

Practitioner insights on challenges and options for advancing blue Nature-based Solutions

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ABSTRACT

The dual environmental crises of climate change and biodiversity loss pose severe threats to human health and well-being. Nature-based Solutions (NbS) are promoted as an important component of the response to simultaneously address both crises. However, their uptake in policy and planning has been impeded by evidence gaps and barriers to implementation, particularly in marine and coastal systems. Here, we describe practitioner perspectives on perceived challenges to implementing NbS in marine and coastal ecosystems (blue NbS) and make recommendations to overcome the most significant. These consensus perspectives were obtained through an exploratory, qualitative workshop, attended by environmental policy and practice stakeholders representing government and non-profit organisations from across Northern Europe, that identified and prioritised perceived challenges for in-depth discussion. Key priority challenges were: (1) policy driver and appropriate legislation to support NbS; (2) funding mechanisms; and (3) stakeholder awareness, values, and engagement. Discussions highlighted that successful implementation will require addressing these through better collaboration, communication, longer-term funding of projects, and better integration of top-down and bottom-up approaches to management. The strength, and at the same time difficulty, of NbS is that they draw together diverse actors and approaches, but improved standards are needed for application if they are to realise their potential. Ultimately, reducing uncertainty in the definition and concept of NbS amongst stakeholders is needed to accelerate their deployment in complex marine social-ecological systems.

1. Introduction

The world is changing rapidly from increasing human pressure on planetary systems [1–3]. Marine and coastal ecosystems are increasingly degraded, adversely affecting ecosystem service provision vital for human health and well-being [1,4]. Recently, focus has been directed towards using nature to address societal challenges, emphasising the importance of maintaining and restoring healthy ecosystems, and reducing human impacts, with actions that deliver co-benefits for nature and people. Nature-based solutions (NbS), which integrate protection, restoration, and management interventions, have therefore received

considerable attention at the science-policy-practice interface [5–7]. Evidence suggests marine and coastal (blue) NbS-like interventions provide ecological, social, and economic benefits when effectively implemented [e.g., 8–10]. Blue NbS are, therefore, an important strategy to fulfil local, national, and global environmental and societal ambitions as laid out in commitments to biodiversity protection, climate change, and sustainable development.

Despite the potential of NbS to protect biodiversity, confront societal challenges, and support communities, blue NbS implementation has been slow [6,11]. A better understanding of practitioner knowledge and experience is needed to advance blue NbS. Efforts to explore practitioner

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viewpoints are particularly timely given recent moves to include NbS within international policy commitments [e.g., The Kunming Montreal Global Biodiversity Framework, 12], and the need to deliver on these nationally. Therefore, we conducted an exploratory, qualitative stakeholder consultation workshop to provide insight into key challenges to blue NbS implementation perceived by practitioners, and their priorities for addressing them. Practitioners represented three countries across Northern Europe: England, Norway, and the Republic of Ireland; case study countries in the European Union's Horizon 2020 research project 'MaCoBioS' (www.macobios.eu) research project. Here, we summarise our discussions and present six practitioner-led recommendations to help inform blue NbS research and practice in Northern Europe and beyond. The challenges described and recommendations presented stem directly from workshop discussions. Consequently, to maintain integrity and avoid inference we refrain from drawing upon broader examples from literature in these sections, reserving this for our concluding remarks.

2. Gathering perspectives

A one-day workshop was held at the University of Portsmouth in March 2023 to collect views from Northern European blue NbS practitioners. We invited individuals from: (a) national and subnational public departments/agencies responsible for marine management and research; and (b) environmental non-profit organisations related to marine management and education. Participants were selected because they represent blue NBS projects ranging from coastal restoration through to marine protection in different social-ecological contexts thereby encouraging knowledge exchange by drawing from broad experiences. Workshop attendees comprised 13 individuals (7 female: 6

male) from England (n=7), Norway (n=3), and the Republic of Ireland (n=3) representing public entities (n=7) and non-profit organisations (n=6). Organisations represented were: Blue Marine Foundation, Eden Project, Environment Agency, Fair Seas, GRID-Arendal, Institute of Marine Research, Joint Nature Conservation Committee, Kent Wildlife Trusts/Wilder Carbon, Maharees Conservation Association, Marine Institute, Natural England, Ytre Hvaler National Park.

