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POLICY DIRECTION

Tracking data and the conservation of the high seas: Opportunities and challenges

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Abstract

1. Biologging technology is rapidly advancing—scientists are obtaining data on movement and behaviour for a range of species, more accurately than ever before. With this information, it is possible to understand more about important areas and their connections across the open ocean including the high seas, beyond national jurisdictions. But an absence of a global governance framework has so far hindered a coordinated approach to conservation action on the high seas.
2. We showcase a candidate high seas MPA in the Northeast Atlantic identified primarily from seabird tracking data and being taken forward under a regional process: the North Atlantic Current and Evlanov Seamount (NACES) MPA, under the OSPAR Commission. It provides a unique case study to learn about the intricacies of implementation when applying tracking information for conservation. From this, we identify the facilitating conditions and challenges faced from identification to designation and highlight actionable opportunities for future area-based management of the high seas that will be made possible under a new agreement.
3. *Policy implications*. The North Atlantic Current and Evlanov Seamount (NACES) MPA demonstrates the power of translating tracking data into usable geospatial knowledge to inform conservation and policy and provides an exemplar for a data-driven approach to high seas conservation that can become a reality under the forthcoming governance framework (under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (known as the BBNJ Agreement)). This new agreement presents a unique conservation opportunity both for the application of tracking data to conservation outcomes and for the protection of migratory species.

KEYWORDS

areas beyond national jurisdiction, Atlantic, BBNJ treaty, biologging, connectivity, high seas, important bird and biodiversity area, marine-protected areas

1 | INTRODUCTION

Tracking data (animal-borne devices collecting location data) are providing unparalleled insights into animal movement and behaviour, particularly in the marine environment. Over the last decades, advances in tracking technology have grown considerably with miniaturisation of devices, battery engineering and software development (Hussey et al., 2015). Long-term tracking is now routine for many marine taxa, including fish, birds, mammals and turtles (Hays et al., 2019). Tracking data provide important information on distribution and connectivity, which is critical to inform government policy and management actions (Dunn et al., 2019; Hays et al., 2019). In particular, tracking data have proven valuable for identifying important marine areas, and informing site-based conservation approaches, including the design and implementation of marine-protected areas and other effective conservation measures for important habitats (Hays et al., 2019; Lascelles et al., 2012).

Tracking data have demonstrated the importance of the high seas (waters beyond national jurisdiction, generally beyond the 200 nautical mile Exclusive Economic Zone (EEZ) of coastal nations) for many migratory species (Harrison et al., 2018; Queiroz et al., 2019), but have, so far, only informed limited and selective management measures, predominantly for a single species and within the remit of a single regulatory body (e.g. bluefin tuna and Australian longline fishery; Hobday et al., 2010). The site-based application of tracking data has also primarily occurred within national jurisdictions (Harrison et al., 2018). Yet tracking data present a considerable opportunity for an evidence-based approach for site-based conservation of the high seas because it is a relatively low-cost source of marine megafauna data (compared to at-sea surveys), less prone to some biases (e.g. associated with observer effort) and allows for a more accurate analysis of seasonality. Many important sites have already been identified on the high seas, including through the process of Convention on Biological Diversity (CBD) for describing ecologically or biologically significant marine areas (EBSAs; Bax et al., 2016; Johnson et al., 2018), via NGO-driven initiatives (Roberts et al., 2019), regional seas organisations and regional fisheries bodies (Ardron et al., 2014). However, many of these are focussed on bathymetry or oceanographic features, such as seamounts or convergence zones. Tracking data can provide a complementary data layer that moves beyond physical proxies and directly describes the biological importance of sites on the high seas, and their utility for identifying important at-sea areas has been well demonstrated (Bax et al., 2016; Beal et al., 2020).

An absence of a global governance framework has so far hindered a coordinated approach to conservation action on the high seas. Rapid finalisation, ratification and implementation of an international legally binding instrument (ILBI) under the United Nations Convention on the Law of the Sea (UNCLOS) on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (known as the BBNJ Agreement), currently under negotiation, will, in theory, address this gap and provide a framework to guide implementation of conservation actions. The adoption of the BBNJ Agreement will present an exciting opportunity to catalyse efforts to identify areas on the high seas that are suitable for site-based protection and to translate the knowledge from tracking data into enforceable action. But much can be done to advance protection today and to apply these lessons learned to accelerate progress under the forthcoming agreement.

