Research orientations for blue Nature-based Solutions

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This policy brief provides research orientations for the implementation of marine and coastal, or 'blue' Nature-based Solutions (NBS).

Blue NBS are of increasing interest to address societal challenges. Integral to blue NBS is the enhancement of biodiversity while supporting human health and wellbeing through inclusive, evidence-informed decision-making. Scientific research has a critical role to play in informing the evidence base on which practitioners develop and action effective policies. Taking a stakeholder-informed approach, broad research orientations designed to inform blue NBS understanding and implementation are provided. These highlight the diverse local contexts of blue NBS and the need to take an integrated social-ecological approach and aim to help direct research towards actionable science to inform blue NBS delivery and to help inform priority research areas that should be funded.

Introduction

Evidence increasingly shows the important contribution of nature in addressing societal challenges from multidimensional perspectives[1-3]. Implementing marine and coastal (blue) Nature-based Solutions (NBS) takes advantage of the strong connections between nature, society, and planetary functioning. They aim to address concerns that nature and its contributions to people through ecosystem services are declining rapidly around the world[4].

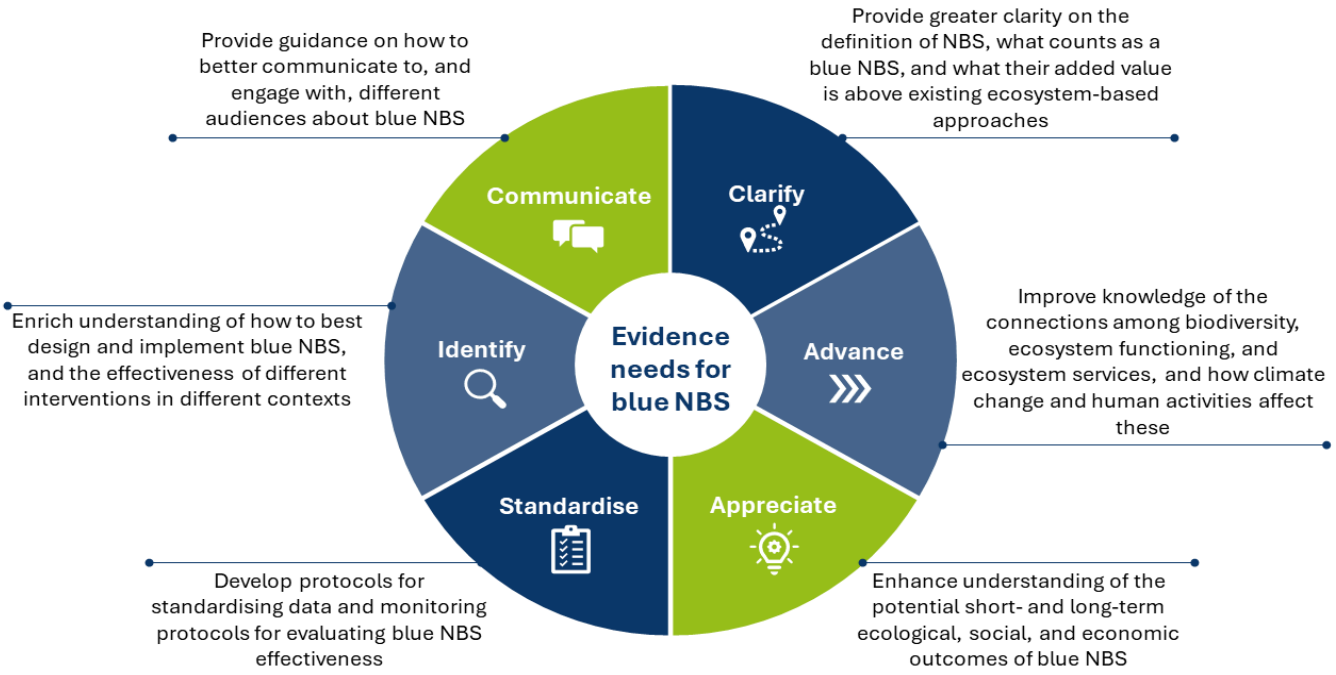
Integral to blue NBS is the enhancement of biodiversity while supporting human health and well-being through inclusive decision-making. They build on existing ecosystem-based approaches to management, aiming to improve the effectiveness of such approaches by demanding a comprehensive and integrated outlook to achieve greater outcomes for cross-cutting issues[4].

Blue NBS operate in complex social-ecological systems to achieve diverse ecological and societal objectives. Therefore, a portfolio of blue NBS interventions may be employed depending on the social-ecological context. This portfolio includes marine protection (i.e., fully, highly, lightly, and minimally protected areas), restorative activities (i.e., active, passive, and partial restoration; rehabilitation of ecological function; and ecosystem creation), and other sustainable management measures (i.e., implementation and enforcement of regulation)[5].

