THE ROYAL SOCIETY

Conserving the high seas

Key scientific considerations for selecting sites for area-based management tools, including marine protected areas, under the new Biodiversity Beyond National Jurisdiction agreement.

Background

This policy note presents developing areas of scientific consensus regarding the identification of candidate sites for establishing area-based management tools (ABMTs), including marine protected areas (MPAs)[1], under the Biodiversity Beyond National Jurisdiction (BBNJ) agreement. It is aimed at scientists and policy officials involved in implementing this agreement.

This policy note was derived from a roundtable convened by the Royal Society on 5 September, 2024.

List of abbreviations	
ABMT	Area-based management tools
BBNJ	Biodiversity Beyond National Jurisdiction
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
EBSA	Ecologically or Biologically Significant Area
MPA	Marine protected area
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
SCOR	Scientific Committee on Oceanic Research

Global context

The high seas[2] constitute nearly half of the Earth's surface and two-thirds of the global ocean, providing an estimated 95% of the habitat occupied by life on Earth[3]. They are critical for a range of ecosystem services, yet are increasingly under threat due to human activity and a lack of coordinated international governance to sustainably manage their resources. The UN BBNJ agreement, adopted and opened for signature in 2023, seeks to address this need for greater international coordination to conserve the high seas. Note that at the time of writing, the agreement was in the ratification process and had not yet entered into force.

One of the major achievements of the BBNJ agreement once ratified will be the establishment of a legal basis for creating ABMTs in the high seas. Previously, the establishment of ABMTs in these waters has been specific to regional or sectoral agreements, resulting in a patchwork of international frameworks. This fragmented and regionalised approach has limited ability to coherently and holistically conserve the high seas and large-scale marine processes, such as the migration of marine species[4]. The BBNJ agreement presents an opportunity for a more coordinated and global approach to management of the high seas (with the caveat that it should not undermine existing legal processes and mandates).

Scientific understanding of marine environments is critical to inform their effective management, yet the high seas remain among the least-understood environments on Earth. Context and scale are critical, not just understanding species but species assemblages and interactions. In this context, this policy note examines some key scientific considerations for approaching site selection for ABMTs in the high seas.

1. The Biodiversity Beyond National Jurisdiction agreement refers to 'area-based management tools, including marine protected areas', recognising that marine protected areas are one type of area-based management tool, but not the only one. For brevity, hereforth this policy note simply refers to 'area-based management tools', which includes marine protected areas by definition.
2. For readability, when using 'the high seas', this document refers to Areas Beyond National Jurisdiction, which technically includes both the water column and the international seabed.
3. United Nations. 2017 The Conservation And Sustainable Use Of Marine Biological Diversity Of Areas Beyond National Jurisdiction: A Technical Abstract Of The First Global Integrated Marine Assessment. See https://www.un.org/depts/los/global_reporting/8th_adhoc_2017/Technical_Abstract_on_the_Conservation_and_Sustainable_Use_of_marine_Biological_Diversity_of_Areas_Beyond_National_Jurisdiction.pdf (accessed 3 October 2024).
4. For example, see discussion in IUCN. 2021 Strategy for designing and implementing area-based management tools including MPAs under the future BBNJ agreement. See https://iucn.org/sites/default/files/2022-07/iucn_abmt_strategy_2021.pdf (accessed 18 October 2024)

Recommendations

RECOMMENDATION 1

Building on existing knowledge under other conventions

It is critical that site selection under BBNJ builds on, and learns from, experience under existing frameworks. While the scale and coordination of BBNJ is new, there are many frameworks under which priority areas for the enhanced protection of biodiversity and ecosystem services in the high seas have already been identified. Some sites have already been designated by the international body that identified them (eg MPAs under the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) and Vulnerable Marine Ecosystem closures by some Regional Fisheries Management Organizations). Other potential sites have been identified with the intention of motivating their consideration by appropriate management authorities (eg description of important marine areas, including Ecologically or Biologically Significant Marine Areas (EBSAs) under the Convention on Biological Diversity, or Important Marine Mammal Areas by the International Union for Conservation of Nature Marine Mammal Task Force).