Two regional organisations—one in the North Atlantic and one in the Southern Ocean—have set the precedent for the protection of the high seas and provide an opportunity to learn about the intricacies of implementation. In the North-East Atlantic, the creation of the first MPA identified from tracking data is being considered by the OSPAR Commission—the North Atlantic Current and Evlanov Seamount (NACES) MPA (595,000 km^2). The site is awaiting formal designation by the OSPAR Commission but is hereafter referred to as the NACES MPA. The NACES MPA is a pertinent case study to illustrate how tracking data can be applied on the high seas and the challenges faced from identification to designation; these challenges will likely be common to forthcoming MPAs with delineation supported by tracking data analyses. Here, we evaluate the facilitating conditions and challenges of this first candidate high seas MPA identified from tracking data to provide actionable insights for future efforts under the emerging BBNJ Agreement.

2 | THE FIRST HIGH SEAS MPA IDENTIFIED FROM TRACKING DATA: TRANSLATING DATA TO ACTION

The OSPAR Convention (the Convention for the Protection of the Marine Environment of the North-East Atlantic) includes a mandate for managing areas beyond national jurisdiction (ABNJ) within its geographical remit (the OSPAR Maritime Area) on behalf of its 16 Contracting Parties (15 Governments and the European Union). OSPAR established the world's first MPA network on the high seas in 2010 (O'Leary et al., 2012). These six sites were mostly designated for benthic features, including fracture zones and seamounts (Johnson, 2016). Despite a further pelagic MPA designated in 2012, an ecological coherence assessment of this MPA network found that seabirds were poorly represented (Johnson et al., 2014) and all Contracting Parties agreed to work to address this gap.

BirdLife International sought collaboration via the Seabird Tracking Database (www.seabirdtracking.org) to gather all relevant seabird tracking data that overlapped with the OSPAR Maritime Area. Following a workshop with data holders to discuss the analytical approach, over 2,000 seabird tracks were analysed, which revealed an Important Bird and Biodiversity Area (IBA), now called the NACES MPA (Davies et al., 2021; Figure 1). It is estimated that the site is used by up to 5 million birds throughout the year, travelling from a minimum of 56 colonies across 16 countries in both the North and South Atlantic—making it one of the most important concentrations of migratory seabirds in the world. Twenty-one different species have been tracked to the site, including boreal breeders such as Arctic terns *Sterna paradisaea*, long-tailed jaegers

