



Human-ocean relationships: Exploring alignment and collaboration between ocean literacy research and marine conservation

Jen McRuer ^{a,*}, Emma McKinley ^{b,2}, Diz Glithero ^{a,3}, Ronaldo Christofoletti ^{c,4}, Diana Payne ^{d,5}

^a Canadian Ocean Literacy Coalition, Canada

^b School of Earth & Environmental Sciences, Cardiff University, MarSocSci, UK

^c Instituto do Mar - Universidade Federal de São Paulo, Brazil

^d Connecticut Sea Grant, University of Connecticut, USA

ARTICLE INFO

Keywords:

Ocean literacy research, Community, and Program
Ocean Literacy Dialogues
Marine conservation
Ocean decade

ABSTRACT

In recent years, global attention on marine conservation and sustainability has surged. Understanding the relationship between society and the ocean is crucial for achieving conservation targets, ocean sustainability, and community well-being. Toward these ends, the UN Ocean Decade recognizes ocean literacy as a transformative mechanism to reshape society-ocean relationships. Ocean literacy seeks to empower global communities to better understand, value, and care for the ocean in ways that support, restore, and ensure ocean-human health and well-being. By extension, ocean literacy research is an emergent transdisciplinary field of inquiry that explores diverse dimensions, drivers, and impacts of human-ocean relationships. It considers these relations across different socio-cultural, economic, political, and geographic contexts and perspectives. In this article, we position ocean literacy research and the wider concept of ocean literacy as a framework for exploring the relational aspects of marine conservation to inform effective policy and conservation. We begin by situating ocean literacy and ocean literacy dimensions, research priorities, and community alongside broader ocean conservation efforts. We next share insights gleaned from the third edition of the Ocean Literacy Dialogues series, led by the Canadian Ocean Literacy Coalition and the Marine Social Sciences Network, with support from IOC-UNESCO, held during the fifth International Marine Protected Area Congress (IMPAC5) in Vancouver, in early 2023. Through a series of participatory sessions, we explored the application of ocean literacy research in supporting future marine conservation and management. Drawing on insights co-developed through this process, we outline potential agenda alignment between IMPAC5 marine conservation themes and co-identified ocean literacy research priority areas. We lastly speak to the importance of ongoing collaborative initiatives like the Ocean Literacy Dialogues series to foster global collaborations, dialogue, and capacity sharing to advance ocean literacy, marine conservation, and policy efforts.

1. Introduction

The ocean plays a life-dependent role in collective societal health and well-being [3], yet it is experiencing biodiversity loss and ecosystem degradation of unprecedented scales. The impacts of the twin climate and biodiversity emergencies are being felt across ocean systems and

coastal communities, resulting in an urgent need to rethink priorities, policies, and procedures within marine conservation, as well as reimagine opportunities for community bridging, capacity sharing, and aligning agendas [12,14]. Aligning marine conservation goals with marine social science research and practice offers a tangible area of focus to deliver the change needed to address ocean challenges. This is

* Corresponding author.

E-mail addresses: jen@colcoalition.ca (J. McRuer), McKinleyE1@cardiff.ac.uk (E. McKinley), diz@colcoalition.ca (D. Glithero), christofoletti@unifesp.br (R. Christofoletti), diana.payne@uconn.edu (D. Payne).

¹ Research Manager, Canadian Ocean Literacy Coalition; Dalhousie University, PO Box 15000, 6283 Alumni Crescent, Room #44, Halifax, NS, B3H 4R2

² Senior Research Fellow, Cardiff University, Cardiff Wales CF10 3AT United Kingdom

³ Executive Director, Canadian Ocean Literacy Coalition; Dalhousie University, PO Box 15000, 6283 Alumni Crescent, Room #44, Halifax, NS, B3H 4R2

⁴ Instituto do Mar - Universidade Federal de São Paulo, Brazil Unifesp Edifício Mariângela Duarte - Rua Silva Jardim, n° 136 - Santos - SP - CEP: 11015-020

⁵ Connecticut Sea Grant, University of Connecticut, Lowell P. Weicker Jr. Building, 1080 Shennecossett Rd, Groton, CT 06340

<https://doi.org/10.1016/j.marpol.2024.106418>

Received 15 November 2023; Received in revised form 27 August 2024; Accepted 27 August 2024

