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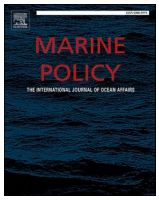

Navigating a transformative policy route for High Seas conservation

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ABSTRACT

Progress in establishing marine protected areas (MPAs) in areas beyond national jurisdiction (ABNJ), commonly referred to as the "High Seas", remains delayed by three high level challenges: (1) gaps in scientific data and knowledge, (2) lack of international and regional capacity, and (3) institutional barriers. In the present study, we created a new comparative framework based on 11 previous lessons learned that we grouped across these three challenges. We used the framework to compare the policy routes that the regional seas OSPAR Commission took pre- and post-2012 to establish MPAs in ABNJ in order to document uptake of previous lessons and identify any transformative improvements in the policy process. We evidence strong uptake of all 11 lessons and many transformations taking place to overcome challenges in scientific data and knowledge and capacity. Examples of uptake included: using multidisciplinary scientific approaches that overturned the concept of ABNJ being data-poor; multiple concurrent policy drivers that created significant momentum and political will; and OSPAR's Collective Arrangement with the North East Atlantic Fisheries Commission. Many lessons were interdependent, particularly the need for a clear and transparent science to policy process. Transforming future routes to establishing MPAs in ABNJ needs to recognise these interdependencies and recurrent challenges such as climate change and capacity, and build on transformations including the use of big data and artificial intelligence and the role of regional seas commissions as enablers of cooperation.

1. Introduction

Areas beyond national jurisdiction (ABNJ), popularly referred to as "the High Seas", pose unique challenges to authorities tasked with establishing effective measures for their conservation and sustainable use. As a result, unsustainable practices are evident throughout ABNJ. For example, 86 % of global squid fisheries and up to 66 % of demersal fisheries effort for Patagonian toothfish are unregulated in these areas [1,2] while other human activities such as international shipping, military exercises, and illegal dumping exert unquantified tolls on the biodiversity in ABNJ [3]. In addition, large gaps in scientific data and knowledge about species, habitats, ecosystems in ABNJ, alongside the ramifications of climate change, make it difficult to establish measures that effectively protect and sustainably use those areas. These gaps are compounded by a lack of international and regional capacities to undertake the necessary policy processes across multiple nations, actors, and diverse stakeholders. Institutional barriers such as weak cooperation and collaboration between relevant authorities, fragmented sector-based regulatory regimes, and challenges of monitoring, control and surveillance (MCS) in international waters intensify the problem and render the *status quo* of "High Seas" governance unsustainable.

The overarching international legal framework for regulating activities in ABNJ is the UN Convention on the Law of the Sea (UNCLOS), with authorities' competencies reinforced by its latest and long- awaited implementing agreement on the Conservation and Sustainable Use of Biological Diversity in Areas beyond National Jurisdiction. This "Biodiversity Beyond National Jurisdiction" (BBNJ) Agreement outlines among other things the means by which area-based management tools (ABMTs) including marine protected areas (MPAs) can be established. Under Article 1 of the BBNJ Agreement, an MPA is defined as "a geographically defined marine area that is designated and managed to achieve specific long-term biological diversity conservation objectives

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and may allow, where appropriate, sustainable use provided it is consistent with the conservation objectives".

Currently, commissions of five Regional Seas Conventions (RSCs) have legal competence to establish MPAs in ABNJ [4]: the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, and the Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific.

However, only OSPAR and CCAMLR have applied this mandate, and currently MPAs only cover a small fraction (1.44 %) of ABNJ due to the aforementioned challenges [5,6]. This mis-match between the vast ABNJ and sparse MPA coverage leads to concerns that the global biodiversity target of protecting 30 % of the ocean by 2030 is not achievable in the absence of increased ABNJ protection [7]. Without transformative High Seas MPA policy processes that address knowledge and capacity gaps while overcoming institutional barriers, the route for conservation and sustainable use of Earth's largest biome will remain compromised.

The transformations needed to implement a more effective policy route to establish MPAs in ABNJ can be inspired by regional, cross-boundary, and national experiences in the North Atlantic and Southern Ocean [5,6,8]. Several studies on OSPAR's MPA process for ABNJ identified many lessons learned up until 2012 [5,8,9]. Combined with advances in scientific knowledge gained from seabed mapping and ocean observations over the last decade, this leaves the open question of whether those lessons took root in 2012 and actually transformed the subsequent policy route to establish MPAs.