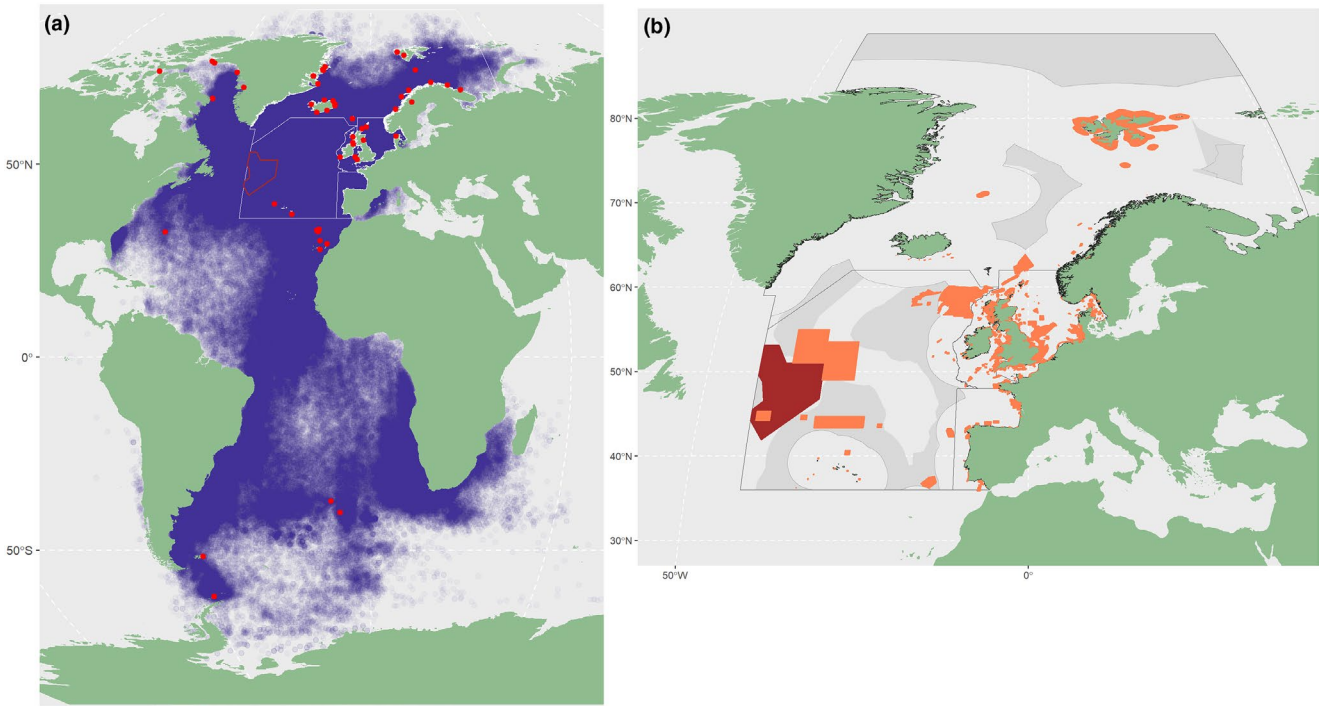

FIGURE 1 (a) All tracking data points considered in the analysis for the identification the NACES MPA. Colonies of origin shown in red circles. (b) The OSPAR Maritime Area with the NACES MPA (dark red) and all other OSPAR MPAs (orange). Extended continental shelf claims shown in light grey (from: continentalshelf.org/shapefiles2.aspx). Both maps in Kavrayskiy VII projection

Stercorarius longicaudus and Cory's shearwaters *Calonectris borealis* that use the site as a staging area to fuel trans-equatorial migrations and South polar skuas *Catharacta maccormicki*, Great shearwaters *Ardenna gravis* and Sooty shearwaters *Ardenna grisea* that migrate up to 13,000 km from the Southern Hemisphere to spend their winter at the site. The NACES MPA was first presented to the OSPAR Commission in 2016 by BirdLife International, an Observer to the Convention (see OSPAR Agreement 2013-02). It has since passed through three full meeting cycles (2017–2018; 2018–2019; 2019–2020) gaining the support of all Contracting Parties to move to designation.

3 | FACILITATING CONDITIONS

There were several facilitating conditions that helped the NACES MPA progress towards designation:

- *Familiarity with the importance of protecting seabirds*: Seabirds are a focal taxon in the North-East Atlantic because many populations have undergone serious declines (Dias et al., 2019). Within the EU, countries have an obligation under the Birds Directive to protect all seabirds within their jurisdiction. Many countries have their own national action plans to address seabird population declines and OSPAR has listed seven seabird species as threatened and/or declining to prioritise protection efforts (OSPAR 2008-6). Within the EU, IBAs are well recognised as sites of conservation importance, and once IBAs are identified, they have to be protected under the Natura 2000 network (Donald et al., 2018; Waliczky et al., 2018).
- *Open and transparent discussion of methods*: Marine IBAs have consistently informed intergovernmental biodiversity-related processes, including CBD-organised regional EBSA workshops (Johnson et al., 2018) and the designation of sites under the Ramsar Convention. This has provided an international platform to discuss the utility of seabird tracking data for site-based approaches, with the methods and analyses undergoing scrutiny and acceptance. Many of the same governments within OSPAR have been involved in such meetings (e.g. Baltic Sea EBSA Workshop 2018, Northeast Atlantic EBSA Workshop 2019, CBD CoP EBSA discussions 2012 to present).
- *Sustained support for and from the scientific community*: Following an expert workshop to discuss the methods and approach, a representative dataset was compiled for analysis, with seabird tracking data contributed by 79 researchers from nine OSPAR countries. This facilitated support for the site through demonstrating connectivity to the seabirds' countries of origin. This data collaboration was facilitated through the Seabird Tracking Database, which is a long-term central repository for seabird tracking data managed by BirdLife International. The database is a prominent forum for sharing and collaboration and enables broadscale analyses to be conceived and undertaken.
- *Robust and actionable knowledge*: The level of data available for seabirds provided a robust dataset that allowed a level of certainty

that the birds were foraging in the area—a detail that was not possible for other taxa at that stage. The resultant identified site is an IBA and foraging hotspot for 21 species. By synthesising the available raw data and providing a robust, easily interpretable, geospatial outcome, many of the persistent obstacles to the incorporation of conservation knowledge by management organisations were removed (Rose et al., 2018). There are increasing amounts of tracking data being collected, but the power of these data is when they are shared and compiled for large-scale analyses.