Available online 11 October 2024

0308-597X/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

evidenced by international commitments to protect 30 % of terrestrial, inland water, coastal and marine areas by 2030 [10], for example through the designation of Marine Protected Area (MPA) networks (or Marine Protected Areas (MPAs), collectively) and the recently approved High Seas Treaty [35]. Complementary to these initiatives is the Barcelona Statement published in May 2024 [16] that outlines key global priority areas toward ocean solutions with an emphasis on human-ocean connections. For these and other initiatives, social science research focused on ocean, coastal, and freshwater environments will be key to ensure conservation efforts are grounded in diversity and equity. As efforts toward the 2030 target continue, it is increasingly apparent that success depends on formative and integrated understandings of 'the peopled seas' [3] that are defined by local contexts and community values. Without such consideration, guiding questions such as—What biodiversity and ecosystems to prioritize? Which designations are supportive, and supported? How are local communities involved and affected? and How are sustainability and equity being meaningfully considered?—are open for debate. Moreover, if diverse relationships are neglected, how to sustain efforts toward protection remains unclear. To support the success of ocean protection efforts, including through MPAs, society's reliance on the ocean and our understanding of its contribution to our well-being, must be at the fore.

The United Nations Decade of Ocean Science for Sustainable Development (2020–2030) (henceforth 'Ocean Decade') and the Framework for Action by the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO) have recognized ocean literacy as a transformative mechanism for understanding and reshaping society-ocean relationships [15]. At its simplest, ocean literacy refers to understanding how the ocean influences us and how we influence the ocean. Originally focused on education and knowledge of core ocean science principles [8,26], the field of ocean literacy has expanded to include the intricacies of human-ocean connections, both internal factors (e.g., emotions and values) and external (e.g., politico-economic and socio-cultural) [19,31]. These factors guide human behaviours and decision-making shaping our health, well-being, livelihoods, economies, geographies, cultures, and more. Research aimed at exploring the myriad of influences on human-ocean connections, using the evolving concept of ocean literacy as a framework, provides valuable insight into ecological, social, economic, and political dimensions of marine conservation. For example, recent work by McKinley et al. [22] has further expanded ocean literacy to include ten proposed dimensions. Summarized in Fig. 1, they recommend expansion of the six dimensions proposed by Brennan et al., [5], namely, knowledge, attitude, awareness, communication, behaviour and activism, to include 'emoceans' (i.e., emotional connection to the ocean), access and experience, trust and transparency, and adaptive capacity. Research on measuring each dimension of ocean literacy and their collective influence on fostering motivation, opportunities, and capabilities for behavior change across scales is essential [13]. This work can better inform evidence-based, locally-contextualized policies and practices that support adaptive and effective marine conservation measures aligned with global sustainability targets.

This paper highlights key insights derived from the third edition of the Ocean Literacy Dialogues series that was held during the fifth International Marine Protected Area Congress (IMPAC5) in Vancouver, in early 2023. By bringing together ocean literacy and marine conservation experts, we explored the application of ocean literacy research in supporting future marine conservation and management. Drawing on insights co-developed through a participatory dialogue process, we outline potential agenda alignment between IMPAC5 marine conservation themes and ocean literacy research priority areas. We lastly speak to the importance of ongoing collaborative initiatives like the Ocean Literacy Dialogues series [7] to foster global collaborations, dialogue, and capacity sharing to advance ocean literacy, marine conservation, and policy efforts. While not an empirical or exhaustive study, this paper is

timely in that it seeks to explore the alignment between the growing ocean literacy agenda and ongoing marine conservation efforts.

1.1. Introducing ocean literacy research

Ocean literacy research has been co-defined as 'an interdisciplinary, cross-sector field of research which explores the diverse dimensions, drivers, influences, and impacts of initiatives aimed at strengthening human-ocean relationships. Ocean literacy research 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.' [24]. In these ways, it is foundational to growing and strengthening the ocean literacy movement, and is essential to informing marine conservation initiatives and tools, including MPA designation. Ocean literacy research enables collective insight into what experiences, approaches, and messaging help to transform people's understanding of, and relationship with, the ocean; as well as what aspects of ocean literacy work are fostering agency, driving behaviour change, and influencing ocean policy.

As marine protection goals increasingly seek to meaningfully include human considerations into marine conservation efforts inclusive of design, designation, and implementation [1,12], ocean literacy research is foundational to inform perceived value, support, and impact of said efforts. The ocean literacy research agenda aligns with growing calls for improved understanding of human-ocean relationships, as is particularly evidenced by the growth in public ocean perceptions research [17, 21,27]. In other efforts, Paredes-Coral et al. [25] analyzed existing ocean literacy research outputs, leading them to conclude that ocean literacy, science, and policy are needed to support common agendas such as the blue economy,¹ which is increasingly being encouraged to consider aspects of marine conservation. Bennett et al. [4] support this sentiment, stressing that the 'rhetoric of equity, inclusion, and benefit sharing appears to be outpacing (blue economy) policy-making and the implementation of best practices,' further emphasizing the need for the more holistic lens afforded by the evolving concept and practice of ocean literacy research. This has the potential to bridge common efforts toward improved understanding of these human dimensions to support efficient implementation and monitoring of conservation initiatives. With growing political weight attributed to it, and building on its broader marine social science research foundations [36], ocean literacy research can importantly shed light on the ways intentional, collaborative efforts can emphasize and strengthen the varied approaches working toward the common goal of ocean-human health and wider marine conservation.