The present study adopts the OSPAR Convention as a case study as it has the legal duty to institute protective, conservation, restorative, or precautionary measures related to specific areas or sites including MPAs in the north-east Atlantic. To date, OSPAR's network includes 12 MPAs that partly or wholly include ABNJ (Fig. 1). Eleven of these were established between 2010 and 2012, and it was not until 2021 that a new MPA in ABNJ was designated, in response to an identified gap for seabirds within the OSPAR MPA network. OSPAR's twelfth and most recently established North Atlantic Current and Evlanov Sea basin (NACES) MPA offers an ideal case study for comparative analysis, especially as it underwent a unique re-nomination to expand its conservation objectives.

In 2016, the NACES MPA proposal was championed by BirdLife International (an observer to OSPAR processes) and the Germany Federal Agency for Nature Conservation in collaboration with a large pool of experts that contributed their data via the Seabird Tracking Database. After several revision and review cycles, a three-month process seeking views, and independent scientific advice from the International Council for the Exploration of the Seas (ICES), the NACES MPA was adopted by OSPAR in 2021. The MPA was established to protect and conserve seabirds, and the ecosystems of the waters over the seabed including the biodiversity and processes that support seabirds. Agreement to protect the seafloor could not be reached during this meeting, and so the NACES MPA was designated alongside a two-year roadmap to review the available data with the aim to expand the conservation objectives of the site, including to the seafloor. The unique re-nomination process expanded the NACES MPA conservation objectives to include other features including sea turtles, tuna, oceanic sharks, and cetaceans, but also habitats such as seamounts and cold-water corals, and ecosystem processes such as benthopelagic coupling and the roles of mesoscale eddy activity (Henry et al., submitted). The revised proposal was adopted in 2023 and entered into force in 2024, with the MPA now encompassing protection from the surface to the seafloor.

The present analysis examines the extent to which the process for establishing and then re-nominating the NACES MPA adopted and innovated from previous lessons learned. Using a comparative approach also allows us to characterise transformational steps this process took to

