape (Jefferson et al., 2021; Paredes-Coral et al., 2021; Shellock et al., 2024). In particular, a recent review of 298 publications by Shellock et al. (2024), found knowledge to be the most frequently explored dimension (in 21% of OL publications). This echoes earlier findings, reinforcing the historical emphasis on the dimensions of knowledge and awareness, often framed through Western conceptualisations of ocean science and knowledge (Worm et al., 2021; MacNeil et al., 2021).

Global initiatives are beginning to address these gaps, particularly through the development of effective metrics for evaluating the multifaceted and evolving concept of OL across diverse audiences and contexts. For example, since the beginning of the UN Ocean Decade, several national assessments have been conducted in the UK (Defra, 2022), Canada (McRuer and Glithero, 2025) and elsewhere, culminating in the co-development of the global Ocean and Society Survey (McRuer et al., 2025). However, despite increasing attempts to extend the geographic range of OL research, prior to this study, no national-scale assessment of OL had been carried out anywhere in Africa. Therefore, building on global initiatives and research, whilst also recognising the potential restrictions of the concept of OL in the African context (Worm et al., 2021; MacNeil et al., 2020), this paper is a first step in exploring OL in South Africa. It provides an overview of OL in the country, presents results of the first survey, and offers recommendations for future research and practice that challenge and broaden the historically Western, Global North framing of OL.

2 Ocean literacy in South Africa

South Africa has one of the largest ocean territories of mainland Africa, with an exclusive economic zone (EEZ) of 1.1 million km^2. Its EEZ supports a remarkable diversity of life and high levels of endemism, shaped by the country's unique geographic position at the southern tip of the continent, influenced by three major ocean basins - the Southern, the Indian and the Atlantic, and connected to the rest of the world by the Agulhas and Benguela Currents (Sink et al., 2019). This natural wealth underpins diverse opportunities, including fisheries, medicinal resources, precious minerals, oil and gas reserves, tourism and other facets of the Blue Economy. Yet, across Africa, the ocean represents more than biodiversity and economic value: it is also a source of spiritual rejuvenation, recreation and deep cultural connections, associated with the ocean's likely role in modern human evolution (Sink et al., 2019).

South Africa is a place of contrasts: high potential but ongoing challenges across economic, social, educational and environmental dimensions. Approximately 46% of the country's more than 62 million people live in coastal provinces (RSA, 2023I), but only about 30% live within 100km of the coast (Theron and Rossouw, 2008). Nevertheless, South Africa has one of the highest coastal population densities in Africa of about 81/km^2, compared to the average African density of 55/km^2 (Republic of South Africa (RSA), 1998; Republic of South Africa, 2023), highlighting the importance of understanding South Africans' relationship with the coast and ocean.

Connections between people and the ocean in South Africa have long predated Western approaches to raising ocean connections and education, rooted in traditional knowledge systems and spiritual practices (McGarry, 2023; Dunga et al., 2025). More recently, in 1988 National Marine Day was declared in South Africa to 'make people aware of the marine environment and the need to conserve it' (Mann-Lang, 1995). The first efforts to co-ordinate ocean education took place in 2000, with the formation of the Marine and Coastal Educators Network (MCEN) (Branch and Branch, 2018). Marine citizen science projects have played an important role in building OL (Potts et al., 2021; Mann-Lang et al., 2022), while the inclusion of Marine Sciences as a subject in the formal school curriculum in 2019 provides opportunities for enhanced OL at school (Stevens, 2021).

At the same time, increased awareness of the economic value of South Africa's ocean has been accompanied by intensifying pressures from climate change and resource exploitation. For

example, in a recent case, the threat of offshore mineral deposit surveying revealed the deep cultural connections of many indigenous South Africans to the ocean (Erwin et al., 2022), highlighting the role of cultural, traditional and spiritual knowledge systems in shaping how people act on, and with, the ocean as much as scientific and economic models. For many South Africans, the ocean is a place of tangible and/or intangible cultural heritage, expressed through traditions, oral histories, cultural practices and ceremonies, places of indigenous cultural heritage and spiritual significance (Boswell and Thornton, 2021; Strand et al., 2022; Dunga et al., 2025).

The legacies of colonialism and apartheid, however, continue to cast a long shadow on human-ocean relationships and the implications for OL discourse in South Africa cannot be overlooked (Sowman and Sunde, 2018; Erwin et al., 2022; Strand et al., 2022). By 1948, apartheid, segregation and dispossession of ocean and coastal rights were entrenched in a series of laws that governed all aspects of the relationship between people and the ocean in South Africa (Goble et al., 2014; Whittingham and McGarry, 2024). It is against this background that current OL challenges are explored.

For South Africans to benefit fully from the ocean - economically, socially, culturally, emotionally and spiritually - it is essential to view OL through multiple lenses. It is already acknowledged that many South Africans have a deep connection to the ocean (Erwin et al., 2022; Strand et al., 2022) and these connections, ways of knowing and ocean care are powerful manifestations of multiple dimensions of OL. However, not all South Africans share a deep connection to and understanding of the ocean and many remain largely unaware of the influence of the ocean on human health and wellbeing (Sink et al., 2019; Mann-Lang et al., 2021). Building inclusive approaches to OL in South Africa is therefore needed. This study offers an opportunity to pilot one methodology for better understanding human-ocean relationships in South Africa, using the lens of OL as a framework. While this paper presents an initial assessment of the currently recognised OL dimensions, it also recognises the need to embrace other methods and concepts to further build understanding and learn from existing ocean knowledge systems across the country.

3 Methods

3.1 Questionnaire design

Undertaken as part of a British Academy funded project, we designed an online questionnaire, using the UK's Ocean Literacy survey (Defra, 2022) as a starting point, with the aim of generating comparable data sets. The questions were carefully reviewed and edited as required, drawing on the expertise of South African partners to ensure all questions and response options were appropriate for the South African context. The questions underwent multiple review cycles, with the South African research team leading necessary edits and additions to the questions, as well as undertaking a pilot process to gather feedback on the questions and identify any changes needed. Minor amendments were made to the questions following the pilot process prior to final administration of the questionnaire.

Composed of four sections, the questionnaire covered a range of topics relating to the ten OL dimensions (SM 1), relationships and values between respondents and ocean and coastal environments, attitudes and concerns about the marine environment.

1. Section One explored respondents' views, concern and knowledge about the global ocean, as well as their agreement with the existing OL principles (Cava et al., 2005).
2. Section Two focused on their views, attitudes and knowledge about the ocean and marine environment around South Africa.
3. Section Three included questions about how respondents got information about the ocean, their level of trust in sources of information, ocean action, perceived impact of their lifestyle on the ocean and individual behaviours.
4. Finally, Section Four encompassed questions about the individual respondents, including gender, age, employment and education history, and engagement with maritime sectors or industries.

A full version of the final questionnaire is available in the Supplementary Material. Ethical approval for the research was obtained from Cardiff University in July 2022 (Ref E EARTH SREC 10/22MS).

The online questionnaire was distributed using Survey Monkey through the research team's professional and personal networks. A list of the networks and organisations approached is presented in SM 1. Using these networks alongside social media posts, respondents were recruited using a self-selection, convenience-based sampling approach, with criteria for inclusion (e.g. being over 18 years old and ordinarily resident in South Africa) presented at the outset of the questionnaire. The questionnaire was open from 24 July to 30 November 2022 initially and then reopened between 10 May until the end of June 2023, following an in-person workshop in Cape Town, South Africa, during which participants expressed an interest in further promoting the questionnaire link to increase the response rate.

3.2 Data analysis

3.2.1 Quantitative data analysis

As a first step, we visualised participants' responses using bar plots and stacked bar plots to explore general response distributions and highlight patterns across questions. Then, to statistically examine how demographic characteristics influenced respondents' understanding, use, experiences and perceived value of the marine environment around South Africa, we used either ordinal or logistic regression models depending on question type.

We used ordinal regressions to analyse questions where participants selected a single response from an ordered set of categories (e.g. Likert-type questions). This approach allowed us

to test how demographic moderators influenced the probability of selecting higher versus lower response categories. For multiple-response (select-all-that-apply) questions, we recoded each response option as a binary variable (1 = selected, 0 = not selected) and fitted separate logistic regression models for each. This approach enabled us to examine how respondent characteristics influenced the likelihood of selecting each specific response option, treating them as independent binary outcomes.

The respondents' demographic characteristics included in both ordinal and logistic regressions were all categorical, namely: gender (2 levels: male, female; responses from other gender identities represented ~1% of the sample and were excluded from regression analyses due to low sample size), whether the province of residence was coastal or not (2 levels: inland, coastal), age (4 levels: 18- 34, 35-54, 55-74, >75), educational attainment (3 levels: high school, graduate, postgraduate; respondents with no qualifications represented ~1.5% of the sample and were excluded from regression analysis due to low sample size), employment status (3 levels: students, not employed, employed), and whether the respondent or their family had any employment relationship with the marine environment (2 levels: yes, no).

All model assumptions were checked. For ordinal regressions, we tested the proportional odds assumption, and discarded models with a Hessian value >10,000, which is a sign of non-identifiable models. For logistic regressions, the assumptions of a binary outcome and independence of observations were met, as each model was fitted independently per response option. No multicollinearity was detected (assessed using variance inflation factors), and the linearity of the logit was not assessed as all predictors were categorical.

All analyses were conducted in R (R Development Core Team, 2024). Ordinal regressions were run using the ordinal package. All R scripts used in this analysis are publicly available at: https://github.com/jordipages-repo.