2. Ocean literacy research priorities and the research community

The importance of establishing a coordinated ocean literacy research agenda based on co-identified research priorities and initiatives across scales (organizational, domestic, regional, and global) has been recently acknowledged (e.g., All-Atlantic Ocean Research Alliance). In order to achieve the Ocean Decade goals, a cohesive approach is needed to augment ongoing research endeavors; facilitate knowledge exchange between research and policy-making; and strengthen collaborative efforts in funding, dissemination, communication, and co-designing strategies. However, previous efforts to establish collaborative research projects, both within and outside the field of ocean literacy research, have been limited to successful and long-serving academic funding proposal outcomes, making joint efforts difficult to sustain. Attempting

¹ The blue economy can be defined as "a long-term strategy aimed at supporting sustainable economic growth through oceans-related sectors and activities, while improving human well-being and social equity and preserving the environment" [34].



Fig. 1. Evolving Dimensions of Ocean Literacy. (Adapted from [23]).

to remedy these challenges, a global initiative² was launched in July 2021 with the aim of co-developing an ocean literacy research program for the Ocean Decade and beyond. The initiative supported a research agenda and direction by creating an Ocean Literacy Research Community (OLRC) through an emergent series of workshops and thematic surveys (see [24]) to:

- Co-identify ocean literacy research priorities and gaps;
- Co-develop potential collaborative and comparative research initiatives;
- Share and examine existing measurement tools of ocean literacy and, where necessary, co-design new ones to track changes and impacts, domestically and internationally, over the Decade (and beyond); and
- Co-develop a shared understanding of how ocean literacy research can feed into practice through key pathways, leverage points, and impact opportunities.

This initiative resulted in the generation of a definition of ocean literacy research (see ‘Ocean Literacy Research’ subsection above); and the analysis of participant contributions, yielding five co-identified ocean literacy research priority areas (see Table 1). By co-establishing a coordinated OLRC and dedicated ocean literacy research program to address these priority areas, streamlined messaging and targeted joint proposals can help leverage and secure long-term partnerships and

² By the Canadian Ocean Literacy Coalition, the Marine Social Science Network, and University of Portsmouth.

sustained funding for the Ocean Decade and after 2030. The developing OLRC is committed to ocean science diplomacy—inviting the co-development of knowledge and best practices. Ultimately, it aims to promote better inclusion, equitable representation, and efficient research and action among diverse partners with aligning agendas toward ocean-human health goals.

3. Aligning ocean literacy research and marine conservation

Ocean literacy research and the wider concept of ocean literacy provides a valuable framework for exploring the relational aspects of effective marine conservation across a range of scales. Take for example, MPAs, which have historically intended to ensure the sustainable use and protection of marine ecosystems [18]. Today, they are increasingly adopted as an ocean management and conservation tool, seeking to consider not only the ecology of ocean environments, but also the interests of different user groups such as conservationists, industry professionals, and coastal communities (e.g., [9,30]). Too often, however, MPA design (and wider conservation efforts) fail to reflect all vested interests and thus the incorporation of diverse understandings of human-ocean relationships [6,29]. This oversight results in ineffective strategies, inadequate protection, and a lack of shared commitment for successful implementation [29,32]. To promote timely and effective conservation efforts, ocean literacy research has a significant role to play.

Ocean literacy research offers policy-makers evidence-based insights into the complex interactions between human activities and marine ecosystems. Ocean literacy research can inform comprehensive

Table 1
Co-identified Ocean Literacy Research priority areas, associated needs, and importance.