- *Adequate timing*: OSPAR has agreed to contribute to the delivery of the Aichi Biodiversity Targets,[1] including Target 11 that commits to 'By 2020 at least 10% protection of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through a set of qualitative parameters' (Rees et al., 2018). OSPAR Contracting Parties were also working to address a known gap for seabirds (and other migratory species) within their MPA network (Johnson et al., 2014). The alignment of the deadline for the Aichi Biodiversity Targets and the decadal OSPAR Ministerial meeting provided added impetus to achieve these targets, and an informal deadline to reach consensus to announce designation with high-profile publicity on the work of the convention.
- *Strong support from the start*: The OSPAR Convention requires that any observer proposal is supported by a Contracting Party to receive formal consideration. France, Germany and Sweden were early sponsors of the proposal.

4 | TACKLING THE CHALLENGES

The NACES MPA faced several challenges that will likely be encountered by other high seas MPAs identified from tracking data.

- *Lack of scientific knowledge on vertical connectivity*: Vertical connectivity in areas beyond national jurisdiction is not yet well understood, and for many species for which there are tracking data, there is still limited knowledge on the processes that support them, including food webs and associated interactions with the seafloor.

For the NACES MPA, the decision on whether to include the seafloor has been a long-standing issue of contention. Three Parties want to exclude the seafloor from the designation, citing a lack of evidence for a direct link between seabirds and the seafloor, and the final decision is still pending. For seabirds, there are two possible (not mutually exclusive) linkages to the midwater column and seafloor: (a) bathymetry: seabirds associate with seamounts for foraging (Morato et al., 2016); and (b) mesopelagic fish: their primary food source at the site (Davies et al., 2021; Dias et al., 2012) that connect different depth zones and seabed environments via their diel vertical migrations (Wright et al., 2020). In the absence of complete or direct knowledge of connectivity in ABNJ, decision-making by the OSPAR Commission is to be guided by the precautionary principle,[2] which would indicate continuous protection from seafloor to sea surface is needed (O'Leary & Roberts, 2018).

The BBNJ Agreement is to be guided by an ecosystem approach. However, in the absence of direct knowledge on vertical connectivity, there is a risk that the seafloor is excluded from designation, which risks undermining the biodiversity benefits that MPAs identified from tracking data will be able to provide. This is a concern because any extractive activities on the seafloor would have a pelagic element and the process of accessing the seafloor would have potential impacts on midwater ecosystems (e.g. deep sea mining requiring riser pipes to a collection vessel; Drazen et al., 2020). For the NACES MPA, of particular concern would be any sediment plumes that impact seabird foraging (both directly through increased water turbidity and indirectly through changes further down the food web; Drazen et al., 2020; Miller et al., 2018); as well as the presence of surface support ships because any lights at night easily disorient petrels and shearwaters and can lead to fatal collisions with vessels (Miles et al., 2010; Montevecchi, 2006). Thus, any extractive activities on the seafloor would likely compromise the management objectives of the MPA, illustrating why protecting the seafloor is an essential element to ecosystem-based conservation. Further understanding vertical connectivity in the high seas is an urgent research need that would help facilitate future decisions. In the absence of direct knowledge, however, the burden of proof is best placed on those seeking to disprove the linkage.

- *Balancing boundaries of importance and jurisdictional submissions*: Balancing the often-competing agendas for biodiversity and human use is a challenge for all MPAs. For the high seas, extended continental shelf claims provide an added layer of political complexity that needs to be considered.

The NACES MPA avoids all areas of extended continental shelf submissions. This was agreed by all Contracting Parties because it did not compromise the importance or relevance of the site for seabirds and circumvented any legal uncertainty associated with extended continental shelf submissions. OSPAR has sought to ensure that MPA deliberations do not prejudice the rights of coastal States (Elferink, 2018) until recommendations have been issued on the individual, partial, joint and/or overlapping submissions to the UN Commission on the Limits of the Continental Shelf. The high seas MPAs established within OSPAR in 2010 provided experience of this complex legal process (Johnson, 2016). Most of the OSPAR high seas MPAs are extensive, including precautionary buffer elements, and their boundaries are described using straight lines, which are easier to manage and more exact in legal text but may not precisely follow ecological contours.

