# Ocean literacy research community: co-identifying gaps and priorities to advance the UN Ocean Decade

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**Introduction:** The overarching goal of the UN Ocean Decade is to "change humanity's relationship with the ocean." While this may be a challenge, it is, at the same time, a once in a generation opportunity. How can 8 billion people, including those who don't live near coastal areas, be inspired to value and care for the ocean? This is the essence of ocean literacy, and the driver of ocean literacy research (OLR).

**Methods:** In 2021, we began a research initiative to co-create a global OLR agenda by the developing OLR community, to better understand existing research themes, gaps, future priorities, actions, and impacts of ocean literacy initiatives. To deliver this, a series of virtual workshops – with the first taking place as part of the UN Ocean Decade Laboratories – was complemented by a participatory methodology using digital survey and mapping tools for crowdsourced collaboration.

**Results and discussion:** Through this process, four initial OLR priorities were identified, including measuring ocean literacy, the role of ocean literacy as a policy mechanism, and alignment of OLR with climate change and the blue economy agendas. Finally, a working definition of OLR was developed to further guide OLR priorities for the UN Ocean Decade and beyond.
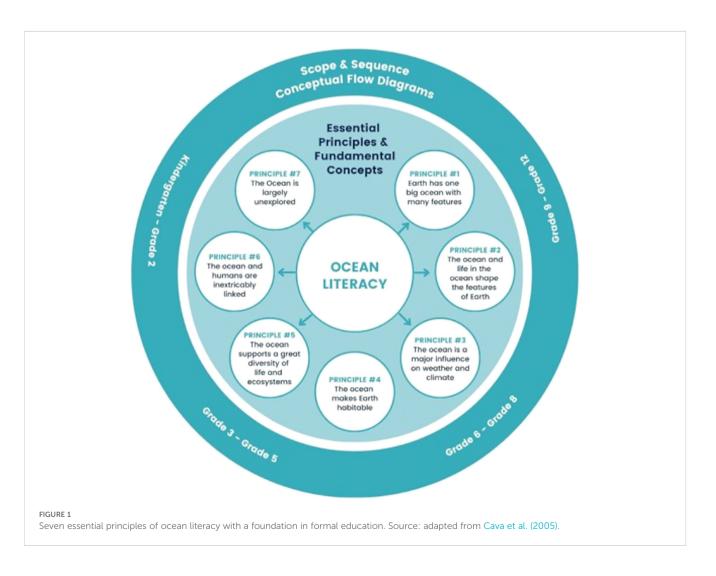
# 1 Introduction

Originating from the United States in the early 2000s with an initial grounding in formal education and ocean science knowledge, ocean literacy in its simplest form can be defined as having "an understanding of your influence on the ocean, and the ocean's influence on you" (National Marine Educators Association (NMEA), 2023). Originally based on seven essential principles (Cava et al., 2005; National Oceanic and Atmospheric Administration (NOAA), 2013), ocean literacy initiatives have frequently focused on developing public knowledge and awareness of the ocean, with numerous scholars exploring ocean literacy primarily through the lens of school curricula and teacher education over the last two decades (see for example Steel et al., 2005; Guest et al., 2015; Fielding et al., 2019; Mogias et al., 2019; Hunt, 2021). Recent years have seen a fervent interest in expanding this to better account for the many ways that ocean literacy, and ocean literacy research (OLR) in particular, are needed to help bring to the fore the diversity of ways that society is connected to and dependent on, the ocean. Increasingly recognized as a reciprocal and cyclic relationship that ultimately determines our shared vitality, this requires a more thorough investigation into diverse experiences and values of ocean influence in place-based contexts than have previously been explored through the concept of ocean literacy.

To situate and position the emerging pathways of OLR, we must start with its foundation in (and efforts to advance) ocean literacy. Although not a new concept, we can say that oceans literacy has experienced a renaissance in recent years, with the launch of the UN Decade of Ocean Science for Sustainable Development (2021–2031) (hereafter "UN Ocean Decade"). Having spent the previous two decades on the periphery of ocean sciences, ocean literacy now finds itself at the center of ocean science and governance discourse, increasingly recognized for its value in redefining societal–ocean relationships (Haugan et al., 2021). While there are critics of ocean literacy and it is right that the concept continues to be challenged and pushed to ensure inclusivity (see for example Sustainable Management of UK Marine Resources Integrating Diverse Values into Marine Management; McKinley et al., 2020; Worm et al., 2021), the groundswell of interest and momentum surrounding the concept of ocean literacy cannot be denied. For example, most recently ocean literacy has been importantly positioned, with growing recognition, as a societal outcome in the Challenge 10 White Paper, reflective of better understanding, value, and care for the ocean (Glithero et al., 2024). Despite this, however, recent reviews of existing publications and collaborations relating to ocean literacy have shown a



FIGURE 1
Seven essential principles of ocean literacy with a foundation in formal education. Source: adapted from Cava et al. (2005).
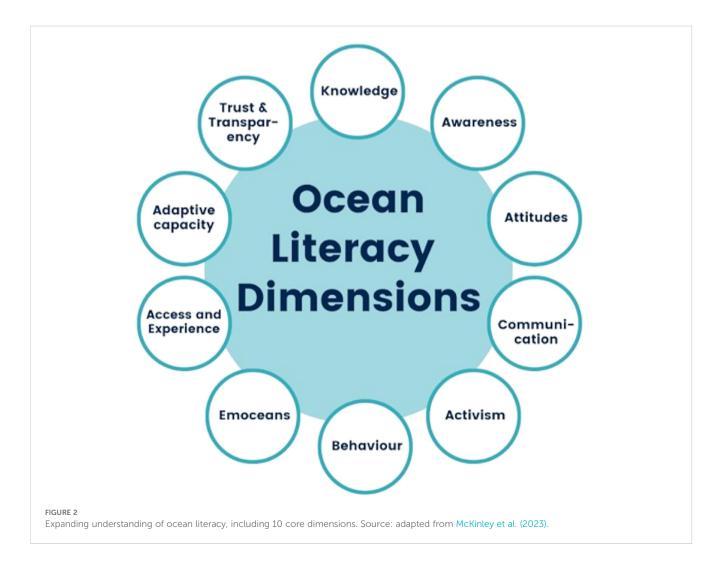
geographical skew towards North America and Europe, with a significant gap in the global South (Costa and Caldeira, 2018; Paredes-Coral et al., 2021). Furthermore, these papers emphasize the historical focus on education and knowledge highlighted above (represented in Figure 1) (Shellock et al., 2024).