Despite recognising the importance of NBS in all social-ecological systems, most efforts have focussed on terrestrial – particularly urban – environments, and the implementation of blue NBS has been slow[4]. To address challenges hindering blue NBS implementation and consider how to resolve these issues, the MaCoBioS project conducted a priority-setting exercise with blue NBS researchers in 2022 and organised a series of high-level workshops between September 2022 and March 2023, bringing together practitioners working in the field of blue NBS implementation in Northern Europe, the Western Mediterranean, and the Lesser Antilles. Below, the main conclusions of this work are used to support integrated social-ecological blue NBS research by developing research orientations designed to inform blue NBS understanding and implementation.

Blue NBS evidence needs

Policy-makers and practitioners we consulted identified a broad range of cross-cutting evidence needs to support the delivery of marine and coastal NBS and their objectives:



Clarity: Clarify the concept. Research and consensus building on the definition and conceptualisation of blue NBS, including clarification on design, standards, added value, and policy requirements.

Advance: Improve biodiversity-related ecosystem services knowledge. Research on levels of allowable biodiversity loss based on ecosystem service delivery, human impact thresholds that should trigger management change, scales of ecosystem services delivery, and comprehensive value assessments of ecosystem services provided by marine and coastal ecosystems.

Appreciate: Enhance understanding of co-benefits, trade-offs, and the effects of time. Research on co-benefits and trade-offs across timescales, including designing blue NBS for diverse objectives and setting conceptual boundaries for evaluation.

Standardise: Develop standards for data, monitoring, and evaluation. Research and consensus building on standardised protocols and indicators for ecological, social, and economic data collection and monitoring, drawing upon existing initiatives to avoid effort duplication.

Identify: Enrich the evidence base for design and effectiveness. Research on blue NBS effectiveness through multidimensional evaluations incorporating different geographical and social-ecological contexts, synthesising existing evidence and gathering robust and comparable data to inform new insights.

Communicate: Prioritise communication and collaboration. Research on how to integrate blue NBS into systems with pluralistic views and values, and how to tailor communication and engagement to diverse stakeholder groups.