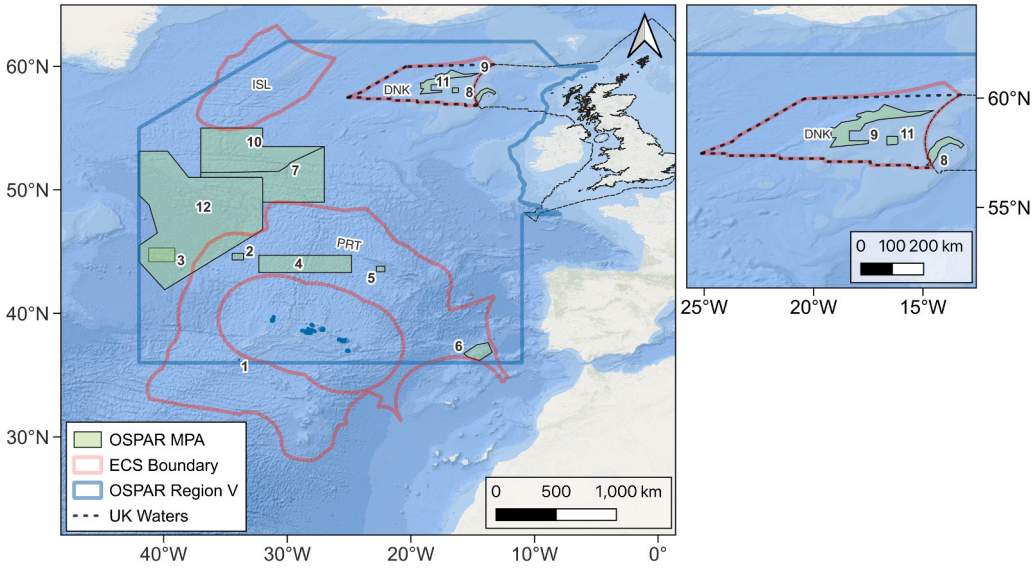


Fig. 1. The OSPAR network of MPAs in ABNJ established between 2006 and 2022, numbered in order of designation: (1) Rainbow Hydrothermal Vent Field; (2) Altair Seamount High Seas MPA; (3) Milne Seamount Complex MPA; (4) MAR North of the Azores High Seas MPA; (5) Antialtair Seamount High Seas MPA; (6) Josephine Seamount High Seas MPA; (7) Charlie Gibbs South High Seas MPA; (8) North West Rockall Bank Special Area of Conservation; (9) Hatton Bank Special Area of Conservation; (10) Charlie-Gibbs North High Seas MPA; (11) Hatton-Rockall Basin; and (12) North Atlantic Current and Evlanov Sea basin MPA. Note, only the Milne Seamount Complex MPA and the Charlie-Gibbs South High Seas MPA are wholly in ABNJ; the other 10 are either partly in a Contracting Party's Exclusive Economic Zone, or may be future due to submissions to the UN's Commission on the Limits of the Continental Shelf (CLCS) by Portugal (PRT), Iceland (ISL), and Denmark (DNK). The UK Waters layer denotes both the EEZ which overlaps with the North West Rockall Bank MPA, and the area covered by The Continental Shelf (Designation of Areas) Order 2013 that contains Hatton Bank and Hatton-Rockall Basin MPAs. The OSPAR MPA layer was sourced from the OSPAR Marine Protected Areas Network (1 January 2023) layer via ODIMS: https://odims.ospar.org/en/. The CLCS submission boundary and UK Waters layers were accessed via Flanders Marine Institute [10] and edited to select only those features overlapping with the MPAs.

overcome scientific and knowledge gaps, capacity issues, and institutional barriers that beset earlier processes. The analysis leads us to conclude whether the new route lends itself more to achieving OSPAR's goal of representative, connected, and effectively managed MPAs in order to make "High Seas" governance more sustainable.

2. Methods

Several highly relevant and critical reflections on OSPAR's MPA process for ABNJ have been published. These draw from regional and cross-boundary experiences in the OSPAR maritime area but also the Sargasso Sea and Southern Ocean. The present study integrated these reflections into a new framework that enabled OSPAR's latest (2021–2023) policy route to be compared to its former (up until 2012) route. O'Leary et al. [9] first proposed 11 lessons learned from the policy process that OSPAR underwent to establish its MPA network in ABNJ. In the present study, we used these lessons as a scaffold for the new framework developed and applied within the NACES MPA designation process. These lessons were supplemented by analysing text on further insights and recommendations comparing OSPAR's process to other governance regimes. These included the Sargasso Sea experience through the work of the Sargasso Sea Commission (SSC) and the Southern Ocean experience under CCAMLR offered by Freestone et al. [5] and Smith and Jabour [8], respectively.

Additional relevant policy and process analyses of the challenges in establishing MPAs in ABNJ were also instrumental in refining the final framework, particularly Ardron et al. [11] and Friedman et al. [12]. Between the original and revised MPA designation, Davies et al. [13] reflected on challenges that the first NACES MPA designation in 2021 faced with aspirations that this could inform future policy routes for establishing MPAs in ABNJ. These challenges are also considered in the comparative framework in the present study, as are the authors' own reflections on the nomination and re-nomination processes. A full account of explanations to underpin each lesson is available (Supplementary Material Table 1).

Each lesson in the new integrated framework was grouped according to a unique challenge that it could address in transforming the policy process of establishing MPAs in ABNJ. These were grouped into high-level challenges involving scientific data and knowledge, international and regional capacity, or institutional barriers. Implementing the integrated framework provided a longitudinal analysis of the transformations OSPAR has made towards ensuring its MPA designation process for ABNJ enables conservation and more sustainable use in its maritime area.

Taking a longitudinal approach revealed many transformations between 2012 and 2021, and the subsequent adoption of the revised NACES MPA in 2023 (Fig. 2). This allowed our results to document the NACES MPA policy route that the process adopted to look for the uptake of these 11 lessons and identify key transformations that innovated on lessons.

3. Results

First, we outline three lessons learned that relate to scientific data and knowledge. These spanned the need for clear and transparent processes, ensuring independent expert evaluations, and adopting the use of a nomination proforma.

3.1. Lesson 1: adopt clear and transparent science to policy process

Technical criteria, the selection process, and agreed objectives are key components that help to focus site nomination and selection while building trust among actors including the public [5,8]. Since 2012, nominations followed OSPAR MPA criteria to identify and select candidate MPAs under OSPAR Agreement 2003–17. Nominations must demonstrate ecological criteria and considerations including: threatened or declining species and habitats/biotopes, important species and habitats/biotopes, ecological significance, high natural biological diversity, representativity, sensitivity, and naturalness. Practical criteria and considerations must also be included in the nomination such as: potential for restoration, degree of acceptance, potential for success of management measures, potential damage to the area by human activities, and scientific value. Besides criteria, OSPAR has used roadmaps since 2007 to guide the MPA process, with the 2021–2023 roadmap