Recent years have seen the models and dimensions of ocean literacy expand and evolve (Brennan et al., 2019; Stoll-Kleeman, 2019; McKinley et al., 2023). Alongside this, the emergence of parallel constructs of marine citizenship (McKinley and Fletcher, 2012; Buchan et al., 2023), nature and ocean connectedness (Howell et al., 2011; Capaldi et al., 2014), and an increasing emphasis on public ocean perceptions research (Gelcich et al., 2014; Jefferson et al., 2015; Potts et al., 2016; Glithero and Zandvliet, 2021; Jefferson et al., 2021) illustrate a growing interest in understanding the complex relationships between society and the ocean, and recognizing these spaces as "peopled" (Bennett, 2019).

Drawing insight from these other constructs and the broader field of marine social sciences (Bennett, 2019; McKinley et al., 2020), ocean literacy has accordingly begun to move away from its original education foundations with increasing consideration given to other aspects of human relationships with ocean and coastal spaces. This has been evidenced by a number of scholars – Brennan et al. (2019), for example, identify six dimensions of ocean literacy, including knowledge, awareness, attitudes, communication, activism, and behavior. Building on this, recent work suggests a need to further expand the scope and definition of previously identified dimensions alongside the inclusion of four additional components – "emoceans," trust and transparency, access and experience, and adaptive capacity (McKinley and Burdon, 2020; McKinley et al., 2023) (see Figure 2). Furthermore, examples of this broader understanding of ocean literacy are increasingly being applied, for example, in the work done by the Canadian Ocean Literacy Coalition (Glithero and Zandvliet, 2021), studies exploring the language and terminology of ocean literacy (MacNeil et al., 2021), implications of ocean literacy for the blue economy (Paredes-Coral et al., 2021), and an increased focus on how we can best support and foster effective levels of ocean literacy on a global scale (Kelly et al., 2021).

As the discourse of ocean literacy has continued to evolve, so too has the research and scholarship community around it. While ocean literacy as a concept and potential model for change has gained traction in recent years, the historical focus on the education and knowledge components of ocean literacy means gaps in our understanding remain. There is a need, therefore, to extend the scope of OLR beyond traditional areas of exploration and practice to ensure that the current momentum behind ocean literacy has the opportunity to realize its potential across a broad range of social,



FIGURE 2
Expanding understanding of ocean literacy, including 10 core dimensions. Source: adapted from McKinley et al. (2023).

cultural, and geographical contexts, as well as transdisciplinary lenses, to ultimately contribute to the success of UN Ocean Decade goals.

## 1.1 UN Ocean Decade goals and rationale for OLR community initiative

Recognizing that sustainable development and ocean equity cannot be achieved without ocean-literate societies, ocean literacy has been integrated into the framework for the UN Ocean Decade (Intergovernmental Oceanographic Commission (IOC), 2021). Societal objectives of the UN Ocean Decade are to enhance the sustainable development and health of the ocean by promoting scientific knowledge, infrastructures, and partnerships; alongside calls for ocean science, data and information are specifically emphasized to inform policies that in turn will support overarching aims (The United Nations Educational, Scientific and Cultural Organization (UNESCO), 2023). Ocean literacy research has the potential to be both a mechanism of change toward these goals and a pathway to help transform society's relationship with the ocean – the overarching challenge (Challenge #10) of the UN Ocean Decade. Yet, despite recent growth in research efforts (Paredes-Coral et al., 2021), OLR, until now, has been undefined, uncoordinated, and dispersed. Furthermore, the majority of ocean literacy publications to date have focused on ocean literacy initiatives and activities (i.e., ocean literacy practice) rather than on *OLR*. More specifically, there are questions as to how OLR could and should be distinguished from ocean literacy practice. How do geographic and social-cultural contexts shape different OLR agendas? How are existing and emerging ocean literacy programs being measured? How do we learn from, amplify, and scale ocean literacy practice that is having measured impact? To begin addressing these questions, this work focused on establishing a global network of ocean literacy researchers (as well as practitioners and users) to co-map the current ocean literacy research community (henceforth "OLR community") (i.e., who is doing what, where, with whom) and to co-identify research gaps and priorities. In so doing, we propose an initial collaborative forward-looking OLR agenda from the perspectives of those working in the field. Finally, the paper presents a working definition of OLR supported by a list of recommendations aligning with UN Ocean Decade actions to further advance OLR.

## 2 Methodology and analysis

This research adopted a co-development and mixed methods approach, drawing on a range of methodologies to explore and map the existing global OLR community. We based our process on the primary tenets of participatory action/community action research (McRuer et al., in press[1]), namely:

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1  McRuer, J., McKinley, E., and Glithero, D. (in press). *Co-developing a global ocean literacy research community and agenda for the UN Ocean Decade. Ocean literacy: the foundation for the success of the Ocean Decade.* (Springer).

- Democratic, participatory pathway for community reflection and expression.
- Equal access to liberties, rights, and opportunities.
- Investigating root causes of problems that directly impact communities.
- Taking action: reaching policymakers and stakeholders to catalyze change.

With this broad scope and intention in mind, we aimed to create an interactive space for the global community of ocean literacy researchers and evaluative-focused practitioners to share, learn, and exchange their perspectives on OLR with consideration to better understand the current global OLR "seascape"; co-identify research gaps and priorities; organize research projects to address these gaps and priorities; co-produce a series of outputs and strengthen knowledge exchange; and increase support for and impact of OLR. The interactive space to explore these questions evolved through an iterative process of workshops and surveys from July 2021 to June 2022 which will next be elaborated (see Supplementary Table S1 for research design outline).