Priority Area	Identified Need
Measuring Ocean Literacy Dimensions and Impact	There is a need to develop metrics of assessment to ensure the effectiveness of ocean literacy initiatives. Historically, ocean literacy research has focused on assessing ocean knowledge, yet there has been limited focus on the design of tools to measure the impact of ocean literacy initiatives. For example, measuring each of the dimensions of ocean literacy and their influence on fostering behaviour change. Doing so can help to support sustainable ocean management and governance across a range of topics (e.g., protected area designations, blue economy agendas).
Ocean Literacy Research and Climate Change	As the interconnectivity between ocean and climate continues to be positioned at the center of ocean governance debates, there is a need for ocean literacy research to consider the impacts of current and future climate change and how this might affect societal relationships with the ocean, and in turn, levels of ocean literacy in different communities. Additionally, ocean literacy research needs to include aspects of societal resilience and adaptive capacity in response to change.
Ocean Literacy Research and the Sustainable Blue Economy	There is a need to explore how the dual agendas of ocean literacy and the blue economy can be aligned (or not), including understanding how ocean literacy research can support: sustainable coastal economies; businesses becoming more ‘ocean literate’ (e.g., integrate pro-ocean actions into corporate social responsibility policies); making diverse ocean-based career paths more known and accessible; and measuring the impacts of blue economy activities. Research is also needed in relation to (Indigenous) conservation economies and how community views and values are being taken into consideration, e.g., cultural use and traditional rights.
Ocean Literacy Research as a Policy Tool	There is a need to test approaches and develop recommendations to support the use of ocean literacy as a practical policy tool such that ocean literacy research can feed directly into decision-making with a focus on better understanding the science-policy-society interface and associated science diplomacy.
Ocean Literacy Research and Equity, Diversity, Inclusion,	Future ocean literacy research must place equity, diversity, and inclusion at its core, drawing on critical social science and governance theories which can explore this ocean literacy research priority. Crucially, this must be enacted as a cross-cutting theme across all priority areas of ocean literacy research.

understandings of ocean health and the root causes of challenges, to facilitate the design of targeted policies, support conservation strategies, and foster public engagement at an early stage. The urgent need for improved understanding of human-ocean connections in relation to MPAs and conservation at large, is recognised in the Ocean Decade ocean protection targets, aligning policymaker and government

Table 2
Alignment between five core marine conservation themes from IMPAC5 and co-identified ocean literacy research priority areas; discussed with international participants during the Ocean Literacy Research Café.

IMPAC5 Themes	Ocean Literacy Research Priority Areas	Example of aligning question
Building a Global MPA Network	<ul style="list-style-type: none"> • Knowledge, Awareness, Communication • Policy Tool 	What are effective knowledge-sharing approaches to build public awareness of/ support for MPAs, and how can ocean literacy research be used to support policy?
Managing MPA and Human Activity	<ul style="list-style-type: none"> • Measuring Ocean Literacy Dimensions and Impact • Climate Change 	How are we monitoring and evaluating behaviour change?
Conserving Biodiversity and Addressing Climate Change	<ul style="list-style-type: none"> • The Sustainable Blue Economy • Equity, Diversity, and Inclusion 	How does the public understand, experience, and feel about climate change?
Advancing Conservation in the Blue Economy		How does a sustainable blue economy impact, engage, and incentivize the public?
Connecting Ocean, Culture, and Human Well-being		How do intergenerational interactions with the ocean (and local waterways, coastal areas, sea ice) inform cultural identity, social values, and practices?

agendas, and associated planning and convening. Integrating ocean literacy research into conservation efforts, such as MPA design and implementation, is essential to planning effective, people-centered, science-based strategies for protecting and responsibly managing the global ocean for future generations.

IMPAC5 presented a timely opportunity to explore the potential alignment between the marine conservation themes guiding the Congress agenda and the co-identified ocean literacy research priority areas (see Table 2). A participatory Ocean Literacy Research Café³, facilitated by the OLRC lead coordinating organization⁴, co-organizing institution⁵, and supporting partners⁶, featured context-setting introductions and dynamic conversations to explore the application of ocean literacy research in supporting future marine conservation and management through the lens of the IMPAC5 themes. Over 60 participants⁷ from more than 10 countries representing diverse fields of expertise, discussed: potential alignment between these agendas; the importance of finding synergies for collaboration; how best to promote and facilitate active dovetailing; and how to better support inclusion of more voices within marine conservation efforts.

Participant-led insights (see Table 3) positioned ocean literacy research as a fundamental tool for marine conservation to influence decision-making and offer enhanced understanding of the science-

³ A participatory workshop hosted by a team of OLRC facilitators, the Ocean Literacy Research Café began with a context-setting introduction followed by dynamic Café conversations with participants—one per IMPAC5 Theme—before returning to a concluding plenary. The Café provided space to share observations in a public venue without manipulating the context or environment, and thereby document a common theme through public information sharing and dialogue. The Ocean Literacy Research Café concluded an initial workshop series aimed at co-developing a global ocean literacy research program for the UN Ocean Decade.