The workshop design was underpinned by three research questions that have important implications for the development and long-term sustainability of blue NbS implementation pathways: (1) What are the challenges to implementing blue NbS?; (2) Which present the greatest obstacle?; and, (3) How can we overcome them? The workshop began with an introductory presentation (background context, activity overview), before facilitated interactive exercises and discussions to elicit participant perceptions and reach consensus. Activities are described in full in Appendices A and B but, in brief, participants were asked to (1) create a list of challenges to blue NbS implementation perceived or directly experienced by their organisation; (2) rank these based on perceived level of impact; (3) characterise the top three priority challenges; and (4) consider how to overcome them. A live summary of discussions was compiled by two facilitators, circulated to participants for comments on accuracy and content, revised accordingly and reissued. Facilitators are experienced marine scientists spanning social, ecological, and environmental management specialties with experience working with practitioners at the science-policy interface.

All participants gave their informed consent prior to participating in this study. Ethical approval for the research was obtained from the Faculty of Business and Law Ethics Committee of the University of Portsmouth (Ref: BAL/2022/35/CORNET).

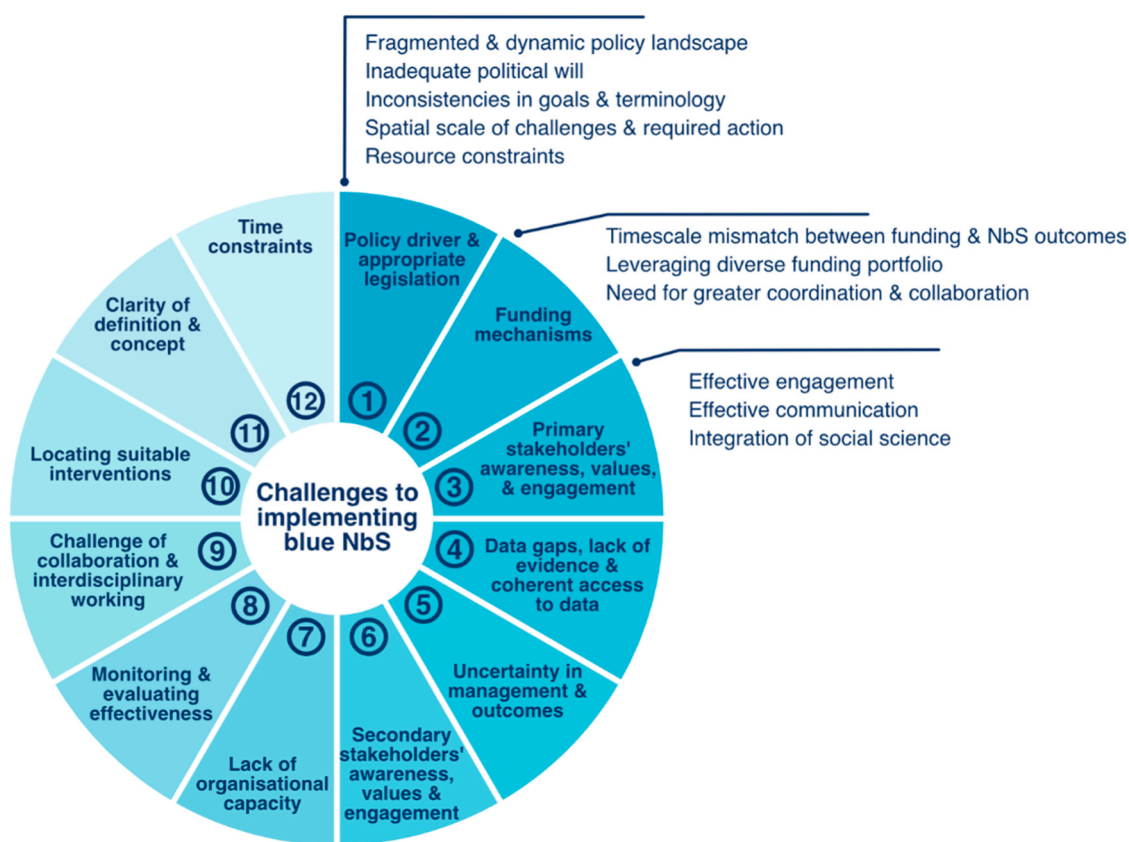


Fig. 1. Twelve challenges to blue NbS implementation recognised and ranked by participants according to perceived level of impact on implementation, with identified subthemes for the top three priority challenges. Note that stakeholders have been categorised as 'primary' and 'secondary' according to stakeholder theory [13]. Primary stakeholders are actors directly involved and affected by NbS that can influence decision-making or have a vested interest in the NbS. Secondary stakeholders are actors not directly involved or affected by NbS but may indirectly influence the process. All twelve challenges are summarised in Appendix C.

3. Challenges to implementing blue NbS faced by practitioners

Participants identified twelve challenges to blue NbS implementation and independently ranked these based on the perceived level of impact on implementation (Fig. 1, Appendix C). 'Policy driver and appropriate legislation', 'funding mechanisms', and 'primary stakeholder awareness, values, and engagement' emerged as the top three priority challenges; these were subsequently further discussed, and subthemes identified (Fig. 1).

3.1. Challenge 1: policy driver and appropriate legislation

Five subthemes were identified during discussions around this challenge (Fig. 1). Participants noted that a *fragmented and dynamic policy landscape* composed of several related policies that can conflict and change over time hinders NbS implementation. One common problem was the initiation of projects under one policy framework but completion under another with implications for consistency of data collection, monitoring, and priorities. Participants also felt that targets set under different policies do not necessarily promote NbS directly making it difficult to match NbS with policy drivers. Compounding this, participants perceived a lack of ownership for NbS because of the interdisciplinary approach they require for planning and management, and the disconnect between government departments and ambitions.