3.2.2 Qualitative data analysis

Thematic coding was carried out on the responses to the open question 'what is the first thing that comes to mind when you think of the ocean' to identify common themes and trends within the data. An emergent thematic coding approach was adopted to allow for all possible topics and themes to be highlighted in this process. Responses were reviewed thoroughly to identify an initial set of emergent themes; each response was re-reviewed to ensure the themes were all relevant and did not need to be combined into broader thematic categories. This process of content analysis highlighted a range of topics, which will be explored in more detail later in the paper.

4 Results

4.1 Respondent profile

Of the 890 respondents, we focused our analysis on those 549 individuals who completed the full survey i.e. every question was answered fully. This conservative filtering step ensured consistent data quality and provided demographic information for each participant needed to assess the influence of demographics on responses.

Respondent characteristics are summarised in Figure 1 and Table 1. Approximately 87% of the respondents lived in the most populated coastal provinces of Western Cape (46%), KwaZulu-Natal (32%) and Eastern Cape (10%), while we received no responses from the Northern Cape province, which is coastal but much less populous. The remaining 12% of respondents resided in the non-coastal provinces of Gauteng (10%), Mpumalanga (0.7%), Limpopo (0.5%), Free State (0.5%) and North-West (0.2%). In terms of gender, 63% of the respondents identified as female, 36% as male, and the remaining 1% either identified as non-binary or chose not to answer this question. Respondents represented a broad age range (18 to >75 years), with a reasonably balanced proportion of 25–40% across all age groups except the oldest group (>75 years), which was less well represented (3%). In terms of education, about 81% of respondents held a university degree or higher. Finally, most respondents (65%) reported that neither they nor their immediate family had any employment relationship with the marine sector in South Africa (Figure 1). Among those with employment links, 26% were employed in marine conservation (17%) or research (9%), with 8% employed in marine recreation and tourism. Other employment categories together made up less than 17% (Table 1). The influence of respondent characteristics on various aspects of OL dimensions is highlighted as appropriate through the results section, with a full summary presented in Supplementary Table 1.

4.2 Assessment of ocean literacy dimensions

4.2.1 Ocean knowledge

Given the prominence of the OL principles in broader OL discourse over the last two decades, respondents were asked to indicate how true they felt each of the seven OL principles was, as an initial assessment of the dimensions of knowledge and awareness. As shown in Figure 2, there were varying levels of agreement with OL principles. The highest level of agreement was observed for

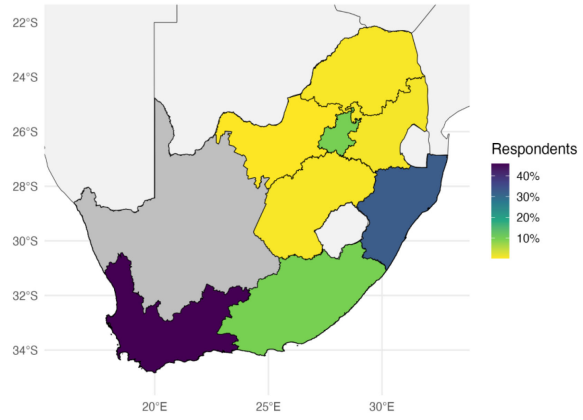

FIGURE 1
Distribution of respondents across South Africa.

TABLE 1 Demographic variables of the respondents who completed the questionnaire (n = 549).

Variable Age	Count	%	Variable Province	Count	%
18 to 34	140	25.5%	Western Cape	250	45.5%
35 to 54	221	40.3%	KwaZulu-Natal	177	32.2%
55 to 74	153	27.9%	Gauteng	54	9.8%
75+	16	2.9%	Eastern Cape	53	9.7%
Not answered	19	3.5%	Mpumalanga	4	0.7%
Education			Limpopo	3	0.5%
No qualifications	8	1.5%	Free State	3	0.5%
High school	84	15.3%	North-West	1	0.2%
Graduate	286	52.1%	Not answered	4	0.7%
Post graduate	157	28.6%			
Not answered	14	2.6%	Link to marine employment		
Gender			Yes	187	34.1%
Female	345	62.8%	No	362	65.9%
Male	196	35.7%			
Other	8	1.5%			

Principle 5 'The ocean supports a great diversity of life and ecosystems', with almost total agreement (99%). Five of the remaining principles also received relatively high levels of endorsement, though the proportion of respondents selecting "completely true" and "mostly true" varied. Principle 1 - 'The Earth has one big ocean with many features' - received the lowest level of agreement, with 55% selecting "completely true" and 23% selecting "mostly true".

Ordinal regression analyses revealed that agreement with several OL principles was significantly associated with demographic and contextual characteristics, although the strength and direction of effects varied across statements. Respondents with employment links to the marine sector showed higher odds of agreement with four out of the seven OL principles (see Supplementary Table 1). For example, they were more likely to agree that "The ocean is a major influence on weather and climate" (OR = 2.20, p = 0.003) and that "The ocean supports a great diversity of life and ecosystems" (OR = 2.46, p = 0.031). Other significant associations included higher odds of agreeing that "The ocean and humans are inextricably linked" among postgraduate respondents (OR = 4.35, $p < 0.001$). In contrast, respondents with graduate or postgraduate education were less likely to agree with the statement "The Earth has one big ocean with many features" (OR = 0.54 and 0.38, respectively). Gender and age also emerged as significant predictors. Male respondents were less likely to agree that "The ocean and life in the ocean shape the features of Earth" (OR = 0.61, p = 0.009), while older respondents (55–75 and 75+) showed significantly lower odds of agreeing that "The ocean is largely unexplored" (ORs ranging from 0.27 to 0.38).

To further explore the dimension of knowledge, respondents were asked to rate their familiarity with a series of ocean-related terms. Again, as with the OL principles, there was clear variation in the responses (see Figure 2). Overall, however, respondents considered themselves to have a moderate to high level of knowledge for most of the terms, including some of the more technical ones, such as ecosystem services or nature-based solutions. Climate change was the most well-known and understood term with 98% of respondents indicating they had at least heard of and had some understanding of the term; followed closely by biodiversity, sustainable fishing and sustainable development all of which had over 90% of respondents indicating moderate to high levels of knowledge and understanding. While the total number of people indicating some level of familiarity with Marine Protected Areas was high (93%), only 63% indicated that they knew the term and understood its meaning. The terms with the lowest levels of familiarity and knowledge, i.e. those that respondents had never heard of (illustrated by the pale green bars in Figure 2B), included blue carbon (38%), eutrophication (33%), marine citizenship (27%), carbon sequestration (25%), ocean acidification (18%) and ocean literacy (15%).

Ordinal regression analyses revealed that higher educational attainment (mainly postgraduate level) and employment ties to the marine sector were consistently associated with significantly higher odds of knowing and understanding all of these terms (except climate change and nature-based solutions). For example, odds of understanding carbon sequestration and eutrophication were over twice as high for those connected to the marine sector (OR = 2.02, $p < 0.001$ and OR = 2.64, $p < 0.001$ respectively, Supplementary Table 1). Male respondents had higher odds of reporting understanding of eutrophication and ocean acidification, while respondents aged 35–54 and 55–74 showed lower odds of familiarity with climate change, eutrophication, biodiversity, ocean acidification, and ecosystem services, compared to the youngest age group.

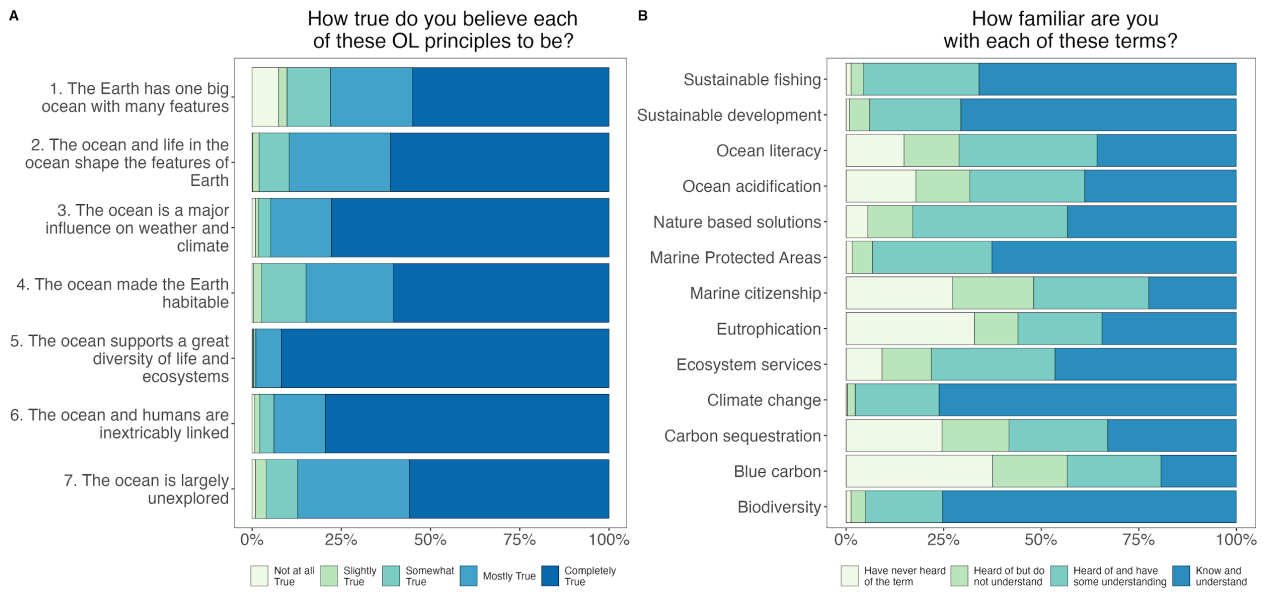

FIGURE 2
Respondent levels of ocean knowledge represented by familiarity with the ocean literacy principles (left panel - **A**) and familiarity with key ocean terms (right panel - **B**).