⁴ Canadian Ocean Literacy Coalition

⁵ Cardiff University and MarScoSci

⁶ Instituto do Mar-Universidade Federal de São Paulo, University of Connecticut

⁷ In the context of the research [herein], participant information is non-identifiable for all practical purposes, when used alone or combined with other available information. Perspectives were shared in group conversation and setting, were not digitally recorded, and conversation notes on arising themes were not associated with any kind of identifier.

Table 3
Participant-led insights on marine conservation themes specific to MPAs and ocean literacy research.

Marine Conservation Theme and Ocean Literacy Research Priority	Arising Synergies	Policy-Specific Insights
Connecting ocean culture and human well-being (Ocean Literacy Research and Equity, Diversity, and Inclusion: Toward social-ecological justice)	<p>Accessible language and solutions: Need to recognize different knowledge, cultures, and conversations.</p> <p>Recognition of diverse ways of knowing and being connected to the ocean; the need to learn from already ocean literate communities and people.</p> <p>Need to further identify ocean literacy research and MPA synergies, across places and ways of knowing.</p>	<p>Ocean literacy research can help to identify and design solutions with which everyone can access and engage.</p> <p>MPA agendas can be strengthened by drawing on the insights gleaned from ocean literacy research investigating diverse human-ocean relationships.</p> <p>To ensure relevance and effectiveness, policies must be grounded in local community ocean relationships (knowledge, cultures, values, actions, barriers).</p> <p>Ocean literacy research can help to generate qualitative and importantly quantitative data needed by policy makers related to, for example: community engagement in MPAs (needs/priorities), tracking community-ocean relationships, adaptive capacity at local levels, and climate change understandings.</p> <p>Policy is needed that reflects systems-thinking in action, not just on paper; need to broaden the reach and potential of ocean-based climate solutions.</p>
Conserving biodiversity and addressing climate change (Ocean Literacy Research and Climate Change)	<p>Adaptive capacity and need to assess priorities of communities related to MPAs.</p> <p>Need to understand how inland communities understand climate change and its relationship to marine conservation; opportunities to action ocean-based climate solutions that are supported for, and by, MPAs.</p> <p>Government frameworks, need for data, and public perceptions ocean research.</p>	<p>Data and documentation needed for policy-digestible communication.</p>
Building a Global MPA Network (Ocean Literacy Research and Knowledge, Awareness, Communication)	<p>Highlight/create opportunities for targeted messages and personal connections with the ocean.</p> <p>Ocean literacy research on the influence of connection with the ocean/water to ocean careers and strengthened pathways for broader public engagement in marine conservation.</p> <p>Need sustainable source (s) of funding, time, and people.</p>	<p>Communication gap: science-policy-public; Community-centered science through co-design, and actioning of science; Identifying existing models/bright spots.</p> <p>Understanding how public interest in/ connection to the ocean may inspire marine conservation career pathways and encourage public input in policy-making.</p> <p>Learning from successful policies/structures (e.g., national parks) to strengthen policy impacts.</p>

Table 3 (continued)

Managing MPA and Human Activity (Ocean Literacy Research and Behaviour Change)	<p>Need for ocean literacy research to evaluate community attitudes/perceptions towards MPAs and wider marine conservation strategies at various stages of design, designation, and implementation.</p> <p>Opportunity to better understand how ocean literacy research can be used to leverage support for MPA designation and successful implementation (e.g., understanding motivators and barriers toward the social acceptability of MPAs).</p> <p>Need for ocean literacy research to identify community priorities relating to marine conservation and to identify opportunities to support MPA designation for alternative reasons (e.g., preservation of cultural heritage).</p> <p>Ocean literacy research is needed to better understand motivations of behaviour change.</p>	<p>In order to achieve the 2030 targets, there may be opportunities to designate MPAs for social and cultural reasons, resulting in a more holistic approach to marine conservation efforts.</p> <p>Clear need for specific mechanisms to engage local and Indigenous communities in discussions regarding MPA designation and related management measures which may impact use/behaviour in the ocean space.</p> <p>Policies reflective of public sentiments and priorities (as discerned through ocean literacy research), have greater potential to lead to improved community engagement and action being taken to support MPAs.</p> <p>In relation to MPAs, ocean literacy research can provide insight into the efficacy of penalties and incentives and how these may motivate acceptance of management measures.</p> <p>The need to build a synergistic conservation and sustainable blue economy narrative, rather than a conflicting approach.</p> <p>The need for policies based on risk assessment and definition of limits for resource use.</p> <p>To establish participatory decision-making processes to decrease stakeholder conflicts.</p>
Advancing Conservation in the Blue Economy (Ocean Literacy Research and the Blue Economy)	<p>MPAs promote a healthy ocean and can be developed to align with a sustainable blue economy.</p> <p>The importance of understanding the uses for a sustainable blue economy, and to provide an alternative to exploitative, non-renewable activities.</p> <p>Engaging stakeholders to co-produce and build consensus on sustainable activities to transform conflicts.</p>	

policy-society interface. It is notable that many synergies exist across themes and priorities, emphasizing the need to comprehensively consider agenda alignments, and the opportunities for improved integration and holistic approaches.