Experience from these existing structures can and should guide the design of the BBNJ agreement's site selection processes. For example, experts involved in the EBSA process now have more than a decade of experience in operationalising site selection criteria. Given the significant overlap between the BBNJ indicative site selection criteria and the EBSA description criteria, lessons can be adopted to avoid some of the complications encountered, such as disputes over the interpretation of definitions of criteria. In addition, lessons learned from MPA designation under CCAMLR include ensuring that site selection processes can be adapted to the heterogeneity of sites and variable availability of baseline data in different regions, and allowing for decisions to be made based on limited data under a precautionary approach. Scientists and policymakers engaged in site designation processes under existing frameworks will be well-placed to input into BBNJ processes to ensure they build on relevant knowledge.

RECOMMENDATION 2

Building a strategic scientific agenda

Science is critical to the establishment of effective ABMTs in the high seas. To ensure that decisions regarding site selection are evidence-based, a strategic international scientific agenda should be designed to deliver the research and data needed to: a) fulfil the objectives outlined in the BBNJ agreement; and b) identify reliable proxies and predictive models, and improve geographic distribution of observations. The establishment of such a strategy should target science needed to fill gaps and act to co-ordinate and direct funding opportunities and subsequently scientific research to where it is most needed.

a. A science agenda to fulfil BBNJ's objectives

Article 17 of the BBNJ agreement (see Box 1) outlines its objectives for Part III which discusses the establishment of ABMTs. Analysis should be conducted to establish what science is needed to achieve these objectives. Understanding of taxonomic diversity exists for some well-characterised ecosystems and can fulfil a subset of objectives in Article 14 in the agreement, although much of the high seas (and particularly the deep ocean) remains poorly characterised in this regard. However, the objectives also relate to the 'function(s)' that high seas ecosystems provide, as opposed to just the diversity of life itself ('form'). For example, the objectives state that high seas ecosystems should be protected "with a view to enhancing their productivity and health, and strengthen resilience to stressors, including those related to climate change, ocean acidification and marine pollution" (see 14(c)). Ecosystem services are less well-characterised, especially in the high seas because understanding and measuring the functional diversity of species (ie the relationship between the presence of specific species in an ecosystem and the services derived from that ecosystem), is more difficult than measuring their 'form' (eg species richness and abundance). If the objective is to protect the functional traits and roles of species within ecosystems rather than taxonomic diversity alone, then scientific research should be targeted to further understand, measure and monitor ecosystem services of the high seas.

BOX 1

The BBNJ agreement

The following extract is from Part III, Article 17, of the BBNJ agreement. The Article lists the following objectives for Part III of the agreement, which discusses measures such area-based management tools, including marine protected areas:

a. Conserve and sustainably use areas requiring protection, including through the establishment of a comprehensive system of area-based management tools, with ecologically representative and well-connected networks of marine protected areas;

b. Strengthen cooperation and coordination in the use of area-based management tools, including marine protected areas, among States, relevant legal instruments and frameworks and relevant global, regional and subregional and sectoral bodies;

c. Protect, preserve, restore and maintain biodiversity and ecosystems, including with a view to enhancing their productivity and health, and strengthen resilience to stressors, including those related to climate change, ocean acidification and marine pollution;

d. Support food security and other socio-economic objectives, including the protection of cultural values;

e. Support developing States Parties, in particular the least developed countries, landlocked developing countries, geographically disadvantaged States, small island developing States, coastal African States. archipelagic States and developing middle-income countries, taking into account the social circumstances of small island developing States, through capacity-building and the development and transfer of marine technology in developing, implementing, monitoring, managing and enforcing area-based management tools, including marine protected areas.

b. A science agenda to identify reliable proxies and predictive models, and improve geographic distribution

Given the vastness of the high seas, direct and regular observations of all marine species, habitats and ecosystems are not currently practicable. Site selection is therefore likely to require leveraging proxy measures and predictive modelling to inform decision making. The effectiveness of these approaches will depend on the careful planning, coordination and funding of empirical studies to iteratively bolster their reliability. A strategic scientific research agenda should therefore aim to:

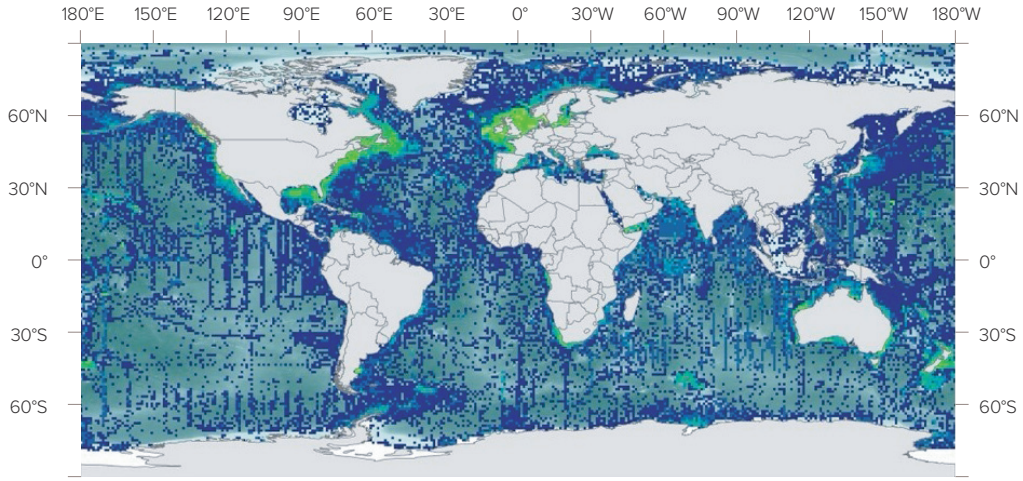
- Establish robust evidence pathways between proxy measures (which represent a partial or simplified perspective and are often cheaper and easier to collect) and the full marine system that they are designed to represent (which is often difficult, prohibitively expensive and/or time consuming to routinely measure in itself). For example, satellite observations of ocean colour (chlorophyll a) can act as a proxy for productivity.
- Co-ordinate, fund and conduct empirical research to inform, build and refine predictive models that inform decision making at an international level, and make these outputs accessible. This is particularly critical for biological modelling, which currently has far larger data gaps than physical oceanographic modelling. Research and funding focused on joining up the findings of both biological and physical models could also be very valuable to underpin decision-making processes.

To promote successful operationalisation of the BBNJ agreement, there will also need to be a concerted effort to improve the geographical distribution of biological observations. The biological data that exist in the high seas are overwhelmingly concentrated in the Global North. Some sites have no available biological data, and other areas, such as some part of the South Pacific, have very limited biological observation data (see figure 1). Observations are also concentrated in shallower waters, meaning that deeper waters (including mesopelagic, bathypelagic, abyssopelagic and hadalpelagic zones, and the benthos) are comparatively under-studied. Experience from other agreements suggests that data-poor areas are unlikely to be prioritised for the establishment of ABMTs, yet data-poor high seas environments, including those in the Global South, may host many critical ecosystems and habitats that the BBNJ agreement sets out to conserve.

FIGURE 1

Volume and distribution of global marine biodiversity data based on Ocean Biodiversity Information Service (OBIS) records[5].

Distribution of biodiversity data for both benthic (deep ocean) and pelagic (water column) organisms (n=~18.9M).