4.2.2 Ocean awareness

Overall, 44% of respondents indicated that they thought the health of the marine environment in South Africa was either poor or very poor, with 30% perceiving it to be good or very good (Figure 3A). Over a quarter indicated some form of uncertainty, either selecting a neutral answer (24%) or stating that they didn't know (3%). Postgraduates showed higher odds of rating the health of the marine environment around South Africa as good or very good, although this effect was marginally significant (OR = 1.67, p = 0.058).

The majority (65%) of respondents indicated they had a high level of awareness (i.e. good or very good) about the challenges facing the global marine environment (Figure 3B). Less than 15% indicated their awareness to be poor. Respondents with an employment relationship with the marine sector had higher odds of assigning high ratings to their level of awareness, while the reverse was true for inland respondents.

Overall concern for the marine environment and its conservation was very high, with almost every respondent indicating it was either important or very important to them personally (98% in total). Further analysis showed that responses to this question were moderated by employment status and distance to the coast, with the odds of considering marine protection as important being lower for students, but higher for people living in provinces nearer to the coast.

In order to understand respondent awareness of the everyday role of the ocean and their perceptions of the benefits from the marine environment, respondents were asked to indicate which benefits they considered to be the most important to South Africa society. Respondents indicated the most important benefit to be provision of diverse habitats for marine biodiversity (49%) (Figure 3C), which also reflects the respondent level of agreement with the ocean literacy principles (Figure 1A). The next most frequently selected benefits were food (45%), oxygen production and carbon storage (34%), weather and climate control (28%). While varying levels of importance for other benefits are also summarised in Figure 3, it is worth noting that three out of four least frequently selected benefits are linked to different cultural uses, including traditional medicine, a sense of identity, and sites for baptism, all selected by 1% of respondents, although tourism and a place that provides spiritual upliftment was selected by a higher percentage of respondents, 25% and 9% respectively.

Logistic regressions revealed key demographic differences in how marine benefits were perceived, with gender, age, and education emerging as the most consistent moderators (Supplementary Table 1). Compared to women, men were more likely to identify food provision and recreation as key benefits, but significantly less likely to recognise the ocean's role in supporting mental health and wellbeing, contributing to research and education, or providing habitat for biodiversity. Older respondents (aged 55–74 and 75+) were more likely to select benefits related to biodiversity, weather and climate regulation, and natural forms of coastal protection.

In terms of awareness of perceived threats and challenges to the marine environment in South Africa, analysis found marine litter and plastic pollution to be selected as the most important threat by respondents (73%), followed closely by overfishing (72%) (Figure 3D). It is worth noting that lack of public understanding about the marine environment was selected by 59% of respondents, with concerns about a lack of political will (50%) and poor management (51%) also highlighted. Aspects relating to climate change and biodiversity loss (i.e. loss of marine species) were lower in the list of priorities, selected by 48% and 43% respectively.

Logistic regression models revealed that demographic characteristics significantly shaped perceptions of threats to the

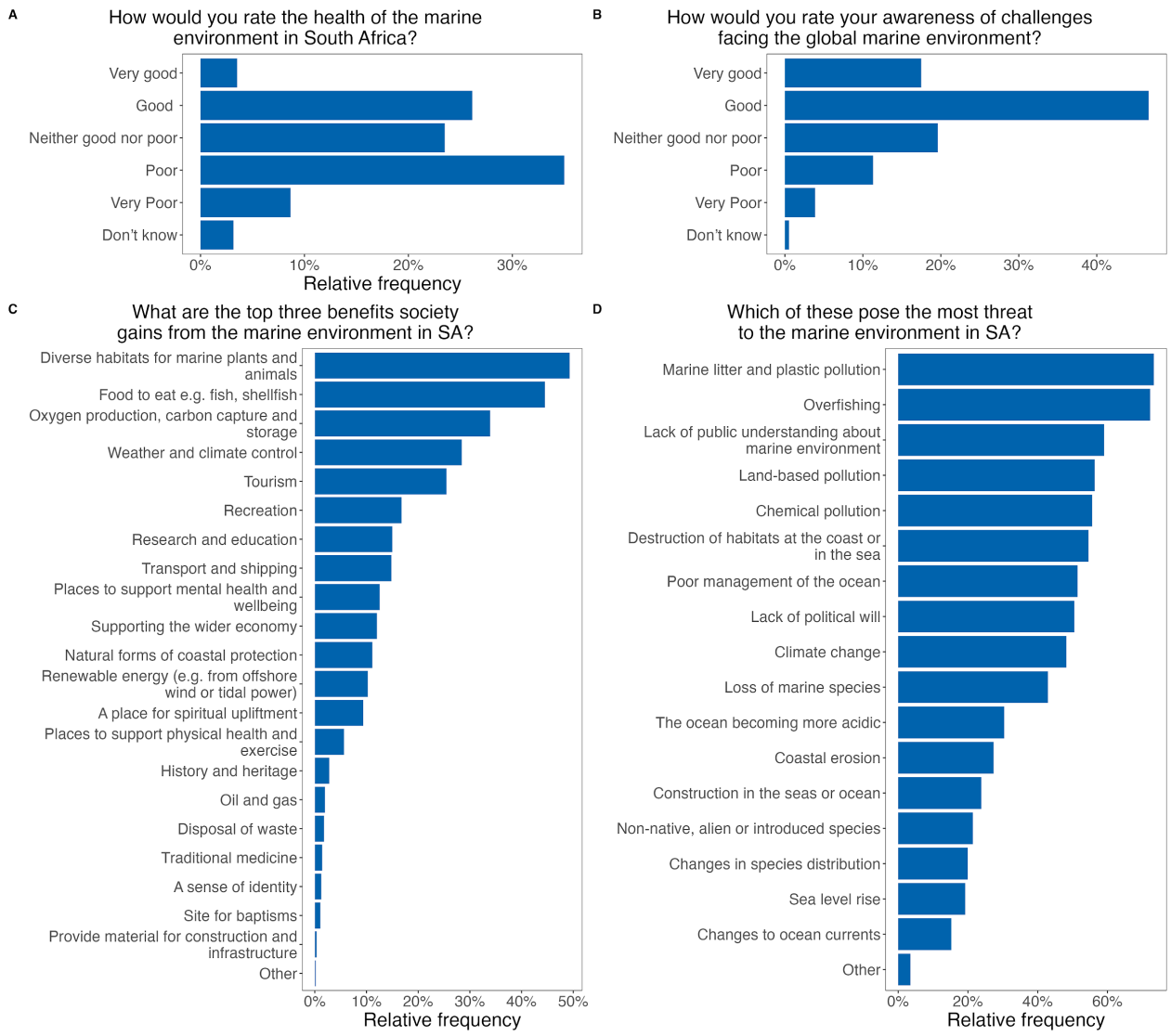

FIGURE 3
Ocean awareness perceptions. **(A)** Respondent perceptions of the health of South Africa's marine environment, **(B)** Respondent perceptions of the health of global marine environment, **(C)** Respondents' views on the most important benefits obtained from society from the marine environment, **(D)** Respondent awareness of challenges facing the global marine environment.

marine environment (Supplementary Table 1). Postgraduates were more likely to recognise scientific issues such as ocean acidification, habitat destruction, species loss or invasives, while unemployed were less likely to identify changes to ocean currents, coastal erosion and sea level rise as threats. Respondents with marine-related employment experience were more likely to identify changing ocean currents and poor management as a threat. Gender differences also emerged: men were less likely than women to perceive coastal and marine habitat destruction as a major threat.

When specifically asked about their views on climate change, 49% of respondents were of the view that climate change is driven by human activity, while 46% agreed that climate change is caused by a combination of both human activity and other natural processes (See Supplementary Figure 1). Furthermore, when asked about several statements about climate change, 89% respondents considered that climate action was urgently needed as true or mostly true, 73% considered true or mostly true that nature can help reduce climate change impacts, while only 23% considered true or mostly true that climate change is not the greatest threat to our natural world.

Ordinal regression models showed that these views were moderated by some demographic variables. Respondents with postgraduate education and those currently studying were less likely to agree with the statement that climate change is not the greatest threat to our natural world. Postgraduates also had higher odds of agreeing that climate action is urgently needed. In addition, respondents with employment ties to the marine sector were more likely to agree that nature can help to reduce climate change impacts, while unemployed respondents had lower odds of agreeing with this statement.

4.2.3 Emoceans and ocean connections

In an initial attempt to explore connection, an open question asked respondents to indicate the first word that comes to mind when they think of the ocean to provide insight into emotional responses and overall emoceans (McKinley et al., 2023), when considering the ocean (summarised in Figure 4).

While the thematic coding process allowed for the identification of key themes emerging from the data, it is interesting to note that several responses covered multiple themes, illustrating the multi-faceted and layered relationships held by respondents towards the ocean. Table 2 presents an overview of the top 10 key themes highlighted through the content analysis process, including examples of how these were referred to by respondents.