Related to this, NbS delivery was considered limited by *inadequate political will*, i.e., the capacity for political and legislative instruments to explicitly support NbS with sufficient resources. Participants recognised that it can be difficult to quickly update policy or legislation to reflect current goals and knowledge, and that this can be accentuated by changing political priorities and lack of long-term planning. However, they emphasised the long-term perspective that NbS require, considering the lag between implementation and outcome delivery (i.e. 10–30 years); timeframes that are at odds with short-term political cycles. Inadequate political will was also thought to impede community-led deployment and scaling up of, and sustaining, interventions.

Recognising uncertainty surrounding the clarity of the NbS concept, participants considered that *inconsistencies in goals and terminology* pose real barriers to NbS deployment. Differing language and legislative criteria between governments and agencies result in inconsistent advice hindering both top-down and bottom-up NbS design and deployment. Moreover, variations in terminology were felt to offer loopholes that can allow greenwashing.

The differing *spatial scale of challenges and required actions* was noted as adding further complexity to the fragmented policy landscape, with policy frameworks operating at different scales and often lacking cohesion. Because NbS exist in interconnected social-ecological systems, how one ecosystem is managed can impact others indirectly, emphasising the importance of an integrated land- and seascape perspective. However, this complicates coordination and integration of actions and stakeholders, including definition of roles, remits, objectives, and budget.

Finally, participants highlighted *resource constraints*, stating that effective NbS require adequate measures (e.g., rules, regulations) and enabling conditions (e.g., financial and capacity resources, stakeholder engagement) in place at the outset, but insufficient resourcing cause delays, and the absence of sustainable finance and incentives hampers NbS design and deployment.

3.2. Challenge 2: funding mechanisms

Three subthemes emerged while discussing this challenge (Fig. 1). The *timescale mismatch between funding and NbS outcomes* was noted as a considerable barrier to NbS implementation. Because NbS projects are typically funded for 3–5 years without guarantee of long-term support, there is a disparity between goals set and the delivery of outcomes that may accrue over much longer timescales. Furthermore, some

participants had encountered funding sources demanding guarantees on results that surpass the feasible assurance for ecosystem restoration or protection interventions. Others highlighted that, although some NbS will build on existing management efforts, many are new, meaning unpredictable funding gaps may emerge during project implementation. Of these, certain costs (e.g., staff time) are less attractive to funders.