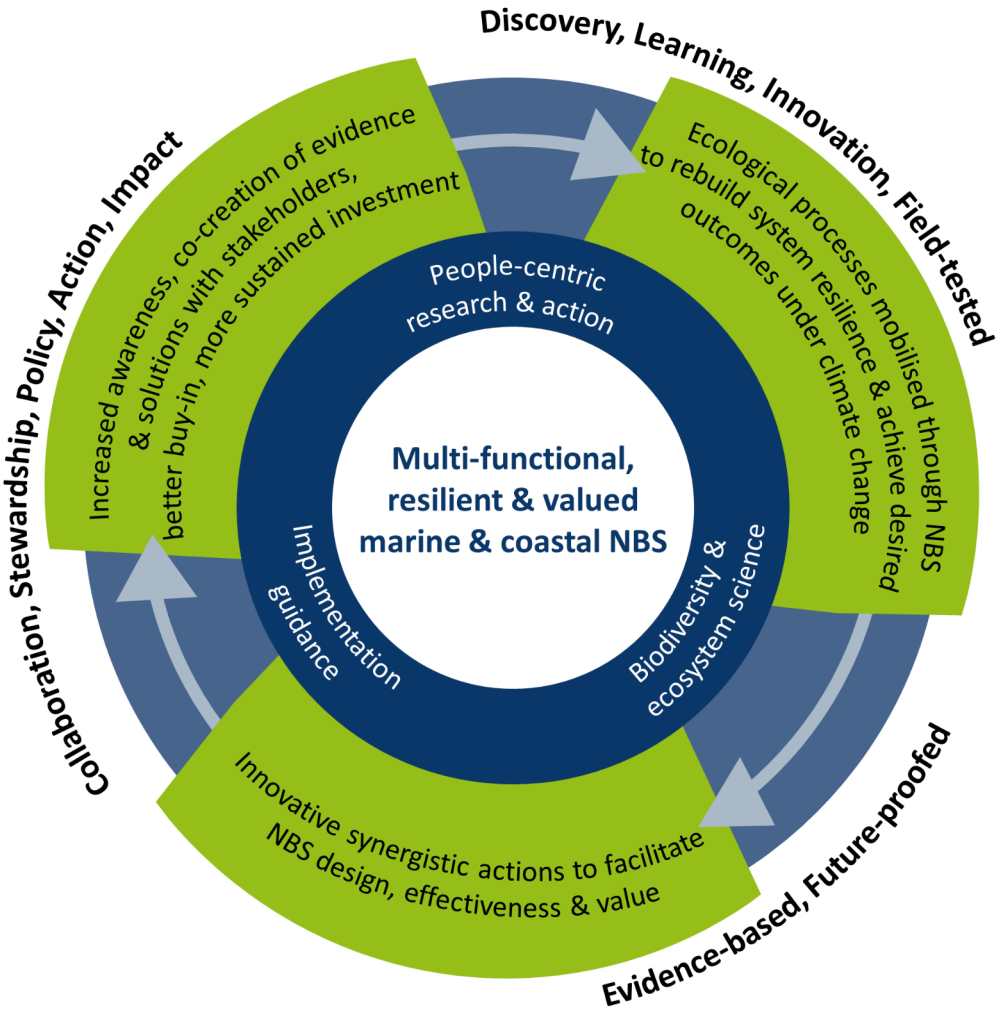
Blue NBS research priorities

Twenty-one blue NBS researchers, marine scientists with expertise spanning social, ecological, and environmental specialities and working at the science-policy interface, identified three interconnected research priorities for blue NBS implementation[4]:

Biodiversity and ecosystem science: improve understanding of marine and coastal biodiversity-ecosystem services relationship. Research on human impacts and climate change on marine life, thresholds for management change, safe operating spaces for marine life, where ecosystem services are delivered, and connections between biodiversity, ecosystem health, extent, functions, and services.

Implementation guidance: provide scientific guidance on how and where to implement blue NBS and better coordinate across blue NBS strategies and projects. Research on concept clarification, operational standards, standardised protocols for blue NbS certification, monitoring and evaluation, and ecological, social, and economic blue NBS effectiveness in different social-ecological and geographical contexts.

People-centric research and action: develop ways to enhance blue NBS communication, collaboration, ocean literacy and stewardship. Research on how best to involve diverse stakeholders in projects, including supporting bottom-up implementation and embedding locally rooted evidence, and how to better communicate an evidence base across sectors and stakeholder groups.



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Key research questions

Research priority areas overlap between practitioners and researchers and are intrinsically linked to each other, suggesting that collaboration between the two groups would deliver successful partnerships for actionable science. Priorities are areas of uncertainty rather than specific questions. Because blue NBS are context-specific, research questions must be developed through stakeholder engagement and partnership. Example questions are provided below but should be adapted and expanded for the project and/or topic being researched.

Example blue NBS research questions for priority areas

See[6] for more examples

Biodiversity & Ecosystem Science

- How do biodiversity & ecosystem condition relate to ecosystem services delivery?
- What are species' & ecosystems' environmental limits, & what are the implications if exceeded?
- What indicators & threshold values best represent ecosystem condition?
- How can blue NBS support and enhance marine & coastal ecosystem services?

Implementation Guidance

- What interventions qualify as blue NBS & where will they add value over existing ecosystem-based actions?
- How do we take a systems approach to blue NBS to predict & evaluate (in)tangible outcomes, interactions, & trade-offs?
- How can we scale up actions, encourage bottom-up deployment, & incentivise public-private partnerships & finance?
- How will blue NBS perform under climate change?

People-centric Research & Action

- What can blue NBS do to enhance the ability of coastal communities to adapt to change?
- How can blue NBS ensure greater participation and be implemented inclusively and equitably?
- How can we align blue NBS concept definition, terminology use, and ambitions?
- How can we better mainstream and share knowledge about good practices and lessons learned from blue NBS?

Policy Recommendations

- Promote comprehensive, interdisciplinary research into blue NBS that avoids traditional research silos and integrates social sciences and co-creation to enhance actionable science and its application.
- Develop or strengthen research funding programmes to encourage practitioner-researcher-community collaborations.
- Require interdisciplinary research impact pathways linking activities to outputs, outcomes, and goals.
- Embed blue NBS in research funding programmes beyond traditional biodiversity topics and support interdisciplinary and intersectoral collaborations.
- Encourage research that takes an integrated land- and seascape approach reflecting the interconnected social-ecological systems blue NBS operate within.
- Routinely incorporate space for reflexive assessments and synthesis of scientific evidence and of translational, boundary-spanning, knowledge exchange, and collaboration activities.

For more information about the topics discussed in this policy brief, please refer to the accompanying policy guideline[6].

References [1] Diaz *et al*. (2019) doi.org/10.1126/science.aax3100 | [2] Pascual *et al.* (2023) doi.org/10.1038/s41586-023-06406-9 | [3] IPBES. (2022) doi.org/10.5281/zenodo.3831673 | [4] O'Leary *et al*. (2023) doi.org/10.1016/j.nbsj.2022.100044 | [5] Perez *et al.* (2024) doi.org/10.1016/j.jenvman.2023.119936 | [6] O'Leary *et al*. (2024). Research orientations for blue Nature-based Solutions. In O'Leary BC, Krause T, Espinoza Córdova F, Fonseca C, Frehen L, Roberts CM (Eds), *Deliverable 4.3 – Nature-based Solutions Policy Guidelines* (pp. 38-47). MaCoBioS.

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