Emotional connections were further explored through questions which asked respondents to select the first three emotions that came to mind when they thought of the marine environment (Figure 5). Four of the five most frequently selected emotions that the ocean transmits to respondents were positive, while 7 of the 10 least chosen emotions were negative ones, highlighting a positive view of respondents towards the ocean. Specifically, the most frequently selected emotion was awe/wonder, a positive emotion chosen by 51% of respondents. Reflecting the concern indicated in other questions, concern, as a negative emotion, was the second most frequently selected option (39%) followed closely by curiosity and calm/relaxed (both selected by 34%). The emotions of happiness and excitement were positive until the 7th in the list, anxiety, with 15% respondents choosing it. Shame (6%), hopelessness (5%) and surprise (2%) were among the least frequently selected emotional responses. Other emotions highlighted by respondents in the open 'other' box also included gratitude, disappointment, fear of the deep ocean, but also a recognition of the complexity of human-ocean relationships with some stating that they experience '*mixed emotions excited, worried about the future of our planet and encouraged*', while others expressed concern and anger about ocean issues, with one stating "*I feel an unmitigated rage that the exquisite marine life and the coral reefs will be harmed or destroyed by oil and gas extraction and exploration. I think the ocean holds the key to the preservation of all life on the planet at this precarious juncture of the threat of global warming.*".

Logistic regression models revealed that several emotional responses to the ocean were significantly associated with demographic characteristics (Supplementary Table 1). Respondents aged 55–74 had higher odds of selecting "anxiety" and "awe/wonder", but lower odds of selecting "curiosity" and "inspired". Inland residents were more likely than coastal residents to report feeling "calm/relaxed" when thinking about the ocean. Educational level and employment status also showed associations: graduates were less likely to report "calm/relaxed", and students showed higher odds of selecting "curiosity" and lower odds of selecting "inspired". In terms of gender differences, male respondents were more likely than female respondents to select "excitement" and "frustration", and less likely to select "inspired".

4.2.4 Ocean access and experience

When asked about how they access and experience the marine environment, most respondents stated they had visited the marine environment in the previous 12 months (87%) (Figure 6A). More specifically, when asked about the places people tend to visit, analysis found coastal or seaside towns to be more commonly visited daily (29%), followed by sandy beaches (4%) and estuaries (4%). Overall, coastal towns, rocky shores and sandy beaches were the types of marine environments visited most frequently. However, respondent characteristics influenced the frequency of visits to the different marine environments. Respondents living in inland provinces had significantly lower odds of frequently visiting all types of marine environments. In contrast, respondents who were not employed had higher odds of visiting sandy beaches, rocky

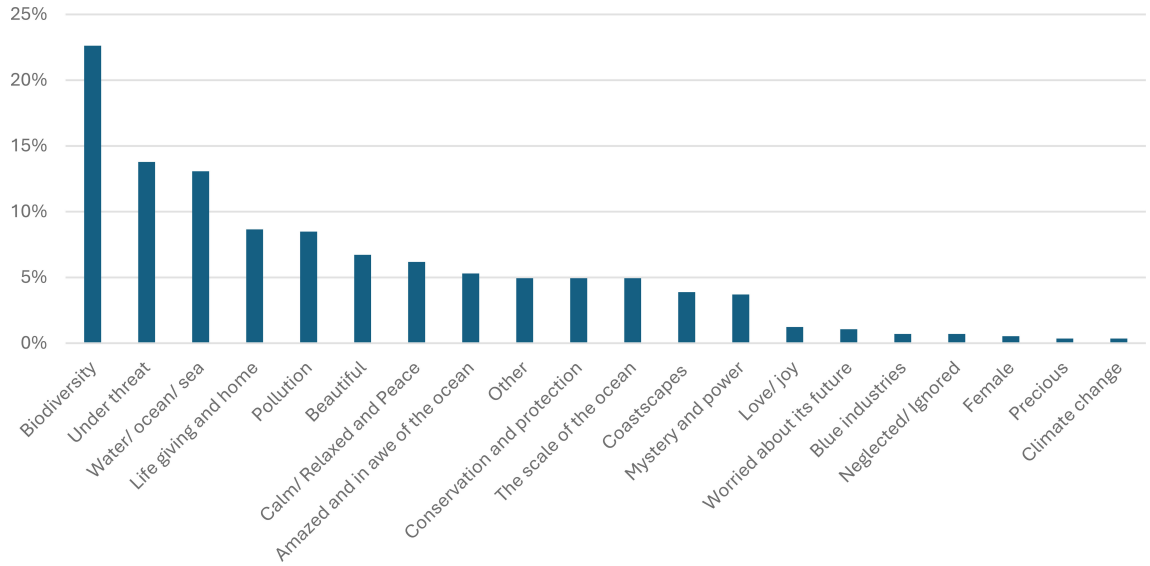

FIGURE 4
Thematic analysis of respondents' first words about the marine environment.

TABLE 2 Examples of themes highlighted by respondents when asked what first comes to mind when they think of the marine environment.

Theme	% of mentions	Illustrative quotes
Biodiversity	23%	*"Biodiversity, Mysterious, Lots more to discover, Spirituality, Rich in Resources, Sustainability, Beautiful, Mental Health Benefits"* *"Full of colourful life"* *"Beautiful biodiverse ecosystem"*
Under threat	14%	*"Wonderful but under threat"* *"Diverse, threatened, unknown"* *"Needs to be protected and we need to see consequences for those who harm the marine environment. Evident consequences reported to the public."*
Water/ocean/sea	13%	*"Vast amounts of water and interesting sea animals"* *"Horizons that extend into the indigo blue oceans"*
Life giving and home	9%	*"Home"* *"Our life blood"* *"My past, present and future"*
Pollution	8%	*"Pollution and overfishing"* *"Plastic filling our oceans"* *"Littered with plastic pollution, over fished, under researched"*
Beautiful	7%	*"Wonder and beauty"* *"Beautiful and captivating"*
Calm/Relaxed and Peace	6%	*"Peace and tranquillity"* *"A place of calm and contemplation"*
Amazed and in awe of the ocean	5%	*"Life-giving, amazing"* *"Special, vulnerable"* *"Fascinating, in awe"*
Other	5%	*"Constant movement and change"* *"Blue breakers breaking on the sunny sands and the sounds connected to it all including sea gulls with it"*
Conservation and protection	5%	*"We need to do more to protect the marine environment"* *"Conservation and Saving our Fishes and marine life"*

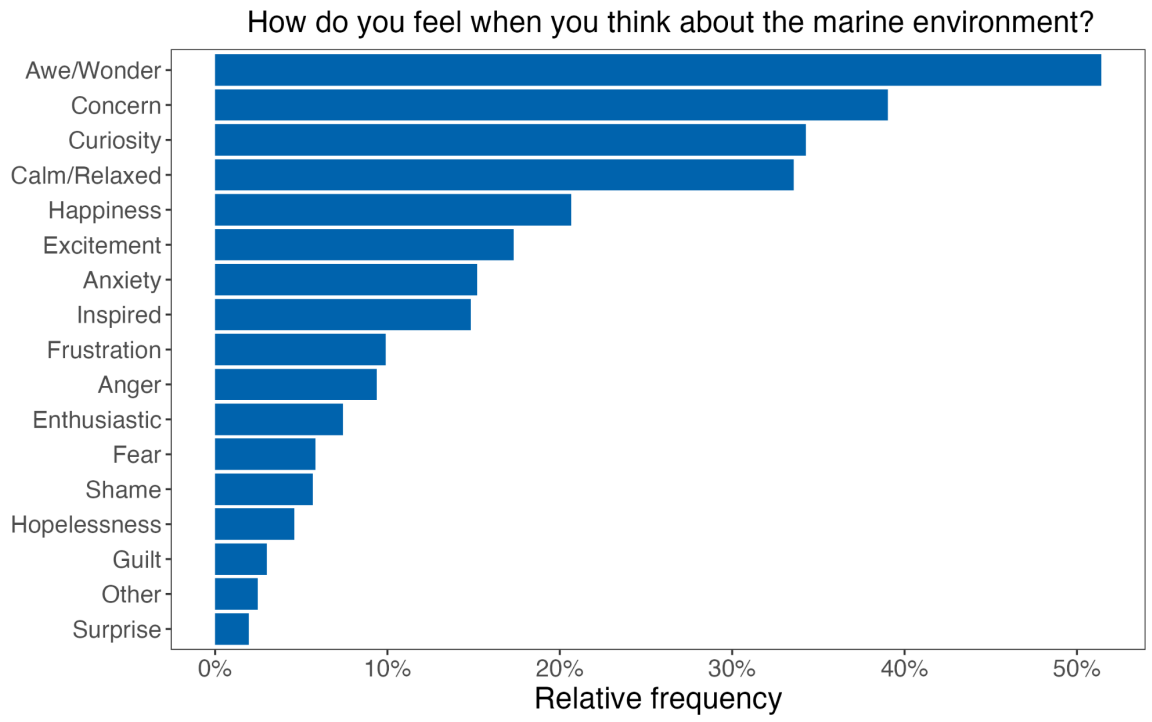

FIGURE 5
Respondents' emotional response when asked to think about the marine environment.

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shores, estuaries and coastal/seaside towns than employed ones. Males had higher odds of visiting the open sea more frequently, while older age groups were less likely to visit the open sea frequently. Respondents with ties to the marine sector were more likely to frequently visit Marine Protected Areas (see Supplementary Table 1).

When asked what sort of recreational activities they participate in, the most frequently selected options included sea swimming (52%), walking with/without a dog (78%), beach cleaning (43%), and wildlife/bird watching (42%). As shown in Figures 6B, there was clearly a broad spread of activities being carried out by respondents. Participation in specific marine recreational and cultural activities varied significantly with demographic and contextual characteristics (Supplementary Table 1). Older age groups showed strong negative associations with scuba diving, hiking, beach cleaning and marine-themed attractions. Living inland, as opposed to coastal areas, was negatively associated with most marine activities, including beach cleaning, walking with a dog, rock pooling, sea swimming, and running near the coast. High levels of education were associated with higher odds of selecting snorkelling, running, walking with or without a dog, and hiking. Male respondents had substantially higher odds of reporting sea fishing, surfing/body boarding, and scuba diving, and were less likely to report beach cleaning or wildlife watching. Finally, respondents with a personal or family employment link to the marine sector were more likely to select scuba diving, snorkelling, and photography/videography at the coast.