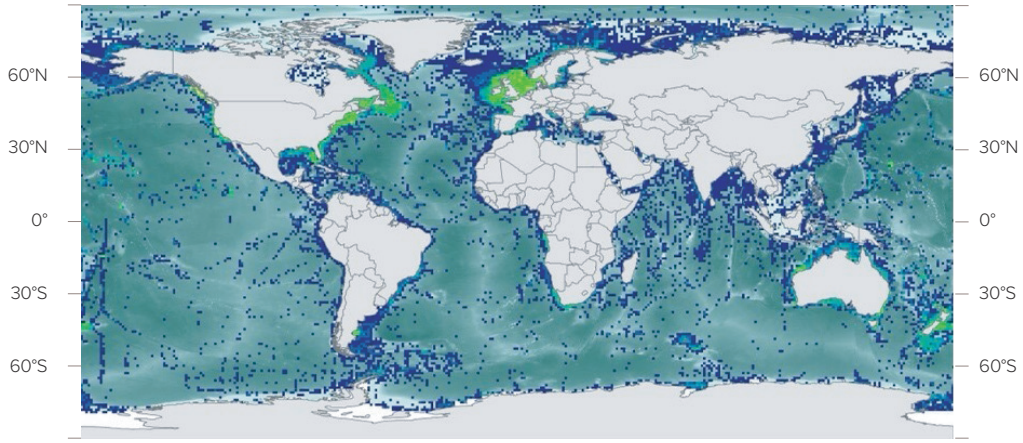


KEY

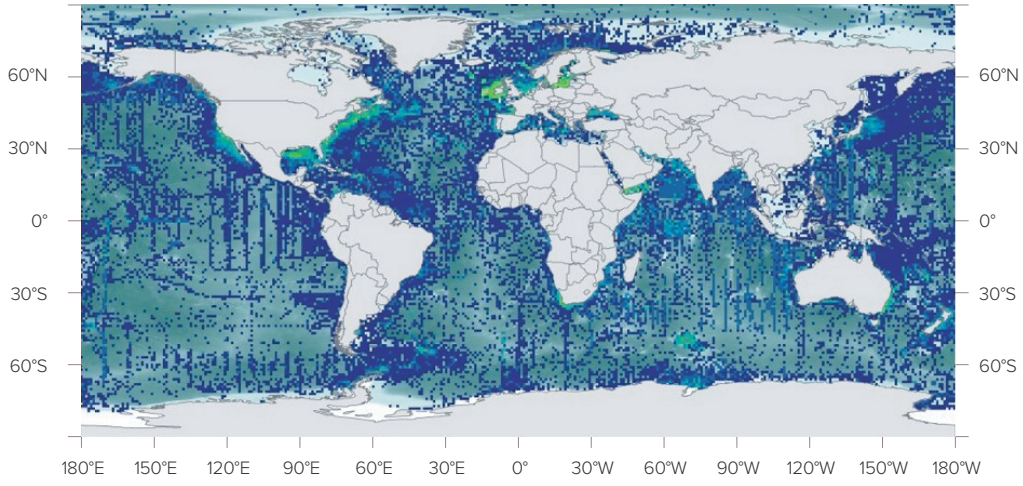
Number of OBIS records

- 1 – 100
- 100 – 500
- 500 – 1,000
- 1,000 – 5,000
- 5,000 – 10,000
- 10,000 – 50,000
- 50,000 – 100,000
- 100,000 – 212,339

Distribution of biodiversity data for benthic organisms only (n=~12.7M).



Distribution of biodiversity data for pelagic organisms only (n=~6.2M).



5. Bridges A, Howell KL (2024). Prioritisation of ocean biodiversity data collection to deliver a sustainable ocean.

c. The delivery of this science agenda

Such a science agenda could be formed into a coordinated multinational programme of research by a body like the Scientific Committee on Oceanographic Research (SCOR). SCOR is well-positioned to facilitate such an effort due to its focus on promoting global cooperation in planning and conducting oceanographic research. Global scientific capacity-building would likely be critical to these efforts, in part because the interconnected nature of marine ecosystems means that territorial waters are ecologically significant for many species' life histories. Existing scientific networks such as SCOR are well-placed to support capacity-building, as they are already engaged in this work; other examples of well-placed networks include the Partnership for Observation of the Global Ocean and the Challenger 150 cooperative. At the earliest opportunity, such an agenda should be presented for consideration by the BBNJ Scientific and Technical Body.