Participants reflected that confusion surrounding the NbS concept was a key constraint for *leveraging diverse funding portfolios*. Environmental management actions were noted as being principally supported by short-term, fragmented, and insufficient domestic government spending, supplemented by voluntary private finance (e.g., philanthropy, NGOs). Given the long-term commitment that NbS require, the difficulty in accessing sustainable finance cementing governmental and philanthropic funding with complementary, alternative financing mechanisms presents a key impediment to NbS. Participants perceived the private sector as unwilling to invest in conservation due to uncertainty in outcomes. They also considered that funding bias can lead toward less appropriate intervention types with current funding focusing strongly on climate change-orientated projects. This means that NbS are prioritised for their climate role but not their biodiversity conservation value. In part this is driven by a failure to bring different sectors and actors together to achieve a portfolio of funds with communication targeted to the interests of funding actors. However, concern remains that suboptimal projects will arise from interventions tailored to the constraints of different funding streams.

Finally, participants emphasised that NbS have appeared in a highly competitive funding landscape and that there is an urgent *need for greater coordination and collaboration* between projects to reduce competition and ensure resources are best spent. NbS projects require high levels of collaboration. This means many organisations, people, ideas, and administrative processes that may not typically work together need to be aligned.

3.3. Challenge 3: primary stakeholders' awareness, values, and engagement

Three subthemes arose from discussions surrounding this challenge (Fig. 1). Participants felt *effective engagement* in NbS was generally missing or incomplete with late involvement of stakeholders making integration often seem an afterthought. Identifying stakeholders to involve, when and how is key to successful engagement that facilitates marrying perceptions and priorities of different groups, especially given the number and diversity of actors invested in blue NbS. Because there can be a lack of willingness from stakeholders to be integrated into projects due to engagement fatigue, the quantity and quality of engagement activities needs to be considered and designed to provide stakeholders with sufficient value gained from the activity to be worth their time and commitment.

Participants perceived that *effective communication* is key to engagement but often not clearly thought through, and agreed that NbS implementation is hindered by the lack of clarity regarding the concept and how actions deemed to be NbS relate to existing ones. This prevents consistency with communication, including terminology and expectations. For stakeholder consumption, language needs to be tailored to their values, perspectives, and understanding. Engaging with secondary stakeholders such as media outlets to frame project messaging was considered particularly important given their ability to influence perceptions and create enablers, or barriers, to action.

Lastly, the *integration of social science* in NbS was generally considered lacking. The importance of better linking social science with ecology was well-recognised by participants. In particular, they noted that NbS demands a much greater understanding of how social and cultural factors motivate and influence people to work with nature. Integrating social scientists and interdisciplinary approaches in project design will be critical to progress.

4. Advancing uptake and implementation of blue NbS

Participants saw great potential for NbS to align action on biodiversity recovery, climate change, and sustainable development in marine and coastal social-ecological systems. They felt that successfully addressing any of the priority challenges could advance blue NbS; addressing all three would substantially improve practitioners' ability to effectively deploy blue NbS. Moreover, while recommendations were developed to help overcome priority challenges, they provide a pathway for advancing on all twelve challenges initially identified (Fig. 1, Appendix C) because of their intertwined nature. For instance, gathering success stories (recommendation 3), developing standardised protocols (recommendation 4), and enhancing communication (recommendation 5) could help support effective stakeholder engagement (challenges 3 and 6), interdisciplinary working (challenge 9), and time management (challenge 12). Similarly, improving policy guidance (recommendations 1 and 2) could provide concept clarity (challenge 11), and strengthen organisational capacity (challenge 7) and effectiveness evaluations (challenge 8).

Through discussions, participants devised six recommendations (Fig. 2) to help overcome priority challenges and create enabling conditions for blue NbS implementation:

1. Develop simplified and accessible concept and policy guidance to provide clarity and consensus on the NbS definition, standards, added value, and how they fit within the current policy landscape. Uniting government agencies and stakeholder groups around common aspirations and expectations would encourage effective implementation and prevent greenwashing. Simple and accessible guidance would also aid bottom-up and community-led NbS deployment by helping reduce the perceived complexity of the policy landscape for targeted projects.

Addresses challenges: 1, 2, 3, 6, 7, 8, 9, 11, 12 in Fig. 1/Appendix C.