In addition to understanding how people use the marine environment in South Africa, questions were also posed to respondents to assess the barriers to access experienced (Figure 6C). For just under 25%, no barriers were experienced over the previous 12 months (indicated by those who selected Not applicable); however, it is important to note that barriers to access and experience were noted by most respondents (see Figure 6C). The most frequently noted barrier was being too busy at work (20%) and living too far away from accessible marine spaces (18%). Cost was recognised by 15% of respondents as a barrier to their ability to access these places. Several demographic and contextual factors

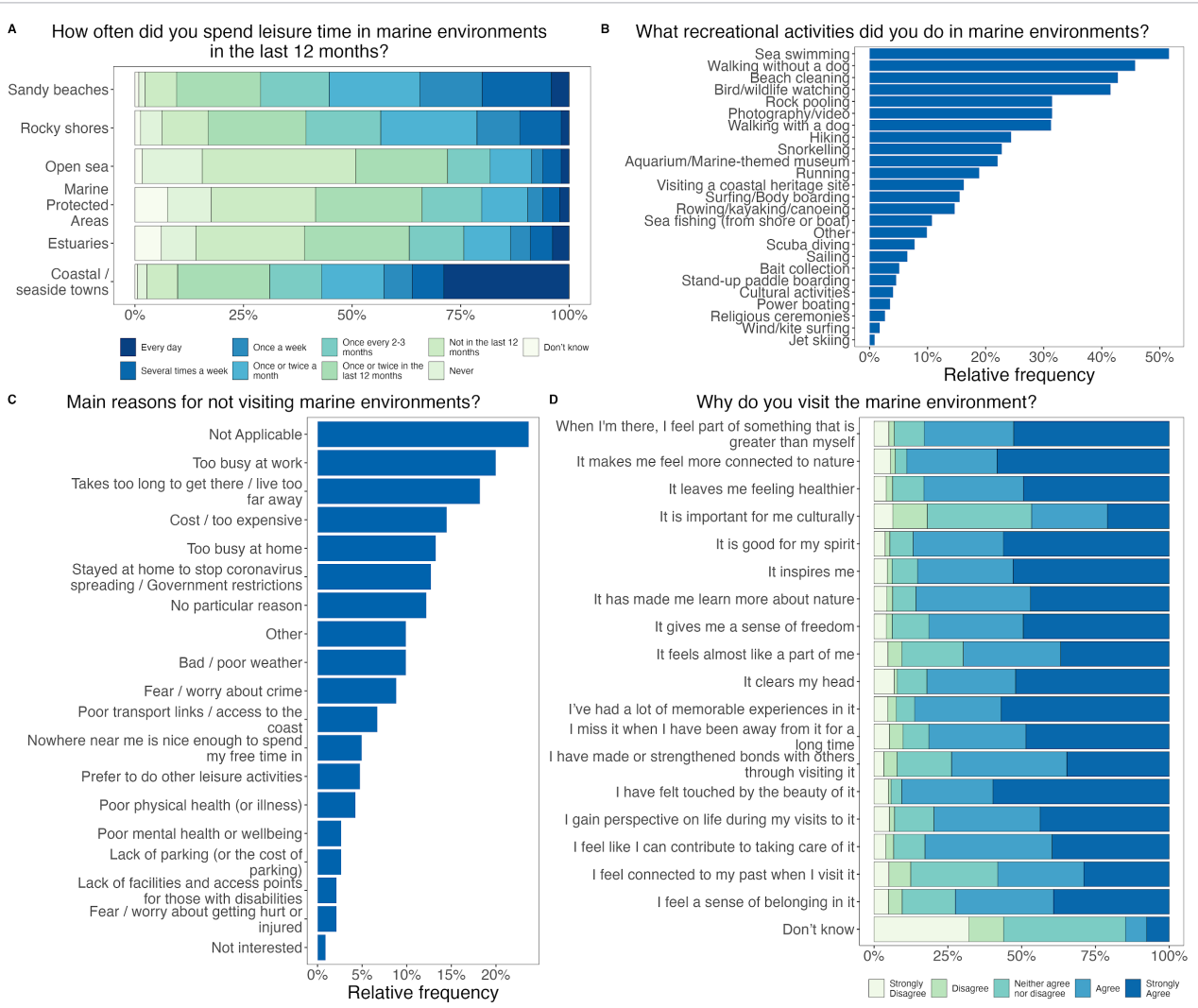

FIGURE 6
(A) Respondents' access and experiences of different types of marine environments in South Africa, **(B)** Summary of the activities that respondents participate in when visiting the marine environment, **(C)** Barriers and reasons for respondents not visiting marine and coastal locations, **(D)** Respondents level of agreement towards reasons for visiting the marine environment in South Africa.

were associated with barriers to visiting the marine environment, according to logistic regressions (Supplementary Table 1). Inland respondents had significantly higher odds of citing distance-related barriers, including "takes too long to get there/live too far away" and "cost/too expensive". Age was also associated with certain constraints: respondents aged 35–54 were less likely to report being "too busy at work" or concerned about crime, and those aged 55–74 were less likely to cite "bad/poor weather" as a barrier. Respondents who were not employed were less likely to report being "too busy at work". Finally, those with a connection to the marine sector were less likely to cite distance ("takes too long to get there/live too far away") as a barrier.

Reasons for visiting the marine environment were found to be varied (Figure 6D). Overall, the vast majority of respondents agreed or strongly agreed with all the reasons to visit the marine environment, except for the ocean being important for them culturally (with < 50% of agreement). The most agreed upon reasons for visiting the ocean were its beauty, feeling connected to nature, having had memorable experiences there, and several reasons related to the ocean improving respondents' wellbeing, such as visiting the marine environment being good for their spirit, clearing their head, feeling healthier, freer, among others.

Interestingly, the most frequent respondent characteristic moderating the agreement to the reasons for visiting the marine environment, was education attainment, followed by gender, age, and having an employment relationship with the marine sector in South Africa (See Supplementary Table 1). Specifically, respondents with higher qualifications (i.e. graduates and postgraduates) had higher odds of agreeing with several statements, mostly related to the wellbeing benefits of visiting the ocean. In addition, being a male decreased the odds of agreeing with several of the reasons for visiting the ocean, such as most of the statements related to the wellbeing and psychological restoration benefits of visiting the ocean, as well as those related to nature connection, feeling part of something greater than themselves, several linked to memories, and other deep feelings in general. Finally, having an employment relationship with the marine environment increased the odds of agreeing with statements related to past experiences in the ocean and feeling they can contribute to improving the marine environment. Contrary to expectation, respondents from inland provinces had higher odds of agreeing with a feeling they can contribute to taking care of the marine environment.

4.2.5 Ocean communication

Communication has long been recognised as a central tenet of ocean literacy, and remains one of the 10 dimensions proposed by McKinley et al., 2023. When asked where they get information about the marine environment from (Figure 7A), the most frequently selected option was films and nature/wildlife documentaries (49%), followed closely by social media (39%), and then different forms of news materials (33%). Public events and places were also selected by a number (e.g. 28% of respondents selected aquariums/zoos and visitor centres). Despite OL emerging from formal education, only 19% of respondents indicated that this is where they got their information, while government agencies were among the least frequently selected (4%).

The logistic regressions identified strong demographic differences in the perceived sources of information about the marine environment. Education level had the most consistent influence: postgraduates were more likely to cite formal sources like scientists, seminars, and news, but less likely to cite social media, television, documentaries or community events as their source of information. Older respondents were less likely to report formal education and social media, instead favouring traditional sources such as TV and print media. Respondents with coastal ties were more likely to use institutional sources, including scientists and government agencies. Gender differences also emerged, with males more likely to cite scientists and government agencies, and less likely to report aquariums and museums.

In terms of the sources of information most trusted by respondents, it is interesting to note that these sources differed from those most frequently used (See Figure 7B). Scientists were

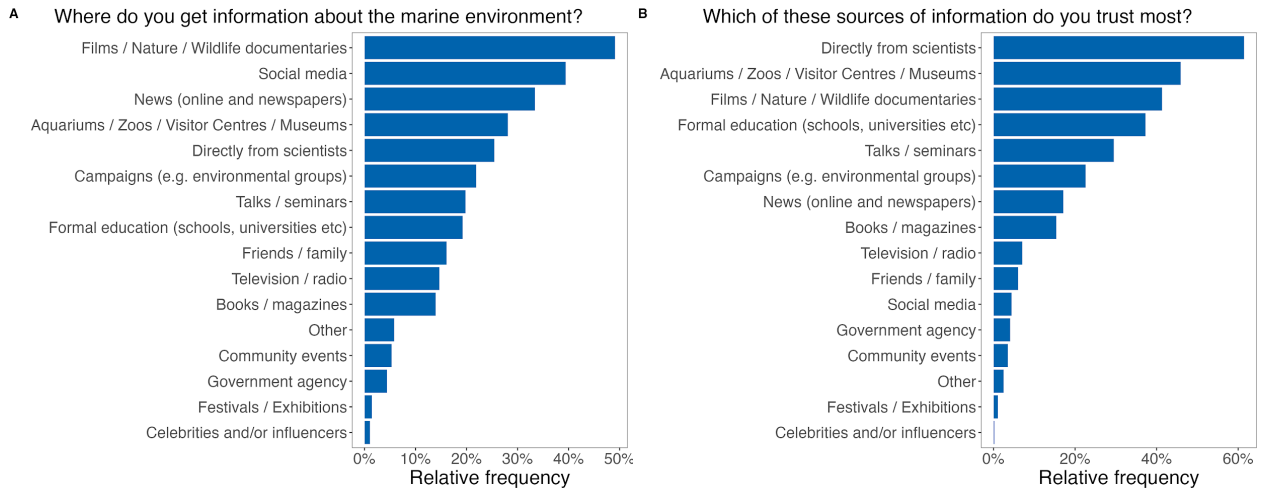

FIGURE 7
(A) Summary of where respondents get information about the marine environment. **(B)** Level of trust of sources of information expressed by respondents.