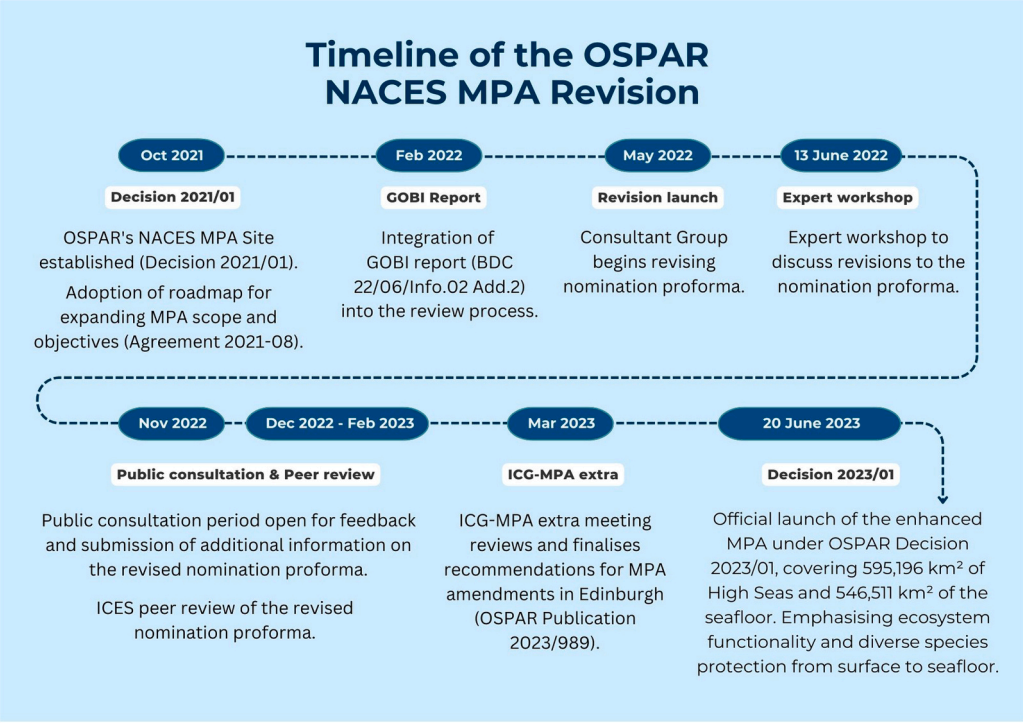


Fig. 2. Timeline of the NACES MPA revision process following the roadmap established under OSPAR Agreement 2021/08.

(Fig. 2) establishing the evidence review process to consider expanding conservation objectives for the NACES MPA.

Two key transformations took place. First, the roadmap initiated a unique evidence review process that included a new step to engage a lead Consultant Group. The Consultant Group's role was to convene and chair an expert workshop, lead the synthesis of new information, and consolidate this evidence and feedback from public consultations into a revised proforma. This saved time on MPA champions and streamlined the process, making it time efficient. Recognising the need for data to adhere to FAIR principles (be findable, accessible, interoperable, and reusable), data underpinning the designation were archived where possible by the Consultant Group and participating experts and made open access [14].

Second, the NACES MPA designation process initiated early, wide, and inclusive expert and public consultation procedures. In 2019, OSPAR developed general consultation procedures for establishing MPAs in ABNJ in its Maritime Area in the spirit of increasing transparency and acceptance. During the first 'seeking views process' July to September 2018, a variety of inputs were received and subsequently taken into account. To help revise the nomination, an online roadmap workshop with structured discussions (Supplementary Material Table 2) coordinated by the Consultant Group chaired by one of the co-authors (JMR) was held in June 2022. The workshop was attended by 39 participants including representatives of the Contracting Parties, observers, and invited experts. Participants were identified as having expertise in the following topics: benthic ecosystems, the deep-sea, fisheries, pelagic ecosystems, physical oceanography, modelling, migratory and ranging species, seabirds, marine policy, management, and ocean governance.

The Consultant Group then revised the proforma based on the workshop expert input and a public consultation procedure was launched by OSPAR in December 2022, wherein notifications, press releases, and written communications were issued with respondents given three months to submit views and concerns. The aim of this step was to collect and use as much information as possible that could help to inform decisions on amending the NACES MPA and to consider implications on management recommendations. Public views were sought, and feedback was used by the Consultant Group to revise the nomination proforma accordingly.