Discussions to date of how to manage and govern the ocean and its resources [6] are not doing enough to adapt to the current, and forthcoming challenges that we, as a society, face. As was identified in our participatory cafe, there exists a collective need to prioritize place-based considerations and dismantle structured affiliations that have stagnated. Alternatively put, we need to explicitly face our decision-making, management, and behavioural trajectories in ways that incentivize change to ensure ocean-human health through re-envisioned drivers and shared agendas [13]. It was clearly expressed throughout workshop conversations that ocean-human health requires transformative action beyond business-as-usual approaches, despite current best intentions. We must importantly position dovetailing agendas to address shared

challenges of sustainability, climate change, and biodiversity [10]; alongside social justice [3], earth justice [11,20], human rights [37], ocean rights [2], and the well-being of all, including current and future generations [33].

4. Discussion and concluding remarks

To ensure policy-makers can make well-informed decisions that positively impact marine conservation and sustainable resource management, the overall health of the ocean must be understood as inextricable from human-ocean connections. Thus, marine conservation decisions must be informed by, and grounded in human experience, to guide collective directions in place-based and resonant ways; to inspire us to see how our actions and resources influence overall well-being; and to ultimately ensure effective policies that lead to solutions and innovation. Recognizing the recent growth in interest in ocean literacy and related research, it is increasingly evident that ocean literacy research offers a valuable lens to investigate and understand the human dimensions of marine conservation. Indeed, as evidenced here, there are clear opportunities for improved collaboration between historically separate aspects of marine research. While not an exhaustive overview of every opportunity to align the ocean literacy and MPA research agendas, this paper provides a clear starting point for identifying opportunities of collaboration and synergy. For example:

- A need to consider diverse communities and their knowledge, values, and experiences within MPA designation and management.
- Development of climate and ocean literate MPAs which support the actioning of climate-ocean solutions driven by the needs of society.
- Development of clear awareness raising and targeted communication strategies which integrate ocean literacy insights to support marine conservation.
- Inclusion of ocean literacy assessments as central components of MPA impact evaluation to assess community attitudes and perceptions toward MPAs impacts, drawbacks, and benefits.

Crucially, integrating ocean literacy research into marine conservation work as standard practice would promote improved understanding of these complex human-ocean relationships and ensure that people are effectively integrated into MPA designation and broader marine conservation initiatives. Echoing calls within marine social sciences more broadly [3,22], in order for ocean literacy research to truly make a difference, it can no longer be an ‘add on’ within marine conservation. Nor can it continue to be viewed solely as an education or communication tool to raise awareness of MPAs, for example. Rather, as discussed during IMPAC5, marine conservation initiatives must integrate ocean literacy and all of its dimensions from the outset, and not be retrofitted into MPA processes, which has frequently been the case. Finally, the importance of facilitating participatory interdisciplinary, and collaborative marine research and practice is increasingly recognised as a crucial step in addressing ocean challenges [22,28]. Initiatives such as the Ocean Literacy Dialogues series that these workshops were part of, create space for inter-, and indeed, transdisciplinary sharing and learning, which are integral to capacity exchange and fostering dialogue to advance both the ocean literacy and marine conservation agendas.

Funding

This research was funded by the Canadian Ocean Literacy Coalition (Executive Director’s and Research Manager’s capacity contributions; visualization and graphic design; communication platform and technical support; travel, accommodations, and conference registration support for co-authors in Vancouver, Canada during IMPAC5); and extended contributions from Cardiff University, the Marine Social Sciences Network, and the UKRI Sustainable Management of the UK Marine Resources programme through the Integrating Diverse Values into Marine

Management project (research capacity contribution).

CRediT authorship contribution statement

Jen McRuer: Co-conceptualization, Co-investigation, Co-facilitation, Data curation, Writing - Draft Visualization, Original & Subsequent Drafts, Review & Editing. **Emma McKinley:** Co-conceptualization, Co-investigation, Co-facilitation, Writing - Draft Visualization, Subsequent Drafts, Review & Editing. **Diz Glithero:** Co-conceptualization, Co-investigation, Co-facilitation, Writing - Draft Visualization, Review & Editing, Acquisition of the financial support for the project leading to this publication. **Ronaldo Christofoletti:** Co-conceptualization, Co-investigation, Co-facilitation, Reviewer. **Diana Payne:** Co-conceptualization, Co-investigation, Co-facilitation, Reviewer.