[1]OSPAR Recommendation 2003/3 (OSPAR 03/17/1, Annex 9), amended by OSPAR Recommendation 2010/2 (OSPAR 10/23/1, Annex 7).

[2]Originally limited in the OSPAR Convention to the pollution of the marine environment through the introduction of substances and energy, the precautionary principle has been broadened under the ecosystem approach of the OSPAR Commission to encompass all human activities: https://www.ospar.org/convention/principles/precautionary-principle

However, this balancing can play a role in the preference of some to exclude the seafloor and may limit the opportunity to expand to other taxa, thus undermining a holistic ecosystem-based approach. Such political challenges will likely be faced under the BBNJ Agreement that will apply to superjacent waters (those above extended continental shelf claims).

- *Conveying the importance of protection from future threats*: Sites that are ecologically important but have low anthropogenic pressures have been considered 'low-hanging fruit' or 'residual' due to the limited impact they have on the extent humans use the ocean (Devillers et al., 2015). This can make it challenging to advocate for their protection in the absence of current, direct threats.

Of the 21 seabird species known to be using the NACES MPA, 18 are experiencing population declines, with 17 of these impacted by marine-based threats, including by-catch, overfishing, energy production and mining, climate change and pollution (including light pollution; Dias et al., 2019). Present threats to seabirds within the NACES MPA are poorly understood: Shipping predominantly occurs in the southern part of the area (risk of disturbance, oil and light pollution); some limited longline fishing (by-catch risk; under the remit of the International Commission for the Conservation of Atlantic Tunas (ICAAT)); and recent oil exploration west of the area (risk of oil pollution, light pollution). However, for the NACES MPA and other areas of the high seas, it is the rapidly growing and emerging threats that are of particular concern because there are a suite of emerging pressures that have high potential impact (Halpern et al., 2019; Merrie et al., 2014; O'Leary et al., 2020). Of particular concern to the NACES MPA, would be the exploitation of mesopelagic fisheries (Hidalgo & Browman, 2019). There are consistent, high concentrations of mesopelagic fish within the NACES MPA (Fort et al., 2010) that support the seabirds in the area. At present, mesopelagic fisheries remain economically unviable, but as global marine fish catches continue to decline, there is growing interest in this fishery, and a number of nations have already issued experimental licences for commercial harvesting (Wright et al., 2020). As well as potentially undermining the importance of the area for seabirds, it is thought that poorly managed extraction of mesopelagic fish will have substantial effects on marine life, food webs and the global climate (Sutherland et al., 2019). Consequently, there have been calls for a mesopelagic fishing moratorium in international waters (Wright et al., 2020). Another emerging threat for the high seas and potentially the NACES MPA is deep sea mining, with high predicted impacts (Dunn et al., 2018; O'Leary et al., 2020). For seabirds, the impacts from deep sea mining will most likely arise from deep sea sediment plumes and anthropogenic light from surface support vessels (Drazen et al., 2020; Miller et al., 2018), which could impact the ability of seabirds to forage in the area (discussed above). Climate change is also a growing threat to marine ecosystems (Halpern et al., 2019). Multi-year tracking data indicate that the NACES MPA is consistently used across years, and it is also associated with a spatially stable oceanographic driver due to bathymetric steering (Rossby, 1996). Large MPAs are also thought to be more resilient to large-scale disturbances like climate change (Toonen et al., 2013). However, monitoring of the NACES MPA will be important to understand temporal trends and improve management efforts.

Under the BBNJ Agreement, forthcoming high seas MPAs need to advocate for effective management against both current and emerging abatable threats. A horizon scan of threats to the area and the possible impacts on conservation features should be completed.

- *Management across competing competencies*: OSPAR has the legal competence to establish MPAs in ABNJ within its jurisdiction. However, other organisations have the competency to manage other activities within this area, highlighting the complex governance of the high seas.