2. Develop and streamline national legislation and policy drivers to support blue NbS. Providing an overarching policy statement could help integrate a fragmented policy landscape and enable practitioners to clearly identify policies within which to embed new NbS. Together with streamlined guidance on implementation this would facilitate communication with stakeholders and facilitate access to different funding sources.

Addresses challenges: 1, 2, 3, 7, 8, 9, 11.

3. Gather success stories to facilitate mainstreaming of NbS across civil society, government agencies, and the private sector. Learning about how NbS are being implemented in different contexts and their social, economic, and ecological costs and benefits will help share good practices, and avoid pitfalls. Better information and examples specifically for blue NbS could increase political commitment, facilitate institutional coordination, be useful for education, and support access to funds from non-traditional sources.

Addresses challenges: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

4. Develop standardised protocols for blue NbS certification, monitoring, and evaluation to promote robust, evidence-based, and verifiable project development, and promote evaluation of outcomes. A standardised framework with specific criteria would facilitate consistent application of NbS terminology and approaches, screening of projects by potential funders, and communication more broadly. It could also help leverage private sector funding by providing greater certainty regarding project and outcome status, e.g., carbon or biodiversity credits and offsetting. It is important that protocols are interdisciplinary, reward best practice, and prevent bad practices.

Addresses challenges: 2, 3, 4, 6, 7, 8, 9, 10, 11, 12.

5. Improve marketing and communication to help catalyse creative solutions that overcome local barriers through collaboration, interdisciplinary thinking, and sustainable funding. Improving understanding of the value of marine and coastal ecosystems by different audiences, and building capacity across local stakeholder groups, will increase support for projects. As NbS can address multiple societal challenges there is opportunity to deploy diverse funding streams but to do so it will be important to market NbS projects in different ways to facilitate access to relevant outcomes (e.g., biodiversity conservation, climate change mitigation and adaptation, sustainable development).

Addresses challenges: 2, 3, 6, 9.

6. Engage stakeholders and embrace bottom-up implementation to advance local solutions and assist groups with top-down strategic, policy, and regulatory support. Stakeholder engagement needs to bring together and involve diverse groups early in a project, building relationships that facilitate frequent engagement. Communication needs to be tailored, consistent, and take advantage of varied pathways (e.g., education, films, festivals, art) and influential people (e.g., celebrities, influencers and local champions). Local communities







Develop simplified & accessible concept & policy guidance	 Enhance clarity & consensus on the operational definition of blue NbS & how they fit within the current policy landscape through evidence-based guidance
Develop & streamline national legislation & policy drivers to support blue NbS	 Facilitate better framing of blue NbS projects through an overarching policy statement that includes standards & protocols
Gather success stories	 Mainstream & share knowledge about good practices, social inclusion, equity, & justice by learning from blue NbS in different contexts
Develop standardised protocols for blue NbS certification, monitoring & evaluation	 Improve ability to consistently communicate about blue NbS, reward best practice, & 'package' NbS to funders
Improve marketing & communication	 Integrate social scientists & interdisciplinary staff into blue NbS projects, target communication of blue NbS to the priorities of different actors, listen & work with stakeholders to catalyse creative solutions that address local challenges
Engage stakeholders & embrace bottom-up implementation	 Combine bottom-up implementation with top-down strategic policy & regulatory support to advance local solutions to problems - get better at stakeholder identification, engagement, & local community integration

Fig. 2. Recommendations from practitioners to advance blue NbS.

also need to be better integrated into funding mechanisms to support community-led deployment and ensure funds are fairly and equitably distributed.

Addresses challenges: 3, 4, 6, 7, 12.

5. Concluding remarks

The field of NbS is rapidly evolving and there is increasing interest in their deployment to respond to societal challenges. The degraded nature of the world's marine and coastal ecosystems and challenges faced by people around the world place increasing urgency on acting now [7, 14–17]. To make the most of the NbS approach, there is therefore an urgent need to bring clarity to the concept and application of NbS, drawing visibility to examples of success stories. This study brings insights from practitioners to the blue NbS literature, however, we recognise that these perspectives may not be representative of the broader practitioner community. This study could be enriched by extending the practitioner sample to incorporate diverse perspectives from different geographical and social-ecological contexts moving from our exploratory approach to a more comprehensive one. Nonetheless, the challenges and recommendations presented here draw from the varied experiences of our practitioners. Recommendations made either respond to a challenge practitioners have faced or reflect successes they have had and were developed in direct response to the three priority challenges to blue NbS identified during our workshop. As such, their perspectives may provide insight for others working in projects dedicated to researching and implementing blue NbS.