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.

Data Availability

The non-identifiable group perspectives that were collected has been shared in the manuscript tables

Acknowledgments

We would like to thank all of the national, international, Indigenous, early career professional panelists and presenters who contributed their time, stories, and expertise throughout the 7 sessions of the Ocean Literacy Dialogue 3rd Ed. The contributions of this community of thought leaders helped to inform and shape the Ocean Literacy Research Cafe—<https://oldialogues3rded.colcoalition.ca/> In addition, we would like to thank the Canadian Ocean Literacy Coalition’s community for their selfless extensions of support, with special call outs to Meghan Callon for visualization, graphic design, and—in collaboration with Aneri Garg and Jacques Gautreau—their technical support and hybrid facilitation.

References

- [1] N.C. Ban, G.G. Gurney, N.A. Marshall, C.K. Whitney, M. Mills, S. Gelcich, S. J. Breslow, Well-being outcomes of marine protected areas, *Nat. Sustain.* 2 (6) (2019) 524–532.
- [2] M. Bender, R. Bustamante, K. Leonard, Living in relationship with the Ocean to transform governance in the UN Ocean Decade, *PLoS Biol.* 20 (10) (2022) e3001828, <https://doi.org/10.1371/journal.pbio.3001828>.
- [3] N.J. Bennett, Marine social science for the peopled seas, *Coast. Manag.* 47 (2) (2019) 244–252.
- [4] N.J. Bennett, A.M. Cisneros-Montemayor, J. Blythe, J.J. Silver, G. Singh, N. Andrews, U.R. Sumaila, Towards a sustainable and equitable blue economy, *Nat. Sustain.* 2 (11) (2019) 991–993.
- [5] C. Brennan, M. Ashley, O. Molloy, A system dynamics approach to increasing ocean literacy, *Front. Mar. Sci.* 6 (2019) 452048.
- [6] T. Brodie Rudolph, M. Ruckelshaus, M. Swilling, E.H. Allison, H. Österblom, S. Gelcich, P. Mbatha, A transition to sustainable ocean governance, *Nat. Commun.* 11 (1) (2020) 3600.
- [7] Canadian Ocean Literacy Coalition [COLC]. (2023, February). Ocean Literacy Dialogues. (<https://colcoalition.ca/projects/ocean-literacy-dialogues/>).
- [8] F. Cava, S. Schoedinger, C. Strang, P. Tuddenham, Science Content and Standards for Ocean Literacy: an Ocean Literacy Update, National Geographic Society, 2005.
- [9] P. Christie, N.J. Bennett, N.J. Gray, T.A. Wilhelm, N.A. Lewis, J. Parks, A. M. Friedlander, Why people matter in ocean governance: Incorporating human dimensions into large-scale marine protected areas, *Mar. Policy* 84 (2017) 273–284.
- [10] Convention of Biological Diversity [CBD], First Draft of the Post-2020 Global Biodiversity Framework, Link, 2022.
- [11] C. Cullinan, *Wild law: A manifesto for earth justice*, Bloomsbury Publishing, 2011.
- [12] A. Di Franco, K.E. Hogg, A. Calò, N.J. Bennett, M.A. Sévin-Allouet, O.E. Alaminos, P. Guidetti, Improving marine protected area governance through collaboration and co-production, *J. Environ. Manag.* 269 (2020) 110757.