RECOMMENDATION 3

Anticipating and managing large volumes of marine data

With respect to ocean observation, obtaining accurate biological data is complex, relative to physical and chemical data. At the same time, the tools available for biological observation of the ocean are vast and growing. These new technologies (eg autonomous underwater vehicles, autosamplers, sensors and genetic tools such as environmental DNA) will significantly advance our ability to map and understand populations, connectivity and dispersal in the high seas. As use of these technologies expands, the volume of data produced is expected to increase rapidly. For example, the US is currently making a concerted effort to expand the collection of environmental DNA data on their regular marine surveys, which could provide detailed ocean biodiversity data. High-resolution environmental DNA autosamplers are already operational from the surface ocean to the deep sea[6]. These endeavors, combined with other new technologies, will generate increasingly large volumes of data.

To enable decision-makers across the globe to utilise these data, there must be a strategic approach to data management and the formulation of data products consistent with the Ocean Decade Data and Information Strategy[7]. At present, the usability of data is undermined by issues such as data standardisation and interoperability, between researchers and across nations. The current global drive for open data is necessary but not sufficient – the form of available (meta)data is too variable and too distributed to support its fluid reuse, especially considering the expansion of analytical and AI tools which rely on machine-readable data formats. Research and policy communities should anticipate this challenge and establish, in advance, the required infrastructure to tackle it. This may include central data collection and reporting initiatives, harmonising with existing global ocean observing systems, such as the Intergovernmental Oceanographic Commission-led Biology and Ecosystems Panel, digital ecosystems and solutions, training programmes, and increasing international coordination.

6. National Oceanic and Atmospheric Administration. 2020 NOAA 'Omics Strategy: Strategic Application of Transformational Tool. See sciencecouncil.noaa.gov/wp-content/uploads/2022/08/2020-Omics-Strategy.pdf (accessed 3 October 2024).
7. Intergovernmental Oceaonographic Commission. 2023 Ocean Decade data & information strategy: The United Nations Decade of Ocean Science for Sustainable Development (2021-2030). See https://unesdoc.unesco.org/ark:/48223/pf0000385542.locale=en (accessed 3 October 2024).

RECOMMENDATION 4

Accounting for uncertainties

Despite this rapid increase in the production and availability of marine data, the high seas will remain data-poor when compared to coastal and terrestrial environments. The high seas will always have unknowns due to their challenging accessibility, vastness, depth, and the complexity and three-dimensional interconnectivity of the habitat. Making decisions in the face of uncertainty will therefore remain an inherent part of policymaking and operationalisation in this environment. This lack of available data should not be leveraged as a barrier to action in terms of conserving the high seas under BBNJ.

To help account for uncertainties, an adaptive and iterative approach should be taken to site identification. Where decisions are made on modelled predictions, the process must be flexible enough to accommodate for site modification as more data become available. Selected sites may need to be regularly revised in response to the uncertainties and shifts associated with a changing climate. To take into account the fluidity of rapidly changing ocean ecosystems, there will be a need to regularly revise area size and site boundaries, depending on measures of progress towards objectives. For example, climate change is altering marine environments faster than some species can tolerate and changing currents and the locations of food web dynamics. An important consideration in the establishment of ABMTs in the high seas will be the need to identify sites that can provide a refuge and thus promote resilience for species displaced by climatic or other environmental changes.

To inform decision making with regards to the high seas, the scientific community must be comfortable with providing advice in the context of significant uncertainty. Scientists should endeavour to take responsibility for clearly articulating and communicating this uncertainty to decision makers, including:

- the volume, strength and quality of evidence available;
- areas of remaining uncertainty, complexity or contention; and
- assumptions, limitations, and evidence gaps[8].

For data-poor environments such as the high seas, a precautionary approach should be at the core of decision making. The marine science community is possibly well-placed to inform what a ‘precautionary approach’ looks like with regards to the management of the high seas, given their proximity to, and familiarity with, the evidence gaps and uncertainties associated with existing data. Implementing a precautionary approach will involve policymakers seeking advice from scientists on an appropriate level of limitation to activities, which is proportional to the level of uncertainty about consequences. In practice, this will mean high levels of precaution in most circumstances, but it will also generate an incentive to collect the data needed to reduce uncertainty.

8. For more on this, see The Royal Society. 2018 Evidence synthesis for policy: A statement of principles. See https://royalsociety.org/news-resources/projects/evidence-synthesis/ (accessed 3 October 2024).

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