found to be most trusted by respondents (62%), followed by aquariums/zoos/museums (46%) and then films and wildlife/Nature documentaries (41%). Despite being the second most common source of information, social media was only selected by 4% as being among their most trusted sources. It is also of note that government agencies were chosen by only 4% of respondents. Respondents' education, age, and connection through employment shaped their trust towards the information sources used (Supplementary Table 1). Specifically, postgraduates showed strong preference for formal sources such as scientists, seminars, and education institutions, while being less trusting of informal sources like TV/radio, or nature documentaries. Trust in formal education declined significantly with age, while older respondents increasingly favoured campaigns and books/magazines. Those with coastal ties showed greater trust in seminars and scientists, but less in TV/radio, news and books/magazines.

4.2.6 Ocean behaviours and activism

With a growing focus on how ocean literacy can lead to improved behaviour change and action, respondents were asked to indicate how much impact they think their lifestyle has on the marine environment. Interestingly, 59% of respondents indicated that they thought they had a positive impact on the marine environment, 26% indicated a negative impact and only 15% felt that they had no impact at all. While it is not possible to ascertain what kind of impacts respondents were referring to when they indicated that they had a positive impact, the number respondents indicating no impact at all indicates lower levels of awareness and understanding of the interconnections and impacts between society and the ocean on an everyday level than would be hoped for. Among respondent characteristics, education was the only significant moderator of self-attributed impact on the marine environment. Specifically, respondents with postgraduate education had lower odds of perceiving their lifestyle as having a positive impact on the marine environment, compared to those with lower levels of education.

In order to understand the behaviours and actions that people already undertake, a series of questions were posed to respondents to explore this dimension of ocean literacy. The majority of respondents were found to have already made changes to their lifestyle to benefit the marine environment (59%) (Figure 8A). Of those who reported that they had already made changes, the most commonly undertaken activities included signing petitions about marine issues (53%), volunteering time to participate in beach clean-ups and other activities (52%) and trying to encourage others to do more to protect the marine environment (44%). The less common activities included attending protests or demonstrations, with 10% indicating that this was something they had done, while 12% indicated they had donated money.

Participation in marine-related activism varied significantly across demographic groups (SM Excel). Respondents aged 35–54 and 55–74 were consistently less likely than younger respondents to report engaging in behaviours such as persuading others, posting marine content online, participating in citizen science, or joining environmental organisations. Inland residents were significantly less likely to volunteer time (e.g. beach clean-ups) compared to coastal residents. In contrast, those with a personal or family connection to the marine sector showed markedly higher odds of engaging in a wide range of pro-environmental actions, including volunteering, citizen science, posting content, and persuading others, and were less likely to report doing "none of the above". Postgraduate respondents were more likely to participate in science and research projects, and students were more likely to report doing "none of the above". Gender also played a role: male respondents were more likely to report participation in citizen science, but less likely to report signing petitions or making lifestyle changes to benefit the marine environment.

With individual purchasing behaviour commonly identified as a mechanism for expressing ocean literacy and marine citizenship (Nuojua et al., 2024; Garcia-Vazquez et al., 2022), questions were included which sought to explore patterns in purchasing behaviour among respondents. As shown in Figures 8B, the majority of respondents had made some changes to their purchasing and consumption behaviours, with reduction in use of single use plastic (85%), re-using plastic (74%), increased recycling (69%) and reduced use of disposable products, such as plates or cutlery (62%) commonly noted, although it is worth noting that every option was selected by at least 40% of respondents.

Logistic regressions showed that males were less likely to report 5 out of 7 of pro-environmental behaviours than women (Supplementary Table 1). In contrast, postgraduates were more likely to report having recycled more, reduced single use plastics and avoided excessive packaging in the last 12 months compared to those with lower education levels. Relating to this, there were also some questions posed relating to respondents' views on ocean governance and management in South Africa, relating to the dimensions of activism and ideas of where responsibility for management lies. When asked their views on the most important activities addressing issues facing South Africa's marine environment, tightening controls over commercial activities, such as oil/gas exploration was identified most frequently by respondents (56%). This was closely followed by tightening controls to reduce pollution from industry/agriculture (47%), restricting and regulating fisheries activities (47%) and expansion of Marine Protected Areas (36%) (Figure 8C). Building human-ocean relationships and supporting more people to engage with the ocean was also highlighted by 30%. Support for specific marine conservation actions varied across demographic groups (Supplementary Table 1). Male respondents showed higher odds of supporting restrictions on fisheries and commitments to safeguard habitats but were less likely to support expanding ocean engagement through education. Respondents with employment links to the marine sector had higher odds of supporting restrictions on fisheries and behavioural change to reduce marine pollution. Respondents aged 55–74 were less likely than younger groups to support increased protection through Marine Protected Areas.

In terms of the actions that the South African government should prioritise for the marine environment (Figure 8D), respondents most frequently selected better enforcement of existing regulations (61%), designation and implementation of

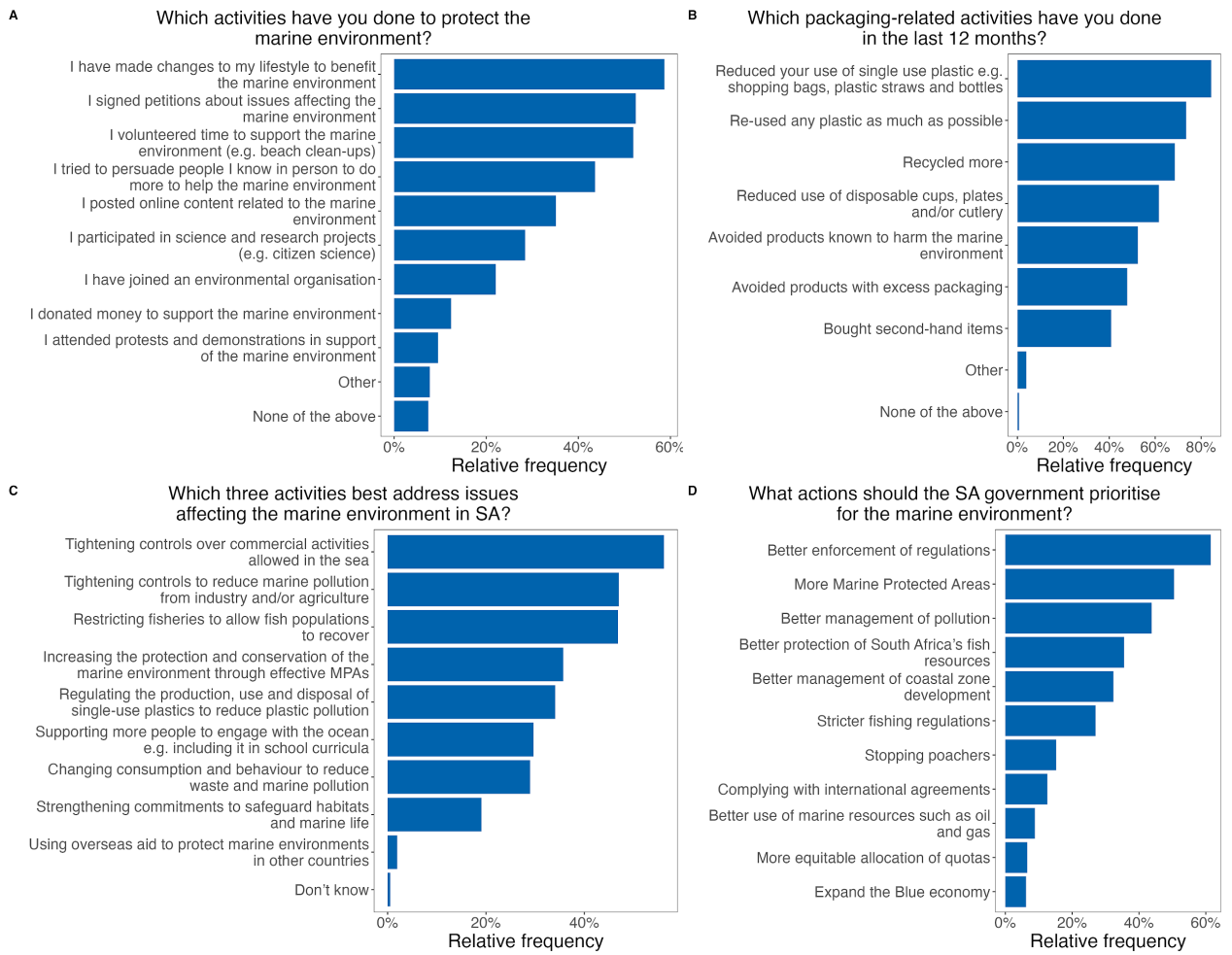

FIGURE 8
Ocean behaviours and activism **(A)** Summary of respondent activities to benefit the marine environment **(B)** Summary of respondents' purchasing behaviour relating to the marine environment. **(C)** Respondents' views on the most important activities addressing issues facing the marine environment. **(D)** Respondent views on priority actions that should be taken by the South African government to support marine management.

more MPAs (50%), and more effective management of marine pollution (44%). Of lower priority to respondents were items relating to blue economy sectors, including better use of oil and gas resources (9%), more equitable allocation of quotas (7%), and, of least importance, overall expansion of the blue economy (6%). Support for specific government actions to manage the marine environment differed by age, education, and connection to the marine sector (Supplementary Table 1). Respondents aged 35–54 were less likely to support the creation of more Marine Protected Areas, while those aged 55–74 were less likely to support stricter fishing regulations, but more likely to support better protection of South Africa's fish resources. Postgraduate respondents showed lower odds of supporting stricter fishing regulations, and respondents with a personal or family link to the marine sector were less likely to select better management of pollution.