The management of the NACES MPA will be supported by a 'Collective Arrangement' between OSPAR and the North East Atlantic Fisheries Commission (NEAFC; NEAFC & OSPAR, 2015). However, the two organisations responsible for the management of activities that pose the largest current threats to the area are longline fishing (International Commission for the Conservation of Atlantic Tunas [ICCAT]) and shipping (International Maritime Organisation [IMO]) and they are currently not part of this arrangement. The arrangement is open for further collaboration, and dialogue has been established across all competent authorities. Given the multiple competencies within the area, it will be challenging to secure a no-take MPA. But at least with respect to seabirds, maintaining longline fishing at the current low level (<3% of the total North Atlantic catch for the last 20 years; OSPAR, 2020) and ensuring the adoption of and strict compliance with by-catch mitigation measures could be considered in line with the conservation objectives of this site. ICCAT already mandates seabird by-catch measures in the South Atlantic (below the latitude of 25°S) and collects seabird by-catch data (ICCAT, 2011). The main management aim in terms of threat abatement should be to prevent any further exploitation (expansion of activities or introduction of new activities), and discussions will need to be started with the relevant competent authorities. While unsustainable extractive activities—typically including industrial fishing—are not considered compatible with biodiversity conservation, managing the low level of fishing effort and ensuring by-catch mitigation measures for seabirds (and ideally all taxa) would be part of an integrated approach to management to achieve the biodiversity conservation objectives of the site. Fishing within MPAs will be a lingering challenge for future high seas MPAs and a context-specific approach will be needed that considers the sensitivity of the conservation features and the ability to achieve the conservation objectives.

One of the strengths of the BBNJ Agreement will be the commitment of Parties to promote the adoption of protective measures in organisations to which they are members (i.e. IMO and ICCAT; Gjerde et al., 2021). The BBNJ Agreement would also have the option to enable Parties to first adopt measures directly amongst themselves, as well as petition other bodies to adopt comparable

measures (Gjerde et al., 2021). It could also adopt a coordinated monitoring, control and surveillance system to track vessel activity in the high seas and enhance the capacity of State Parties to enforce infractions when vessels call in ports. As with any future high seas MPAs, the management of the area would be assisted through a research and monitoring plan to help gather further data on the conservation features and monitor any changes. This information could then directly inform a management plan and assist with managing both current and emerging abatable threats.

5 | CONCLUSION

The imminent finalisation of the BBNJ Agreement presents a unique conservation opportunity both for the application of tracking data to conservation outcomes and for the protection of migratory species. Animals are typically tagged within national jurisdictions, which can provide impetus for action on the high seas, particularly in light of national and global commitment to protect species and halt biodiversity loss. Although there are many national action plans for migratory species, without concurrent protection in ABNJ, halting population declines is unlikely to be realised because of connections between EEZs and ABNJ (Dunn et al., 2019).

While the effective management of remote, high seas MPAs pose many challenges, much can be learnt from large-scale MPAs within national jurisdictions, which have faced similar challenges including multi-jurisdictional partnerships, surveillance and enforcement (Lewis et al., 2017). Remote sensing technologies also offer many opportunities for monitoring, both in terms of biophysical variables, as well as surveillance and enforcement (e.g. vessel monitoring and automatic identification systems, unmanned aerial vehicles and autonomous underwater vehicles). Partnerships across a variety of sectors could also create innovative strategies to use global resources (e.g. shipping industries for at-sea surveillance input, international aerospace agencies for high-resolution remote sensing data, military for surveillance and regional fisheries management organisations).

The NACES MPA demonstrates the power of translating tracking data into usable geospatial knowledge to inform conservation and policy. There are also efforts underway to translate information on migratory connectivity, for example, the Migratory Connectivity in the Ocean (MiCO) system (Dunn et al., 2019). Such efforts typically require a multilateral or an independent body, such as an NGO or academic institution, to champion the data analysis and identified sites. Such groups are well placed to initiate collaborative efforts that bring together researchers, NGOs and civil servants to ensure proposed MPAs become a joint endeavour, with robust data and political buy-in. Although the role of global and regional bodies within the BBNJ Agreement has not yet been defined, inter-regional cooperation and sharing of experience and expertise will be essential to allow the implementation of new area-based management tools to create a holistic network of MPAs across the high seas that benefit the conservation of migratory marine species.

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CONFLICT OF INTEREST

The authors have declared no conflicts of interest.

AUTHORS' CONTRIBUTIONS

T.E.D. conceived the idea for the paper. All authors contributed to writing and gave approval for publication.

DATA AVAILABILITY STATEMENT

We will not be archiving data because this manuscript does not use data.

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