A series of three co-planned, discussion-based online workshops was envisioned with focus and directions evolving through community growth and input. The first workshop was embedded within the formal programming of the first UN Ocean Decade Laboratory – "An Inspiring and Engaging Ocean" in July 2021 – the first in a series of global laboratories to catalyze partnerships and co-design UN Ocean Decade actions. The broad aim of workshop #1 was to invite diverse individuals working and/or interested in the field to establish an OLR community network. To support this effort, we dovetailed surveys through the Environmental Services Research Institute's (Esri) StoryMap and Survey123 platforms. Both open-source platforms integrate data capture through multimodal format (e.g., survey, photo, video, mapping). We applied this methodology in our efforts to create an online space for the global community of ocean literacy researchers and practitioners to connect over the UN Ocean Decade Laboratories timeframe and beyond.

We began by co-designing a StoryMap and inviting interested individuals to complete an embedded survey (the design for which was co-created and collaboratively reviewed), to introduce their stories of identity, place, and ocean literacy research-related work, *prior to workshop #1*. Submitted surveys automatically populated a map of the world – a central feature integrated into our StoryMap – with survey locations, answers, and uploaded photos (see Figure 3). In this way, the OLR community immediately began interacting and learning from one another. Moreover, a growing list of interested OLR community members was evolving through peer networking via invitation and communication surrounding our first workshop, and the two subsequent workshops. This fusion of survey, workshop, and community mapping continued in an iterative fashion over the next 10 months (summarized in Figure 4) as we worked to co-identify current OLR focal areas, gaps, and priorities, and to self-organize in research groups to advance action and impact (see Supplementary Tables S1–S4 for survey details).

In effect, workshop #1 identified four OLR focal areas which were further refined in survey #2 and subsequent workshop #2 focusing on

FIGURE 3
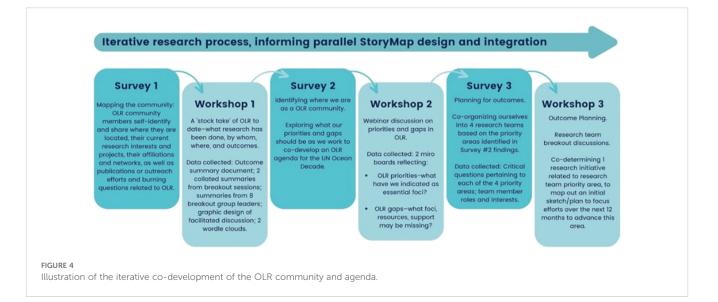Global participation, as indicated through GPS map markers, each of which links to member surveys.

OLR gaps and priorities; which in turn, informed survey #3 and workshop #3 that concentrated on advancing OLR community action and impact. The latter drew on the process as a whole, proposing four initial research areas aimed at addressing the identified gaps and priorities (further discussed in section 3.2). This inductive research approach proved an effective means of inviting and coalescing community member contributions to shape the direction of OLR (see Supplementary Figures S1 – S3 for examples of participant contributions arising through the workshop series).

Central to our research design, data was analyzed through an iterative, thematic coding process, whereby data collected through each OLR community survey informed a complementary workshop design. Workshops were intentionally designed to be participatory, lending to collaborative analysis, which in turn, informed successive

survey and workshop content and direction. In this way, our intention was to pursue a co-creative data collection and analysis process whereby overarching themes were drawn from emergent OLR foci, gaps, and priorities. We further quantified collected data based on demographics (age, gender, geographic location, level of education, profession) as well as active or non-active involvement in an OLR field, using ESRI Survey 123's integrated data analysis tools. The results of this analysis are summarized below.

# 3 Results and discussion

The results below share our data analysis beginning with a depiction of study participants to better understand who's who in



FIGURE 4
Illustration of the iterative co-development of the OLR community and agenda.

the emerging OLR community. This is followed by elaborating the community-identified OLR gaps and priorities in section 3.2, in an effort to outline a research agenda. We conclude with section 3.3 with a discussion of how the results lend to enabling and operationalizing OLR.

## 3.1 Mapping the OLR community

Prior to the first workshop of the OLR community, 147 members expressed their interest by participating in survey #1, and 87 attended the accompanying workshop in July 2021. Members joined from ~37 countries, with Europe being the most represented continent, followed by North America, South America, Africa, Asia, and Australia. Drawing on participant surveys, members mostly self-identified as being between 36–45 years of age (33.3%), followed by 46–55 (23.8%), 26–35 (20.4%), 5665 (10.9%), under 25 (7.5%), and over 65 (4.1%) (see Figure 5). Among participants, 72.8% identified as female, 23.1% as male, 2.72% preferred not to say, and <2% preferred to indicate with their self-identified category. When considering under-represented groups in ocean science, 66.4% of participants self-identified as women, 26.5% as early career professionals, 21.8% indicated English as an additional language, 7.5% as a person of color, 7.5% as a youth, and 2% as either a new immigrant or Indigenous.

According to participant survey responses, 59.2% of participants said they are actively involved in OLR, with the most attributed sectors being research (35.4%), education (32%), and non-governmental/non-profit/foundations (13.6%); and less attributed sectors represented by the government (6.1%), arts and culture (5.4%), and community, media/communications, and youth, each 1.4%. Research-specific engagements included interdisciplinary work (19%), Natural Sciences (8.8%), Social Sciences and Humanities (6.8%), and Other (<1%). Predominant areas of educational foci included Kindergarten–Grade 12 (17.7%), Non-Formal (14.5%) Education Research and Evaluation (14.3%), and Higher Education (13.6%). Educational Policy and Pre-kindergarten were marginally represented (~3% each). Non-Government/Non-Profit/Foundation affiliations were largely represented by being ocean-focused (12.4%), education-focused (8.8%), and conservation-focused (6.8%), with the scope of work