Finally, in relation to the statement above regarding designation of more MPAs, and with protecting marine areas high on the broader conservation and management agenda, respondents were asked to indicate their level of support for the creation of MPAs in South Africa. Analysis found there to be almost complete support (97%). Among respondent characteristics, type of employment was the only significant moderator of this question, with students having lower odds of strongly supporting MPAs in South Africa, compared to unemployed or employed respondents.

5 Discussion

'Restoring society's relationship with the ocean' is the overarching goal of the UN Ocean Decade, and a better understanding of the current state of OL across the world is a key requirement. This study provides the first overview of OL in South Africa, offering a valuable foundation for both a national research agenda and an Ocean Literacy Strategy. Measuring OL across the spectrum of dimensions and in different global contexts has been repeatedly identified as a key priority in OL research, most recently highlighted by McRuer et al. (2024). This paper, therefore, directly contributes to the global OL research and evidence base, filling both a topical (i.e. exploring multiple dimensions of OL) and a

geographical gap. However, given the diversity of South African communities, and coastal concentration of respondents and the high proportion with university education represented within this study, these findings should be interpreted as indicative rather than representative of South Africa's population.

Understanding public perceptions and understanding of the pressures and threats facing the ocean is increasingly recognised as one of the foundational steps in identifying workable solutions (Jefferson et al., 2021). Through the dimensions of knowledge, awareness and attitudes, valuable insights can be gathered to build an understanding of ocean knowledges and perceptions across South Africa. In this study, self-reported knowledge of key ocean terms was found to be quite high across the terms, although this did vary and may reflect the coverage of certain topics within South African media (e.g. climate change) (Mokoena and Nkosi, 2024). Education was found to be a direct moderator of this element of ocean knowledge, suggesting that while OL has begun, and indeed must continue, to embrace and champion diverse ways of knowing the ocean, inclusive of traditional and Indigenous knowledges, for some audiences, more formal education pathways remain a crucial mechanism for enhancing ocean connection and OL (Francolini et al., 2023). The inclusion of Marine Sciences as a subject in the formal school curriculum in South Africa was thus a significant step forward in supporting access to ocean knowledge (Stevens, 2021). Although uptake of the subject in schools has been slow, primarily because of a lack of skilled teachers, the subject is currently offered to Grade 10–12 learners in over 20 schools. Thinking more broadly, there are opportunities to ensure that future OL initiatives in South Africa are designed in ways that are sensitive to and inclusive of the rich diversity of lived experiences, traditional stories and ways of experiencing the ocean, that are part of South Africa's longstanding heritage and connection with the ocean. Examples of these include the use of Empatheatre, animation, traditional storytelling, art, photography and co-creative community activities amongst others (Erwin et al., 2022; Strand et al., 2022; Martin, 2024a; McGarry et al., 2024; McGarry, 2023). More generally, it is of note that the majority of respondents (44%) were of the view that South Africa's marine environment is not healthy, while self-reported awareness of threats facing the global ocean was considered to be high, with those with either a direct or indirect link to marine employment reporting higher levels and those from inland provinces citing lower levels of awareness. Although these findings are perhaps not unexpected, they provide useful insights that can be used to develop targeted campaigns for communities in different contexts across South Africa.

Mirroring the findings of other national OL assessments, plastic pollution/litter (73%) and overfishing (72%) emerged as co-leading threats. While the impact of plastics, both micro and macro across the entirety of the natural world should not be underestimated, numerous studies have suggested that dominance of this in the public psyche is a concern and risks undermining the threat of other issues, such as the impacts of the dual biodiversity and climate crises (selected as threats by a comparatively lower 43% and 48% of respondents, respectively (Stafford and Jones, 2019, but see Waters et al., 2023). As in other studies, such as in the UK (Defra, 2022), this finding suggests a real need for improved communication of ocean science and issues to a broader audience in an effort to raise awareness of the other, perhaps less visible, issues facing the global ocean – and crucially, to highlight the actions that can be taken to address them. It is perhaps reassuring to see that, in this study of South African respondents, the risks associated with a lack of public understanding, limited political will and the consequences of poor management were all highlighted by over 50% of respondents. This highlights an appetite for change. However, for this change to be realised, more voices, viewpoints and people power need to be brought together.

5.1 Insights into ocean connections

With emotional connections increasingly viewed as being a significant motivator in pro-environmental behaviour, understanding the role of 'emoceans' in the context of OL is a rapidly emerging area of research (Nuojua et al., 2024; McKinley et al., 2023). Here, we found that in contrast to other recent national studies where concern was the most frequently selected emotion, more than half of the respondents in South Africa most commonly selected Awe/wonder as their emotional response when they thought of the ocean. While concern was the second most frequently selected emotion, it was by a much lower number than seen in other studies – for example, concern was selected by 45% and 48% in England and Wales respectively (Defra, 2022). Moreover, further analysis showed that there were differences in how different groups of people were likely to respond emotionally to the ocean, as also noted by Engel et al. (2021). Further, O'Halloran (2025) noted the top emotions that motivated environmental action amongst respondents in the USA were positive emotions such as aesthetic appreciation, happiness, awe and gratitude. The positive emotions noted in this study thus provide a good starting point to motivate more environmental action.

In terms of the dimension of access and experience, overall, respondents in this study indicated high levels of visitation and spending time in marine and coastal areas during the previous year, participating in a wide range of activities. The frequency of visits was directly influenced by proximity to the coast, and living further inland was found to be negatively associated with participating in marine activities. While these findings are not surprising, it is perhaps interesting to note that despite indicating lower levels of access and experience, inland residents were found to be more likely to choose feeling calm and relaxed as their emotional response when thinking about the ocean. The power of the ocean, and of ocean connectedness, therefore, must not be constrained in our minds to being only relevant to coastal communities and coastal places – the ocean is far reaching and the relationship between distance, proximity, frequency of experience and connection should not be seen as linear. In addition, this study found suggestions that accessing ocean spaces may be related to emotional connection, with the majority agreeing that they visit the ocean to foster nature connectedness (Strand et al., 2022; Mehta et al., 2023), to improve health and wellbeing (as highlighted in other studies, such as O'Halloran and Silver, 2022), having memorable experiences or, quite simply, the beauty of the ocean. Agreement with wellbeing-related reasons for visiting the ocean was strongest among higher-

educated respondents, whereas men were consistently less likely to endorse wellbeing and nature-connection statements— pointing to the need for tailored framings. Due to the data types, it was not possible to critically analyse the potential relationship between these OL dimensions; however, as the field of OL research continues to develop, there is an opportunity to further explore how each of the OL dimensions interacts with and influences the others (O'Halloran, 2025; Shellock et al., 2024; McRuer et al., 2025).

In addition to understanding how people access the ocean and why, this dimension of OL is increasingly interested in better recognising the barriers to ocean access, recognising existing inequities in terms of who can access and benefit from ocean spaces (Strand et al., 2022). In this study, the most frequent barriers were work/time constraints (20%), living too far from accessible marine spaces (18%), and cost (15%); inland residents were, as expected, more likely to cite distance and cost. While it was not picked up in this study, issues around safety in accessing ocean spaces in South Africa are an important consideration (Mann and Mann-Lang, 2020).

5.2 Active and operational ocean literacy

While it is true that OL has evolved significantly since its inception in the mid-2000s, harnessing it as a mechanism of encouraging ocean positive actions and behaviour remains a central tenet of the concept. Through this study, key insights were gathered relating to the dimensions of behaviour, activism, communication, and trust and transparency in the South African context. First, it is interesting to understand how people perceive their lifestyle to impact the ocean – interestingly, in this study, we found almost 60% of respondents indicated that they felt that they had a positive impact on the ocean, with 15% indicating that they had no impact at all. These results are interesting as they contrast with the findings in other studies – for example, across the UK's national assessments 37-40% of respondents indicated that they had no impact on the marine environment. Despite this relatively high self-reported positive impact, postgraduates were less likely to report this, suggesting greater awareness of complex indirect impacts and possible bias within the sample and the fact that, while every effort was taken to distribute the questionnaire widely, respondents were largely recruited from the research team's personal and professional networks. It is also necessary to note that no details were collected on what a positive impact might be, and that this result suggests relationship and ocean positive behaviours that are perhaps contrary to that suggested in other aspects of the data. Further exploration of specific behaviours found, respondents indicated that many had already undertaken steps to change their lifestyle to benefit the ocean – as in other studies, the most commonly selected activism behaviours tended to be those that were more easily accessible, low cost, and convenient for individuals (e.g. signing petitions, encouraging others to do more). Indeed, the challenges associated with motivating, and crucially maintaining, pro-environmental behaviour have been explored by numerous scholars – these act as significant barriers to mainstreaming behaviour change and action across society (Veríssimo et al., 2024; 2025) and more work is needed to identify solutions that can overcome the myriad of social, economic and cultural blockers. It is critical, therefore, that OL research continues to build an understanding not only of what people already do, but also what prevents them from taking certain action, both in South Africa, but also more broadly (as described in the dimension of access and experience proposed by McKinley et al., 2023). Specifically in South Africa, it is interesting to note the high number of respondents who indicated that they had signed petitions about marine issues – this was the most frequently selected behaviour. Given that there have been only a handful of marine related petitions (e.g. Opposition to offshore oil/gas surveys and seismic blasting; Support for marine conservation and expansion of MPAs and specific species protection (such as African Penguins)), this perhaps speaks to the public response to ongoing oil and gas exploration and the potential impact of media coverage and campaigns on public perceptions related to this (Redelinghuys et al., 2024; McGranahan and Kirkman, 2019; Meissner, 2025).