- [13] L.D. Glithero, N. Bridge, N. Hart, J. Mann-Lang, R. McPhie, K. Paul, A. Peebler, C. Wiener, C. Yen, R. Kelly, J. McRuer, D. Hodgins, F. Curtin, Ocean Decade Vision 2030 White Papers - Challenge 10: Restoring Society's Relationship with the Ocean. Paris, UNESCO-IOC, Ocean Decade Ser. 51 (10) (2024), <https://doi.org/10.25607/ekwn-wh61>.
- [14] K. Grorud-Colvert, J. Sullivan-Stack, C. Roberts, V. Constant, B. Horta e Costa, E. P. Pike, J. Lubchenco, The MPA Guide: A framework to achieve global goals for the ocean, *Science*, 373 (6560) (2021) eabf0861.
- [15] Intergovernmental Oceanographic Commission, Revised Roadmap for the U N Decade of Ocean Science for Sustainable Development, 2018.
- [16] IOC-UNESCO. (2024). Barcelona Statement.
- [17] R. Jefferson, E. McKinley, H. Griffin, A. Nimmo, S. Fletcher, Public perceptions of the ocean: Lessons for marine conservation from a global research review, *Front. Mar. Sci.* 8 (2021) 1705.
- [18] S. Jentoft, T.C. van Son, M. Bjørkan, Marine Protected Areas: A Governance System Analysis, *Hum. Ecol.* 35 (5) (2007) 611–622, <https://doi.org/10.1007/s10745-007-9125-6>.
- [19] K. Kopke, J. Black, A. Dozier, Stepping out of the ivory tower for ocean literacy, *Front. Mar. Sci.* 6 (2019) 60.
- [20] M. Limon, United Nations recognition of the universal right to a clean, healthy and sustainable environment: An eyewitness account, *Rev. Eur., Comp. Int. Environ. Law* 31 (2) (2022) 155–170, <https://doi.org/10.1111/reel.12444>.
- [21] H.K. Lotze, H. Guest, J. O'Leary, A. Tuda, D. Wallace, Public perceptions of marine threats and protection from around the world, *Ocean Coast. Manag.* 152 (2018) 14–22.
- [22] E. McKinley, R. Kelly, M. Mackay, R. Shellock, C. Cvitanovic, I. van Putten, Development and expansion in the marine social sciences: Insights from the global community, *iScience* 25 (8) (2022).
- [23] E. McKinley, D. Burdon, R.J. Shellock, The evolution of ocean literacy: a new framework for the United Nations Ocean Decade and beyond, *Mar. Pollut. Bull.* 186 (2023) 114467.
- [24] McRuer, J., McKinley, E., Glithero, D., Paiz-Domingo, M. (in press). Ocean Literacy Research Community: Co-identifying Gaps and Priorities to advance the UN Ocean Decade. *Frontiers in Marine Science (Forthcoming)*.
- [25] E. Paredes-Coral, M. Mokos, A. Vanreusel, T. Deprez, Mapping global research on ocean literacy: Implications for science, policy, and the Blue Economy, *Front. Mar. Sci.* 8 (2021) 648492.
- [26] D.L. Payne, M.E. Marrero, S.E. Schoedinger, C. Halversen, The rise and fall of the tide: Ocean Literacy in the United States, *Mediterr. Mar. Sci.* 23 (2) (2022) 270–276.
- [27] T. Potts, C. Pita, T. O'Higgins, L. Mee, Who cares? European attitudes towards marine and coastal environments, *Mar. Policy* 72 (2016) 59–66.
- [28] E. Popova, Y. Aksenov, L.O. Amoudry, A. Becker, L. Bricheno, J.M. Brown, A. Yool, Socio-oceanography: An opportunity to integrate marine social and natural sciences, *Front. Mar. Sci.* 10 (2023).
- [29] A.N. Rife, B. Erisman, A. Sanchez, O. Aburto-Oropeza, When good intentions are not enough... Insights on networks of "paper park" marine protected areas, *Conserv. Lett.* 6 (3) (2013) 200–212.
- [30] M.D. Spalding, I. Meliane, N.J. Bennett, P. Dearden, P.G. Patil, R.D. Brumbaugh, Building towards the marine conservation end-game: Consolidating the role of MPAs in a future ocean. *Aquat. Conserv.: Mar. Freshw. Ecosyst.* 26 (2016) 185–199.
- [31] S. Stoll-Kleemann, Feasible options for behavior change toward more effective ocean literacy: a systematic review, *Front. Mar. Sci.* 6 (2019) 273.
- [32] J.W. Turnbull, E.L. Johnston, G.F. Clark, Evaluating the social and ecological effectiveness of partially protected marine areas, *Conserv. Biol.* 35 (3) (2021) 921–932.
- [33] United Nations General Assembly. (2022, July 26). The human right to a clean, healthy and sustainable environment. Accessed on 18/09/2022 at (<https://digitallibrary.un.org/record/3982508?ln=en>).
- [34] United Nations Department of Social and Economic Affairs. (2024). Exploring the potential of the blue economy. Available at: Exploring the potential of the blue economy | United Nations.
- [35] United Nations Treaty Collection (2023). Agreement under the UNIVED Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction. Chapter XXI Law of the Sea. United Nations. Accessed on 3/10/2024 at https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtmsg_no=XXI-10&chapter=21&clang=en.
- [36] J. McRuer, E. McKinley, D.L. Glithero. 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, 2025.
- [37] Assembly. United Nations General, Universal declaration of human rights, 302, UN General Assembly, 1948, pp. 14–25.