being predominantly national (8.2%), followed by regional/local (6.1%), and international (5.4%).
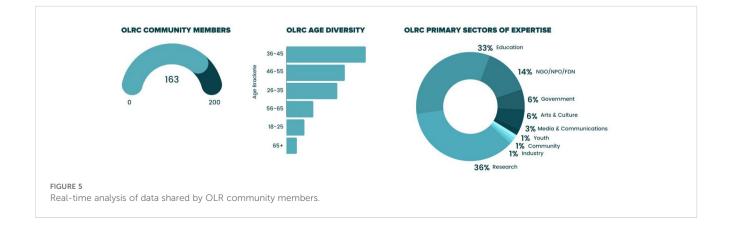
## 3.2 Community identified OLR gaps and priorities – outlining a research agenda
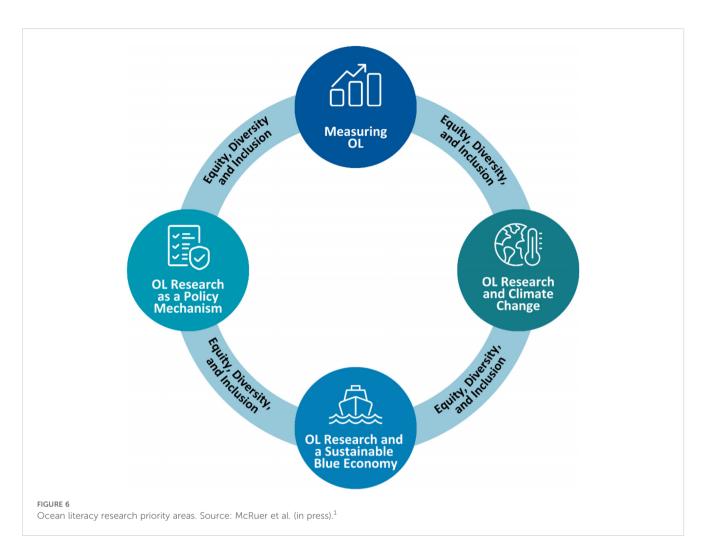
Analyzing OLR community contributions across our collaborative workshop series and participatory methods, the following four priority research areas emerged: Measuring Ocean Literacy, Ocean Literacy and Climate Change, Ocean Literacy as a Policy Tool, and Ocean Literacy and a Sustainable Blue Economy. Equity, Diversity, and Inclusion was identified as a cross-cutting theme for all research areas (see Figure 6).

As the focus on ocean literacy continues to grow, there are many research angles and questions to guide the development and priority of metrics, indicators, and measures of ocean literacy to gauge the impact of varied initiatives and the future direction of OLR. Where to start, what the most salient questions are, how current approaches can be applied and advanced, and what avenues exist for timely and efficient ocean literacy action, require collaborative effort by the OLR community to harness collective knowledge that can guide research practice and uptake. Through our research herein, the OLR community has begun to aid in this direction, by identifying priority areas that may serve to narrow the breadth of potential measurement directions into concrete themes whereby indicator and metric development can be focused. Examples of topics relating to each of these research areas are presented in Table 1, and an elaboration of each area based on co-identified research gaps and priorities follows.

### 3.2.1 Measuring ocean literacy

Central to the overarching challenge of the UN Ocean Decade – changing society's relationship with the ocean – is ensuring that all citizens gain a better understanding of the importance of the ocean; the varieties of human – ocean interactions; and the ways to act sustainably, both individually and collectively, to reduce human impacts on marine systems (Santoro et al., 2017). Developing indicators and measures for ocean literacy is an essential part of the strategies needed to change human behaviors and practices (Jefferson et al., 2015). This is an important challenge for all parts of



FIGURE 5
Real-time analysis of data shared by OLR community members.

**FIGURE 6**
Ocean literacy research priority areas. Source: McRuer et al. (in press).[1]

society, including educators, trainers, students, young professionals, civil society, scientists, consumers, industry, and policy makers (Torre, 2014). Metrics to assess the efficacy and impact of ocean literacy initiatives and approaches is an identified gap and critical research priority of the OLR community for the UN Ocean Decade.

Looking back in order to move forward, in 2015, the most widely known and adopted measurement tool for ocean literacy – the International Ocean Literacy Survey (IOLS) – was established through an unfunded, grassroots, collaborative effort (Santoro et al., 2017). The IOLS allows for the comparison of ocean knowledge levels across 15–17 year olds, and to date, has gone through four iterations, been used in 24 countries, and is available in 15 languages. A celebrated example of a community-led, co-designed instrument, the research has focused primarily on validating the tool, rather than measuring and comparing the results within and between countries. That said, the IOLS, despite its achievements, is a limited tool insofar as only being able to measure a singular dimension of ocean literacy (i.e., ocean science knowledge) and not the multiple other dimensions now recognized as being central to ocean literacy (McKinley et al., 2023; Shellock et al., 2024).

An emphasis on pre and post testing of knowledge reinforces an understanding of how learning works. This is easy research for natural sciences to accept and it gets published in high impact science journals. However, critical social science research that explores how people live in relation to the ocean (e.g., epistemologies of knowledges, ecologies of knowledges, Indigenous knowledge) has not always been included in what constitutes ocean literacy. How do we move beyond this?

Beyond the critical recognition of multiple ways of knowing about the ocean and cultural ontologies, current OLR outcomes are often focused on changing public perceptions and public understanding of ocean knowledge and ocean-related issues (Uyarra and Borja, 2016; Fielding et al., 2019). Other research is inward facing (e.g., what is ocean literacy, what can it achieve, what should it be doing, how should it be done) (McKinley and Burdon, 2020; Shellock et al., 2024). Furthermore, recent research is seeking to better understand the different ways ocean literacy can be harnessed to support sustainable ocean management and governance across a range of topics, for example protected area designations and blue economy agendas (Fauville et al., 2019; Glithero et al., 2024). Further still, with an increasing emphasis of ocean literacy work focused on creating behavior change, there is an assumption of impact. To date, OLR has rarely evaluated or created effective tools for achieving this (Chambers et al., 2019; Fernández Otero et al., 2019; Ashley et al., 2019). In turn, several critical research questions require examination by the OLR community, such as: how do we meaningfully measure behavior change at both medium and long-term scales? How do we measure aspects of affect?