Blue NbS are not a radical concept – they build on existing ecosystem-based approaches, aiming to improve their effectiveness through a more integrated social-ecological approach. Consequently, many of the challenges noted by our practitioners and subsequent recommendations are also well-recognised for general practice in marine and coastal conservation and management. For example, challenges surrounding fragmented marine policy landscapes compounded by a lack of defined mandates [18–20], together with inadequate political will, bureaucratic inertia, and path dependence [21,22] have been documented elsewhere. As have challenges surrounding, for instance, the achievement of sustainable finance [23–25] and effective stakeholder engagement [26,27]. Similarly, the need to improve marketing and communication to build the business case for interventions and improve compliance to regulations [28,29] and integrate bottom-up and top-down approaches implementation [30,31] have been recognised. However, while there are examples of projects and initiatives implementing ecosystem-based actions that are already striving to implement some of our recommendations, there remains a need to accelerate progress on blue NbS implementation and their early stage of development [6,11] meaning it is timely to integrate recommendations for best practice.

The strength, and at the same time difficulty, of blue NbS is that they draw together diverse actors and approaches, but improved standards are needed for application if they are to realise their potential. Work is ongoing to develop standards in many areas (e.g., www.wildercarbon.com) however to scale up impact and improve data availability consistency of practice is required. Gathering success stories may help support implementation of good practice in this regard, as well as generating socio-political support. Existing networks are beginning to draw NbS case studies together, although greater focus on blue NbS is needed (e.g., the NbS Initiative <https://casestudies.naturebasedsolutionsinitiative.org/>, NetworkNature <https://networknature.eu/>, JNCC <https://jncc.gov.uk/our-work/nature-based-solutions-iaccg-case-studies/>, OPPLA <https://oppla.eu/>). The blue NbS agenda is being propelled in some places by committed stakeholder groups; bottom-up community led partnerships focussing on education and raising awareness and local capacity building can help improve inclusivity and could facilitate improved delivery and effectiveness of actions [e.g., 32]. Nonetheless, challenges remain in scaling up this process and the long-term

effectiveness of blue NbS interventions will require better collaboration, communication, and longer-term funding. It will also require better integration of top-down and bottom-up approaches to blue NbS implementation to accelerate progress. Ultimately, however, reducing uncertainty in the definition and concept of NbS amongst stakeholders is especially needed to accelerate deployment in complex marine social-ecological systems.

Ethics

This workshop was approved by the Faculty of Business and Law Ethics Committee of the University of Portsmouth (Ref. No.: BAL/2022/35/CORNET). Informed consent was obtained by all participants prior to their attendance at any workshop. Participants were provided with a participant information form that provided more information about the research project and workshop objectives. They were then asked to sign a consent form to confirm they had read and understood the participant information form and that they voluntarily agreed to participate in the workshop. Only participants who agreed to this were permitted to attend the workshop.

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CRedit authorship contribution statement

Bethan O'Leary: Writing – review & editing, Writing – original draft, Visualization, Supervision, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Callum M. Roberts:** Writing – review & editing, Methodology, Investigation. **Catarina Fonseca:** Writing – review & editing, Writing – original draft, Methodology, Investigation. **Louisa Wood:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Data curation. **Cindy Cornet:** Writing – review & editing, Visualization, Methodology, Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that influenced the work reported in this paper.

Data Availability

No data was used for the research described in the article.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2024.106104](https://doi.org/10.1016/j.marpol.2024.106104).