In addition to broader systemic action and activism behaviours, the contribution of individual behaviours in addressing the challenges facing the ocean must also be acknowledged (Stoll-Kleemann, 2019). Perhaps corresponding with the concerns regarding the threat of plastic to the ocean, the most commonly undertaken behaviours related largely to reduction of plastic consumption in some form. While every action was selected by at least 40% of respondents, the repeated dominance of plastic as a theme here further spotlights the need for better awareness raising regarding the (unfortunately) diverse set of human-derived ocean threats. Here too, differences across respondents highlighted that the ocean literacy efforts and communication need to take account of audience segmentation to tailor messaging and communication (McRuer et al., 2025). In this instance, males were found to be less likely to carry out pro-environmental behaviours, while education levels were also found to be a moderator. Clearly, communication remains integral to overall ocean connection and understanding (McKinley et al., 2023), and as highlighted above, there is a need, therefore, to better understand motivators and barriers to behaviours and to consider how messaging can be improved to resonate more with diverse audiences. A notable gap exists between frequently used channels (e.g., social media, documentaries) and trusted sources (scientists, museums). Ocean literacy initiatives should aim to bridge this gap through co-produced content for distribution across a range of media platforms, developing research-led, evidence-based material packaged for social platforms that can then be amplified by trusted public-facing institutions. South African society is multicultural, multilingual and multi-ethnic (du Plessis and Saccaggi, 2015). South Africa's highly developed urban centres are hubs of economic activity while in rural areas traditional lifestyles continue, highlighting stark inequalities in wealth and opportunities. This diversity means that there is no one size fits all and OL efforts need to be carefully designed to be appropriate for multiple audiences. While many South Africans have a strong spiritual and cultural connection to nature (Nche and Michael, 2024; Lockhart, 2011; Dunga et al., 2025), how this translates into an understanding of the influence of the ocean on human life and

an understanding of how humans affect the ocean has yet to be understood. Finally, engaging society in broader ocean governance remains a key challenge for ocean sustainability – highlighted now by several scholars, but also explicitly recognised within Challenge 10 of the UN Ocean Decade (Glithero et al., 2024) and the Nice Declaration (UNESCO-IOC, 2025). This study highlighted varying levels of public awareness and support for a suite of ocean governance interventions. While 97% of respondents indicated support for designation of more Marine Protected Areas, it is important to note that this may not be a representative reflection of South African views, due to the potential biases in the sample already highlighted. As an initial study, however, this figure offers support to ongoing efforts across South Africa to further develop the MPA network, however this should be done in a way that is equitable and inclusive, designed with and managed by local communities (Peer et al., 2022; Mann-Lang et al., 2021). It should also be noted that for the majority of respondents, there were limited calls for new tools or new legislation – rather, the ask was for better implementation of what already exists. This echoes others who hold the view that the tools for sustainable ocean management are already available, it is ineffective use, poor regulation and implementation and lack of penalty that hinder their success (Norton, 2022, Francolini et al., 2023; Kirkman et al., 2021; Kirkman et al., 2023). However, in the South African context, new tools, including better ways to engage with the complexity of ocean management need to be explored (Norton 2020).

5.3 Ocean literacy and its relevance in South Africa

It is of note that the levels of agreement with the existing OL principles varied significantly among respondents, perhaps reflecting the increasingly common narrative that the OL principles originally designed in 2004 are not necessarily appropriate outside of a North American, formal education context (Shellock et al., 2024; McKinley et al., 2023; Worm et al, 2021). Across the OL research, there are growing calls to revisit the OL principles, not least in light of the two decades of progress within OL research and practice, but also to ensure that the complexity and diversity of human-ocean relationships, including those represented by traditional and Indigenous knowledges and lived experiences, are reflected in contemporary OL discourse (Shellock et al., 2024). This is not only important in the context of South Africa, but also a relevant consideration for the application of ocean literacy as a meaningful and effective concept in a wide range of social, geographical, cultural and economic contexts. The findings of this study provide further evidence of the need to revisit this, particularly given the variation in agreement seen across different gender and age-groups and for those with links to the marine environment through employment. Operationalising OL to support future ocean sustainability will require a framework and principles which represent and speak to a broader suite of audiences than the principles as they currently stand.

While ocean literacy as a concept, and indeed a practice, has, in recent years, begun to evolve beyond the classroom, the importance of fostering awareness and developing ocean knowledge remains a fundamental lynchpin. Related to this, data exploring the OL dimension of awareness found respondents attributed relatively low levels of importance to some of the cultural uses included in the question responses, such as the ocean being a support for traditional medicine, sense of identity or a site for spiritual baptisms. As a pilot study using only an English language questionnaire, the respondents in this study should not be considered to be representative of South African communities – rather the study provides initial insights on which to build future work to understand OL, connections and indeed, ocean fluency, across South Africa. While the project sought to gather insights from a diverse range of communities across South Africa and despite efforts to distribute the questionnaire through various networks, the final sample is dominated by those with an interest in marine issues and that have completed university level education. This bias within the data is a recognised limitation of the study and means that the diversity of benefits and connections between communities and the ocean may not be adequately captured and will require ongoing work, employing a diverse suite of methods to explore these relationships in more depth (McGarry et al., 2024; McKinley et al., 2023; Shellock et al., 2024; Erwin et al., 2022). Furthermore, the current framing and dimensions of OL needs to be re-assessed for an African context, as suggested by others discussing its application outside of its Global Minority, Western roots (Worm et al., 2021; Strand et al., 2023). Ways to explore the multiple perspectives of ocean heritage, value and knowledges while cognisant of the influence of economic levels, literacy challenges, language barriers and broader cultural differences in South Africa will require creativity and innovation (Martin, 2024b).

6 Conclusions: looking to the future

With roots firmly in marine education, contemporary conceptualisations of OL are repeatedly the subject of necessary critique and reflection, stretching, shaping and moulding the concept to better fit a diversity of ocean relationships and experiences. While the concept's application and relevance in South Africa continues to be the subject of debate, its growing position within ocean sustainability and governance discourse at a global scale cannot be denied. With this in mind, and acknowledging the ongoing evolution of the concept, this paper provides an initial insight into OL across some areas of South African communities adding to and addressing existing knowledge and data gaps in, the global ocean literacy evidence and understanding.

The data and discussion presented here provide useful insights into various dimensions of OL and how they are experienced in different South African communities and allow comparisons to be made with other global datasets. While a high proportion of respondents indicated high levels of concern for the marine environment, and a desire for it to be protected, this study found there to be mixed levels of awareness and knowledge of some

aspects of ocean issues, and that for many addressing issues of low public understanding and lack of political will relating to ocean issues is key to addressing the challenges facing the ocean. These findings align with the reframing of OL within the Challenge 10 White Paper, which recognises OL as a whole society outcome.

Crucially, however, this paper is just one piece of a much larger mosaic of research needed to better understand the complexities and nuance of human-ocean relationships in a South African, and indeed African, context. At this point, it is important to recognise the inherent limitations of the study as a pilot and use it as an opportunity to highlight the need for a more comprehensive assessment of OL and human-ocean relationships, with better representation of South African communities and translation of the data collection tool into more South African languages. There is a need also for the OL research community to continue challenging the appropriateness of the term ocean literacy in the context of South Africa and consider the opportunity of other terms and concepts that are more reflective of South African experiences and communities. Moreover, echoing calls from Shellock et al. (2024) among others, future assessments of OL must recognise the limitations of questionnaires as a tool for understanding complex, deep, emotional and often messy relationships that people and communities have with ocean spaces and should draw on qualitative social science methodologies and the expertise from arts and humanities scholars.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Cardiff University Ethics Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

EM: Writing – review & editing, Resources, Formal analysis, Writing – original draft, Validation, Data curation, Investigation, Methodology, Project administration, Funding acquisition, Conceptualization. JFP: Formal analysis, Validation, Writing – review & editing, Data curation, Writing – original draft, Software, Visualization. HL: Writing – original draft, Conceptualization, Writing – review & editing. JM-L: Conceptualization, Resources, Writing – original draft, Funding acquisition, Methodology, Validation, Writing – review & editing, Data curation, Investigation.

Funding

The author(s) declared that financial support was received for this work and/or its publication. Our thanks go to the British Academy Small Grant (SG2122/210785) for funding the work. JFP received financial support from the Spanish Agency of Research (AEI-MICINN), grant DYNCOAST (PID2023-151732OA-I00) funded by MCIN/AEI/10.13039/501100011033 and the FES+, and the Ramón y Cajal programme (RYC2022-036196-I), funded by MCIN/AEI/10.13039/501100011033 and the FES+.

Acknowledgments

We would like to thank the respondents to the survey and the South African Ocean Literacy community for their enthusiastic response.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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