TABLE 1  Co-identified questions pertaining to OLR priority areas.

| OLR priority areas | Example topics/questions |
|---|---|
| Measuring Ocean Literacy | • How to measure ocean literacy dimensions? <br> • How to evaluate success of ocean literacy initiatives and approaches, as mechanisms for behavior and policy change? <br> • How can we effectively communicate and enhance the impacts of ocean literacy work? |
| Ocean Literacy and Climate Change | • How do we better understand and communicate the link between ocean and climate systems? <br> • How can ocean literacy empower communities to be more resilient to both local and global climate change? <br> • How can we use ocean literacy to help establish a systems-thinking approach to management and conservation? |
| Ocean Literacy and a Sustainable Blue Economy | • How can the ocean literacy and blue economy agendas be better aligned to support sustainable coastal communities? <br> • How can ocean literacy be used as a tool to promote and attract talent to blue career opportunities in equitable and inclusive ways? <br> • How can industry/businesses become more "ocean literate"? <br> • How can OLR help vulnerable and marginal coastal people to look for sustainable livelihood solutions integrating protection mechanisms for coastal ecology? |
| Ocean Literacy as a Policy Mechanism | • How can ocean literacy be used as a mechanism for policy change, and operationalized to support specific policy outcomes across a broad range of policy areas (e.g., urban planning, marine spatial planning, waste management, marine protected areas, health, infrastructure)? <br> • How can ocean literacy be used to ensure policy makers and practitioners improve their capacity to use and understand ocean data to influence communication, decision making, and advocacy? <br> • How can we better integrate OLR into wider ocean governance? |
| Ocean Literacy and Equity, Diversity, and Inclusion (cross-cutting theme) | • How can ocean literacy become truly inclusive and equitable, across social, cultural, economic, and geographical contexts? <br> • Whose voices and values are currently included in ocean literacy agendas and initiatives? Whose are missing? <br> • How can diverse actors across regions, sectors, and scales, work together to change society's relationship with the ocean? |

What interventions lead to long-term behavioral and policy changes that are aligned with ocean health? What is the social tipping point for a cascade of ocean-smart behaviors? And perhaps most overarching and specific to the UN Ocean Decade, what does success look like in 2030?; how will we know if we changed humanity's relationship with the ocean?; and what are the indicators or benchmarks?

## 3.2.2 Ocean literacy research and climate change

As the ocean comprises 70% of the Earth's surface and exerts a significant force on energy and water cycles, its role in climate regulation is unquestionable. This dynamic has been highlighted in movements such as "Climate Literacy", "Climate Science Literacy", and "Climate Change Literacy" – all under the umbrella of

"Scientific Literacy" and all positing the climate's influence on humans and society, and our influence on the climate. One criticism of these movements, however, is their emphasis on ocean science concepts such as the biophysical principles of the climate system, with inadequate attention paid to the contributions of the social sciences (Shwom et al., 2017). Without a social science lens, less is known about the human behaviors and social drivers of the ocean–climate nexus (Shwom et al., 2017), resulting in misguided policy and governance (Bennett, 2019). Beyond this, when human dimensions of influence and change are not well-understood, an unengaged and unmotivated public results – at a time when collective action has never been more needed to mitigate planetary health (Kelly et al., 2021).

With the interconnectivity between ocean and climate increasingly positioned at the center of ocean governance debates (e.g., The Intergovernmental Panel on Climate Change (IPCC), 2022), considering how climate action may be complemented by ocean literacy efforts has been gaining recent attention (National Oceanic and Atmospheric Administration (NOAA), 2022). Ocean literacy, although historically a measure of what people know from an ocean science perspective, now emphasizes attitudes, behaviors, connections, and the ability to communicate about ocean issues (Brennan et al., 2019; McKinley et al., 2023), leading to "informed and responsible decisions regarding the ocean and its resources" (National Oceanic and Atmospheric Administration (NOAA), 2022). With this social science slant at the fore, OLR therefore has a critical role to play in investigating human dimensions of climate change, to account for the social, cultural, economic, health, and governance considerations of the ocean and its interconnected life-support systems. There is a need for future OLR to consider the impacts of future climate change and how this might impact societal relationships with the ocean, and in turn, levels of ocean literacy in different communities. Crucially in the context of climate change, ongoing OLR needs to include aspects of resilience and adaptive capacity.

The scientific lens of the climate literacy movement, and the potential for OLR to bridge interdisciplinary fields were discussed by the OLR community members across the participatory research process. In particular, community members wondered to what degree, given current attention on the climate crisis, the ocean has been considered; and spoke to the need to better understand and communicate the link between ocean and climate both on a global level and using local community examples. Members also questioned the public perceptions of climate change initiatives, how these vary in different contexts, and how messaging affects ocean-related action. Action was discussed in terms of how OLR can empower ocean and coastal communities to deal with (be more resilient to and adaptive for) local and global climate change; help establish a systems-thinking approach to ocean management and conservation; and support business and policy shifts to more effectively mitigate ocean health decline associated with the climate crisis.

Existing literature echoes the above questions and directions put forth by the OLR community. For example, related to ocean–climate linkages, Cooley et al. (2019) discuss how global policies such as the UN Framework Convention on Climate Change's (UNFCCC's) Paris

Agreement, need to better incorporate ocean impacts, mitigation, and adaptation in their resolutions toward climate mitigation. Although headway is being made toward this call in dialogue (Dobush et al., 2022), decision-making and action remain to be seen. Conversely, climate change considerations are often overlooked in marine spatial planning, and require better integration to address ocean health (Frazão Santos et al., 2020). Regarding public perceptions, there is an identified need to expand OLR to study public perceptions on climate change worldwide (Capstick et al., 2015; Jefferson et al., 2021); as well as to explore public perceptions in relation to multiple geographies to support sustainable policies (Tuitjer et al., 2022), and in relation to how ocean–climate change messages affect public support for mitigating policies (McComas et al., 2015). OLR and community-level climate adaptation are needed for effective planning and mitigation efforts such as marine protected area governance (Leonardsson et al., 2021) and in forecasted predictions of climate-affected futures (Nash et al., 2022).