References

- [1] IPBES, Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, in: E.S. Brondizio, J. Settele, S. Díaz, H.T. Ngo (Eds.) IPBES secretariat, Bonn, Germany, 2022, p. 1144.
- [2] IPCC, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, in: V. Masson-Delmotte, P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, B. Zhou (Eds.) Cambridge University Press, 2021.
- [3] K. Richardson, W. Steffen, W. Lucht, J. Bendtsen, S.E. Cornell, J.F. Donges, M. Driike, I. Fetzer, G. Bala, W. von Bloh, G. Feulner, S. Fiedler, D. Gerten, T. Gleeson, M. Hofmann, W. Huiskamp, M. Kumm, C. Mohan, D. Nogués-Bravo, S. Petri, M. Porkka, S. Rahmstorf, S. Schaphoff, K. Thonicke, A. Tobian, V. Virkki, L. Wang-Erlandsson, L. Weber, J. Rockström, Earth beyond six of nine planetary boundaries, *Sci. Adv.* 9 (37) (2023) eadh2458.
- [4] B. Talukder, N. Ganguli, R. Matthew, G.W. van Loon, K.W. Hipel, J. Orbinski, Climate change-accelerated ocean biodiversity loss & associated planetary health impacts, *J. Clim. Change Health* 6 (2022) 100114.
- [5] IUCN, I.U.C.N. Global Standard for Nature-based Solutions: a user-friendly framework for the verification, design and scaling up of NbS, Gland, Switzerland, 2020.
- [6] B.C. O'Leary, C. Fonseca, C.C. Cornet, M.B. de Vries, A.K. Degia, P. Failler, E. Furlan, J. Garrabou, A. Gil, J.P. Hawkins, D. Krause-Jensen, X. Le Roux, M. A. Peck, G. Pérez, A.M. Queirós, G. Rózyński, A. Sanchez-Arcilla, R. Simide, I. Sousa Pinto, E. Trégarot, C.M. Roberts, Embracing Nature-based Solutions to promote resilient marine and coastal ecosystems, *Nat. -Based Solut.* 3 (2023) 100044.
- [7] IOC-UNESCO, State of the ocean report 2022: pilot edition, IOC-UNESCO, Paris, 2022.
- [8] J. Jacquemont, R. Blasiak, C. Le Cam, M. Le Gouellec, J. Claudet, Ocean conservation boosts climate change mitigation and adaptation, *One Earth* 5 (10) (2022) 1126–1138.
- [9] M.I. Saunders, C. Doropoulos, E. Bayraktarov, R.C. Babcock, D. Gorman, A.M. Eger, M.L. Vozzo, C.L. Gillies, M.A. Vanderklift, A.D.L. Steven, R.H. Bustamante, B. R. Silliman, Bright spots in coastal marine ecosystem restoration, *Curr. Biol.* 30 (24) (2020) R1500–R1510.
- [10] N.C. Ban, G.G. Gurney, N.A. Marshall, C.K. Whitney, M. Mills, S. Gelcich, N. J. Bennett, M.C. Meehan, C. Butler, S. Ban, T.C. Tran, M.E. Cox, S.J. Breslow, Well-being outcomes of marine protected areas, *Nat. Sustain.* 2 (6) (2019) 524–532.
- [11] A. Chausson, B. Turner, D. Seddon, N. Chabaneix, C.A.J. Girardin, V. Kapos, I. Key, D. Roe, A. Smith, S. Woroniecki, N. Seddon, Mapping the effectiveness of nature-based solutions for climate change adaptation, *Glob. Change Biol.* 26 (11) (2020) 6134–6155.
- [12] Convention on Biological Diversity, Kunming-Montreal Global biodiversity framework. Decision adopted by the conference of the parties to the Convention on Biological Diversity, in: Conference of the Parties to the Convention on Biological Diversity (Ed.) CBD/COP/DEC/15/4, Fifteenth meeting - Part II. Montreal, Canada, 7–19 December 2022, 2022.
- [13] R.E. Freeman, Strategic management: A stakeholder approach, Cambridge University Press 2010.
- [14] E.J. Murphy, Ocean sustainability: act before it's too late, *Nature* 609 (2022) 676.
- [15] S. Georgian, S. Hameed, L. Morgan, D.J. Amon, U.R. Sumaila, D. Johns, W. J. Ripple, Scientists' warning of an imperiled ocean, *Biol. Conserv.* 272 (2022) 109595.