### 3.2.3 Ocean literacy research and a sustainable blue economy

Alongside the evolution of ocean literacy and the emergence of the OLR community, recent years have witnessed a growing focus on the "blue economy" agenda. Given the focus of ocean literacy on the diverse connections, relationships, and indeed, values, held by communities towards ocean and coastal spaces, it is perhaps unsurprising that the alignment between OLR and the global blue economy agenda and discourse was identified as a key research priority throughout this process. While originally framed around economic growth and development, more recent definitions and discussions within the blue economy field increasingly encompass a recognition that in order to deliver a truly sustainable blue economy, there is a need to understand the complexity and diversity of the relationships between people and the ocean – and how the multiplicity of values inherent within this can be included as part of a sustainable *and equitable* blue economy (McKinley et al., 2023). Much like the concept of ocean literacy, the concept of blue economy has changed, moving away from its purely economic growth origins, with recent definitions suggesting that the blue economy can "encourage better stewardship of our ocean [and] blue resources … highlighting the close linkages between the ocean, climate change, and the wellbeing of people" (The Commonwealth Blue Charter, 2021).

As stated by Bennett et al. (2019), the "rush" to promote and develop a global blue economy, viewing ocean values only through the lens of economic growth, presents significant risks to both the ocean and wider society who depend on it. Working towards a socially just, equitable, and sustainable blue economy requires communities, decision-makers, and businesses to be ocean literate so that they can understand, evaluate, and monitor not only the benefits of blue economy initiatives (e.g., strengthening of coastal economies, improved food security, community wellbeing) but also the risks (e.g., limited benefit to local communities, appropriation of ocean resources and spaces, community displacement) (Bennett, 2018; Bennett et al., 2019; Bennett et al., 2021; The Commonwealth Blue Charter, 2021). By aligning and integrating OLR with the emerging blue economy discourse, there is an opportunity to center multiple perspectives and ensure that a blue economy is delivered in a way that is socially equitable and inclusive. While there are

nascent efforts to connect these two areas of research, a recent paper indicates that there is still much to be done, with only 7.2% of papers reviewed (out of 111) covering a blue economy related theme (Paredes-Coral et al., 2021). The need for including more voices and more values in the blue economy dialogue has been further emphasized by Heidkamp et al. (2021), who argue that trans disciplinarity, and what they call the "quintuple helix" of stakeholder engagement, (government, academia, business community, and civil society) is needed to engender a just and sustainable blue economy, one in which all actors are considered and involved.

Through the workshop discussions, a number of key research questions relating to OLR and blue economy research were highlighted by participants – for example, how can ocean literacy in communities be enhanced to ensure that citizens can actively and meaningfully contribute to the transformation of the blue economy? In addition, how can already ocean literate citizens ensure that their knowledge and understanding of the ocean is valued and effectively integrated into, and considered within, blue economy decision-making? While ocean literacy initiatives and research have historically focused on civil society, it is pertinent now to consider how ocean literate business communities are and to invest in improving this. In addition, the need to understand how business communities can be better engaged in ocean issues was raised as a key priority within this research theme – for example, how can businesses be encouraged to understand the importance of ocean literacy as a core component of their corporate strategy and product or service design? With many businesses seeking to improve their sustainability credentials, there may be routes to achieving this through existing social or environmental responsibility programs (Plewa et al., 2015). Moreover, there is the potential to harness the current momentum surrounding ocean literacy and its evolved dimensions to support efforts towards delivering sustainable and equitable blue economies on a range of scale. Recognizing the long standing challenge of attracting new entrants to maritime sectors (Scully, 2018), how can OLR be used to improve recruitment to ocean careers, ensuring that knowledge of the ocean also includes raising knowledge and awareness of maritime career opportunities or possibilities for business diversification? By understanding how people connect to and value their ocean spaces, OLR can clearly provide much needed insight to support the realization of sustainable and equitable blue economies.

### 3.2.4 Ocean literacy research as a policy mechanism

Given the focus within the UN Ocean Decade on ocean literacy as a potential mechanism for change, it is pertinent and timely to consider how OLR can feed directly into ocean and coastal decision-making, acting as an effective policy mechanism and delivering benefits for both the ocean and societal well-being (McKinley, 2022). One key component of this is a need for improved understanding of the science–policy interface and associated science diplomacy associated with ocean issues. Despite the growth in global interest in ocean literacy and its potential role in wider ocean governance, and achieving the goals set by multiple

international agreements (e.g., Plewa et al., 2015; Scully, 2018; Ferreira et al., 2021), examples of how ocean literacy has been integrated effectively into policy development are limited. Emerging research on the concept of marine citizenship (Brennan et al., 2019; McKinley et al., 2023) has explored the importance of political participation, framing marine citizenship as a way of democratizing the relationship between society and the ocean (IOC-UNESCO, 2024) and challenges those working with the OLR community to consider how to harness the current global focus on ocean literacy to work towards active political participation within the UN Ocean Decade and beyond. Recognizing that they are scarce, efforts to move beyond research to meaningful policy action are beginning to emerge. Moving beyond merely evaluating "levels" of ocean literacy within communities to develop Ocean Literacy Strategies (e.g., Canada's Ocean Literacy Strategy), forming government directed Ocean Literacy Task Groups (as seen in in the UK), and implementing local council initiatives, such as the Motion for the Ocean declarations being made by local councils across the UK (Scully, 2018) are just some of the current examples, while, in 2021, Santos, Brazil became the first place to enact ocean literacy into a public policy for school education (MacNeil et al., 2021).

Despite the efforts listed above, the workshop highlighted the need for any future OLR agenda to be multi-scale and multi-sector, moving away from only including the "usual suspects" and including a diverse range of disciplines. It was recognized that OLR has relevance across a range of policy areas, including education, health, trade, transport and infrastructure, with questions raised as to how OLC can support development of public policy to transform and improve the connection of a community (of varying scales) to commit to a sustainable ocean future. To achieve this, however, the levels of ocean literacy within decision-making bodies must be understood. Early work on this is being carried out through the UKRI funded Diverse Marine Values project in the UK, which is working closely with key policy actors to identify existing policy blocks and entry points to support the integration of diverse values into marine decision-making, fostering and enhancing ocean literacy both within the institutions themselves, as well as the communities in which they work (Ferreira et al., 2021). Crucially, it is apparent that there is an appetite for ocean literacy to realize its potential as a policy mechanism; however, future OLR is required to understanding its role in existing the ocean governance landscape, identify meaningful pathways to policy impact and develop recommendations to support the use of ocean literacy as a practical policy tool.

### 3.2.5 Equity, diversity and inclusion and ocean literacy research

Through this participatory process, it was clearly identified that future OLR must place equity, diversity, and inclusion (EDI) at its core. Topics of justice and equity relating to the ocean have received a growing level of attention in recent years, resulting in the emergence of a number of similar terms – ocean justice, blue justice, ocean equity (IOC-UNESCO, 2024). As commented by Bennett (IOC-UNESCO, 2024), while sometimes interpreted

slightly differently and used by different audiences and/or communities of practice, the overarching commonality within these terms is a need to address issues of equity and justice relating to ocean topics. Discussed under the heading of EDI in this paper, the interconnected yet unique topics are complex; and with this in mind, it must be noted that a lens on EDI in theory is acknowledged different in practice. Awareness, sensitivity, and intersectionality must be at the core of research efforts, to recognize the ways that diversity is different from inclusivity, as is justice from equality and equality from equity, across places and contexts (Buchan, 2023). There is a need, therefore, for OLR to draw on critical social science and governance theories that can explore the environmental justice dimensions of OLR, including power dynamics and various social, economic, and cultural factors. Furthermore, in local and global contexts, situated knowledge and the myriad of ways of knowing must be recognized, accepted, and incorporated in ways that uphold the values of the knowledge holders and their respective insight. Particularly in local, place-based contexts, knowledge holders hold key insights to timelines and cycles that are essential to solutions and innovations. Perceived "merit" (or lack thereof) that stems from bias toward education, race, ethnicity, varying abilities, age, gender orientation, geography, employment, religion, or other, must be seen for what it is – discrimination and exclusion of the multitude of voices and experiences that all connect to the ocean, and are needed for ocean solutions.

Through this process, a number of priority research areas were highlighted providing a starting point for future OLR. There is a need perhaps for the OLR community to reflect on ocean literacy efforts to date, and evaluate how inclusive and diverse these have been – for example, what narratives are currently used to communicate ocean stories and enhance ocean literacy? Whose voices, from what communities, are dominant? Further questions were raised as to how future OLR can work to disrupt historical power dynamics and the privilege which can be inherent in much ocean activism or advocacy. These questions echo those from recent literature where the need to recognize the legacy of ocean literacy's academic beginnings on current initiatives, and the unintentional barriers that these foundations may have established, are discussed (see for example Sustainable Management of UK Marine Resources). In addition, considering who has access to ocean literacy initiatives, and indeed the ocean more generally, is another aspect which must be considered if the OL movement is to be truly inclusive and equitable. McKinley et al. (2023) suggest moving away from the notion that accessing and experiencing the ocean can only be achieved by physically being in that space, and suggest that access, experience, connection, and by virtue of this, ocean literacy, can be enhanced through a multitude of media and experiences (e.g., technology advancements such as Virtual Reality bringing the ocean to people regardless of proximity or ability) (Bennett, 2022). The need for future OLR to be cognizant of varying levels of power, access, and capacity to engage in ocean literacy initiatives and to work with communities to develop mechanisms which support their engagement was seen as fundamental to

successfully achieving the UN Ocean Decade's goal of transforming relationships between society and the ocean.

## 3.3 Enabling and operationalizing OLR

The research areas discussed above are currently being mobilized toward action, with EDI as a cross-cutting theme as outlined above. As a continuance of the workshop and survey series, several OLR community members have volunteered as thematic group leaders to help organize conversations to: 1) co-determine one short-term research initiative related; and 2) co-identify one current research initiative/success story to be shared with the public at large. With the interests of collaborative practice remaining at the fore, the aim is to address each research area in ways that are supportive of, and supported by, enabling conditions for OLR, as next elaborated. The iterative research process adopted was designed and guided by the community, affording a deeper understanding of the enabling and operationalizing conditions for effective OLR and shaping our research process. Moreover, barriers to enabling conditions became apparent for our collaborative problem-solving, while also providing important lessons for future OLR practice. We further discuss both enabling conditions and barriers below.

The co-development of the research was an enabling condition in and of itself. Being situated in a co-design approach afforded surveys and workshops to be informed by OLR community members' diverse perspectives and experiences, which dovetailed into successive stages. While research leads helped to enable this process by organizing and hosting the virtual spaces required, the community members shaped the research course and direction. In the third survey and workshop, participants were asked which research area was of most interest to them, and how they saw themselves being involved. Of the 47 members who responded, the research areas of most interest included measuring ocean literacy (16), understanding and operationalizing ocean literacy as a policy tool (10), ocean literacy and climate change (10), ocean literacy and a sustainable blue economy (6), and ocean literacy and EDI (5). Interest in roles to advance research in these areas was most often expressed in writing publications/literature reviews (19), co-planning an upcoming workshop (17), strengthening communication and diverse engagement (16), leading a research area working group (12), and quantitative and/or qualitative analysis (9).