- [16] WEF, The Global Risks Report 2023, World Economic Forum, 2023.
- [17] IPCC, Climate Change 2022: Impacts, Adaptation and Vulnerability, 2022.
- [18] J.S. Link, M. Dickey-Collas, M. Rudd, R. McLaughlin, N.M. Macdonald, T. Thiele, J. Ferretti, E. Johannesen, M. Rae, Clarifying mandates for marine ecosystem-based management, (2019).
- [19] M.A. Rudd, M. Dickey-Collas, J. Ferretti, E. Johannesen, N.M. Macdonald, R. McLaughlin, M. Rae, T. Thiele, J.S. Link, Ocean ecosystem-based management mandates and implementation in the north atlantic, *Front. Mar. Sci.* 5 (2018).
- [20] S.J. Boyes, M. Elliott, Brexit: The marine governance horrendogram just got more horrendous!, *Mar. Pollut. Bull.* 111 (1) (2016) 41–44.
- [21] E.A. Fulton, Opportunities to improve ecosystem-based fisheries management by recognizing and overcoming path dependency and cognitive bias, *Fish Fish* 22 (2) (2021) 428–448.
- [22] T.J. Pitcher, D. Kalikoski, K. Short, D. Varkey, G. Pramod, An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries, *Mar. Policy* 33 (2) (2009) 223–232.
- [23] G.A. Karolyi, J. Tobin-de la Puente, Biodiversity finance: A call for research into financing nature, *Financ. Manag.* 52 (2) (2023) 231–251.
- [24] U.R. Sumaila, M. Walsh, K. Hoareau, A. Cox, L. Teh, P. Abdallah, W. Akpalu, Z. Anna, D. Benzaken, B. Crona, T. Fitzgerald, L. Heaps, I. Issifi, K. Karousakis, G. M. Lange, A. Leland, D. Miller, K. Sack, D. Shahnaz, T. Thiele, N. Vestergaard, N. Yagi, J. Zhang, Financing a sustainable ocean economy, *Nat. Commun.* 12 (1) (2021) 3259.
- [25] N. Pascal, A. Brathwaite, A. Bladon, J. Claudet, E. Clua, Impact investment in marine conservation, *Ecosyst. Serv.* 48 (2021) 101248.
- [26] K.A. Alexander, M. Haward, The human side of marine ecosystem-based management (EBM): 'Sectoral interplay' as a challenge to implementing EBM, *Mar. Policy* 101 (2019) 33–38.
- [27] J. Zaucha, A. Kreiner, Engagement of stakeholders in the marine/maritime spatial planning process, *Mar. Policy* 132 (2021) 103394.
- [28] B.S. Halpern, C.J. Klein, C.J. Brown, M. Beger, H.S. Grantham, S. Mangubhai, M. Ruckelshaus, V.J. Tulloch, M. Watts, C. White, H.P. Possingham, Achieving the triple bottom line in the face of inherent trade-offs among social equity, economic return, and conservation, *Proc. Natl. Acad. Sci.* 110 (15) (2013) 6229–6234.
- [29] B.J. Bergseth, A. Arias, M.L. Barnes, I. Caldwell, A. Datta, S. Gelcich, S.H. Ham, J. D. Lau, C. Ruano-Chamorro, P. Smallhorn-West, D. Weekers, J. Zamborain-Mason, J.E. Cinner, Closing the compliance gap in marine protected areas with human behavioural sciences, *Fish Fish.* 24 (4) (2023) 695–704.
- [30] H. Paridaens, T. Notteboom, National integrated maritime policies (IMP): vision formulation, regional embeddedness, and institutional attributes for effective policy integration, *Sustainability* 13 (17) (2021) 9557.
- [31] A. Di Franco, K.E. Hogg, A. Calò, N.J. Bennett, M.-A. Sévin-Allouet, O. Esparza Alaminos, M. Lang, D. Koutsoubas, M. Prvan, L. Santarossa, F. Niccolini, M. Milazzo, P. Guidetti, Improving marine protected area governance through collaboration and co-production, *J. Environ. Manag.* 269 (2020) 110757.
- [32] E.J. Farrell, G. Smith, A.-M. O'Hagan, M. Le Tissier, Building Coastal and Marine Resilience in Ireland, Environmental Protection Agency, 2022.