Despite these indications of interest, and our efforts toward inclusion and diversification of member involvement and participation, one notable question became apparent: How will community members self-organize their efforts? Given the added responsibility of coordination, an enabling condition for operationalizing OLR is having a dedicated coordinator to facilitate collective directions. A coordinator to take the lead through a paid position, dedicating effort toward continued and sustained OLR community collaboration, communication, engagement, education, and deliverables. Without this designated role, responsibility falls on the continued volunteer efforts, which can be challenging to sustain due to limitations in time and the effort required to carry out coordinating tasks. Moreover, there are risks of duplication of work, divisions of perceived ownership, and silos in organization and practice due to lack of coherence and coordination across the

OLR community. At a time when there is an overwhelming global interest and escalating OLR movement spurred by genuine interests, desire, and ambition to advance this work, we must collectively address ways for our iterative and co-designed research processes to be self-sustained and mobilized by a global community in action. This presents both a barrier and importantly, an opportunity.

Alongside coordination and collaboration, additional barriers were discussed by OLR community members, which have been commonly identified in previous studies. Namely, operational barriers to OLR including funding (multi-year) and resultant competitiveness to secure available funds; time zone differences as a challenge for multi-partner collaborations and effective engagement in OLR initiatives; individual schedules and existing responsibilities; access to technology and internet to connect; capacity for translation into multiple languages; as well as the intentional creation of spaces and systems that allow for diverse representation.

From the perspective of describing OLR, barriers may also exist broadly in relation to ocean literacy as a concept. To enable OLR, there is perhaps a need to redefine what is meant by "ocean literacy" to ensure the definition takes account of how the concept has evolved since its inception, and in particular, how it has moved away from a knowledge or information deficit approach. OLR community members discussed a need to consider more than just "awareness" and to account for diversity in values, emotional connections, and ways of knowing, including knowing the ocean as ALL of the waterways flowing to and from – echoing recent work emerging from the OL literature (Sustainable Management of UK Marine Resources; McKinley et al., 2020; Paredes-Coral et al., 2021). How these aspects translate into ocean literacy and OLR requires further investigation, especially considering ever-apparent changes due to such collective impacts as climate and globalization. Future OLR must be done in a way that respects and includes diverse cultures, ethnicities, knowledge systems, and languages.

Although it may appear that more barriers than benefits are presented herein, the emphasis is not on insurmountable challenges, but on attainable and enabling opportunities. We draw this sentiment from the OLR community voices expressed in our research, and present these barriers as opportunities for ongoing collaborative learning, growth, and collective action. The need to understand diverse relationships with the ocean through the co-creation of, and support for, self-mobilizing spaces is paramount; to reimagine the ways in which OLR is representative and supportive of all voices. Toward this end, we propose the following initial working definition of OLR:

> *transdisciplinary, cross-sector field of research which explores the diverse dimensions, drivers, influences, and impacts of initiatives aimed at strengthening human–ocean relationships. It seeks to understand how these aspects may vary in different social, economic, cultural, political, and geographic contexts and is inclusive of diverse voices, actors and ways of engaging with the ocean.*

Given the continued collaborative insight and efforts needed to promote ocean health during the UN Ocean Decade and beyond, a clear and transparent working definition of OLR can serve to unify

and distinguish research efforts, inform policy, and guide adaptive and transformative UN Ocean Decade actions.

# 4 Conclusion: current steps and continued efforts

Ocean literacy research is key to delivering the goals of the UN Ocean Decade across globally diverse contexts, and is central to understanding the opportunities arising from the growing recognition of the relevance of ocean literacy. Resounding sentiments across the workshop series expressed the potential of OLR to expose, expand, and draw on collective understandings of what initiatives and approaches are demonstrating efficacy and impact towards achieving the UN Ocean Decade goals so we can, in turn, amplify and scale; and likewise, what is not working, so we can pivot, reimagine and move forward. Just as ocean literacy now finds itself at the center of wider ocean science and governance discourse, we suggest that OLR be positioned as a key mechanism of change and a path to a restored relationship between society and the ocean (Glithero et al., 2024) – the overarching aim of UN Ocean Decade actions.

Several OLR recommendations and priorities which can be linked with the societal goals of the UN Ocean Decade have been co-identified through our research:

- There is a clear need to develop useful and transferable metrics and indicators of ocean literacy, beginning with co-identified priority research themes;
- There is a need for the OLR community to be reflexive and consider redefining and/or challenging what is meant by "ocean literacy" and who has historically been included in ocean literacy discussions and initiatives, to ensure diverse representation and resonance with multiple audiences and communities;
- Ocean literacy is not static – it is dynamic and likely to be in an ever-changing state of flux, reflecting the complexity of societal relationships with the ocean. OLR therefore must investigate how perceptions of the ocean may change in the face of constant change. Further, OLR must explore how diverse values, emotional connections, and ways of knowing ocean/coastal/marine environments, and the connecting inland waters, translate into agency, behavior change, and personal/collection action towards a healthy ocean;
- In addition to understanding public levels of ocean literacy, there is also a need to look beyond civil society and for OLR to consider how "ocean literate" our ocean decision-making institutions are; and
- Finally, OLR needs to be coordinated. There is a need for ongoing engagement and collaboration across the OLR community, supported by appropriate resources and funding to ensure the potential impact of OLR can be delivered.

Overall, this research highlighted the need for any future OLR agenda to be multisectoral, transdisciplinary, and inclusive,

exploring the diverse dimensions, drivers, influences, and impacts of societal–ocean relationships. While it may be that approximately 40% of the world's population lives within 100 km (60 miles) of the coast (Amorim-Maia et al., 2022), 60% does not. Yet, the entirety of society is affected by ocean influences, and vice versa; understanding these influences is at the very core of ocean literacy. These diverse and complicated relationships, however held and understood, denote differential connections with the ocean – including all water and waterways flowing to it. Building the OLR community capacity, policy, and practice require openness to all ideas, values, and perspectives, as essential building blocks to ensure place-based and community-based realities are foundational within ocean literacy efforts. Crucially, this should include opportunities to learn from other areas of existing knowledge and practice surrounding similar themes, encompassing but not limited to, environmental education and sustainable development. With this intentional uptake and learning, opportunity and leadership arise to further expand ocean literacy and OLR agendas, with a community of practice that can continue to evolve across the UN Ocean Decade and beyond.

# Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ESRI organizational account privacy settings.

# Author contributions

# Funding

## Conflict of interest

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

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2024.1469451/full#supplementary-material

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