3.2. Lesson 2: MPA proposals must be independently evaluated

While not mandatory, review by ICES has been a vital step for MPAs in ABNJ since 2007, including expert review of a series of MPA proposals in ABNJ and for the Charlie-Gibbs Fracture Zone (CGFZ). Under Agreement 2019–09, the original designation and the roadmap process provided steps for expert ICES review and public consultation, thereby linking Lessons 1 and 2. Consecutive ICES reviews were critical in gaining acceptance by competent organisations for fisheries management. Having a common scientific and/or technical advisory body such as ICES can enhance cross-sectoral cooperation and provide common and standards of independent scientific advice accepted across sectors [8]. Besides eliminating bias and adding scientific credibility, ICES' review allowed for this wider pool of nominated experts to be consulted, adding even more rigour to the scientific evidence base presented in the form of a revised nomination proforma.

3.3. Lesson 3: adopt the use of a nomination proforma to justify MPA selection

The original identification of the NACES MPA used collaborative science, building on a workshop in 2016 with seabird researchers. This led to agreed approaches, methodologies, and a compilation of a representative dataset for analysis, with seabird tracking data contributed by 79 researchers from nine OSPAR countries. This facilitated support for site nomination by demonstrating connectivity to the seabirds' countries of origin. In addition, many data contributors were national experts who also provided scientific advice to their governments, further increasing the acceptance of the seabird science. The collaborative science-led approach and use of multi-species seabird tracking data were cornerstones to establishing the MPA in 2021.

Davies et al. [13] noted shortcomings that prevented the seafloor being included in the original designation of the NACES MPA. The lack of scientific evidence on the vertical connectivity, food webs, and interactions with the seafloor including the physical and biological mechanistic processes that underpin this connectivity were the key barriers to implementing a fully coupled sea surface to seafloor MPA. Lesson 3 is again linked to Lesson 1 because adopting a roadmap structured the process in a clear and transparent way to compile and synthesise enough evidence to justify expanding the MPA's conservation objectives, including to the seafloor.

To launch the roadmap, an initial report compiled by the Global Ocean Biodiversity Initiative (GOBI) summarised much of the data used to describe the Mid-North-Atlantic Frontal System ecologically or biologically significant marine area (EBSA), which fully overlapped the NACES MPA boundary at the time. To revise the nomination to include seabed and water column, the Consultant Group used a multidisciplinary approach as the foundation of the work required to compile the required evidence base for an MPA in ABNJ, despite the common perception that ABNJ are extremely data poor. Therefore, a second key transformation was the multidisciplinary approach taken to revise the NACES MPA (Henry et al., submitted), which overturned perceptions that such vast and remote areas always lack scientific data and knowledge. Multidisciplinary approaches were used to provide a robust scientific rationale for expanding conservation objectives while ensuring more sustainable use, which could meet the burden of proof. These transformations took advantage of scientific breakthroughs in research expeditions (Supplementary Material Table 2), multi-species tracking data, particle tracking models, high-resolution ocean circulation models, and artificial intelligence (AI). The latest and best available science by proxy used our understanding of adjacent and similar abyssal and seamount ecosystems, and other regions with high mesoscale eddy activity.

Specifically, this approach substantially expanded the use of animal tracking data and models of movements and space-use for sea turtles, pelagic sharks, cetaceans, tuna and billfish. The use of particle tracking models also allowed the conservation objectives to expand to include other migratory species such as Atlantic eel, which also helped strengthen the case for juvenile sea turtles. High-resolution ocean circulation models [15] were used to illustrate the global importance of mesoscale eddy activity in the NACES MPA, and its potential to generate upward benthopelagic coupling with benthic ecosystems that had recently been surveyed and mapped during the IceDivA2 research expedition in late 2021 [16]. While fisheries data were provided from the North-East Atlantic Fisheries Commission (NEAFC) and the International Commission on the Conservation of Atlantic Tunas (ICCAT) in the first nomination, the revised proforma also incorporated independent data on apparent fisheries effort estimated using AI approaches by Global Fishing Watch (GFW; Fig. 3). Notably, the use of GFW data in the proforma initiated iterative and cooperative dialogue with NEAFC and the Consultant Group to clarify the true extent of fisheries and to address uncertainties associated with AI-generated data.

A third transformation was that the revised proforma allowed for the adoption of a precautionary principle by allowing for understanding of adjacent or similar systems to be incorporated in the absence of data from within the MPA boundary. Smith and Jabour [8] noted reticence from CCAMLR Members to adopt the precautionary principle in the absence of data. Freestone et al. [5] noted that for many organisations with mandates to regulate human activities in ABNJ, harm has to be demonstrated before conservation measures will be considered. Thus, Freestone et al. [5] called for prudent use of proxy and analogous data and knowledge to help meet the burden of proof. During the NACES MPA re-nomination, proxy evidence of analogous systems included the

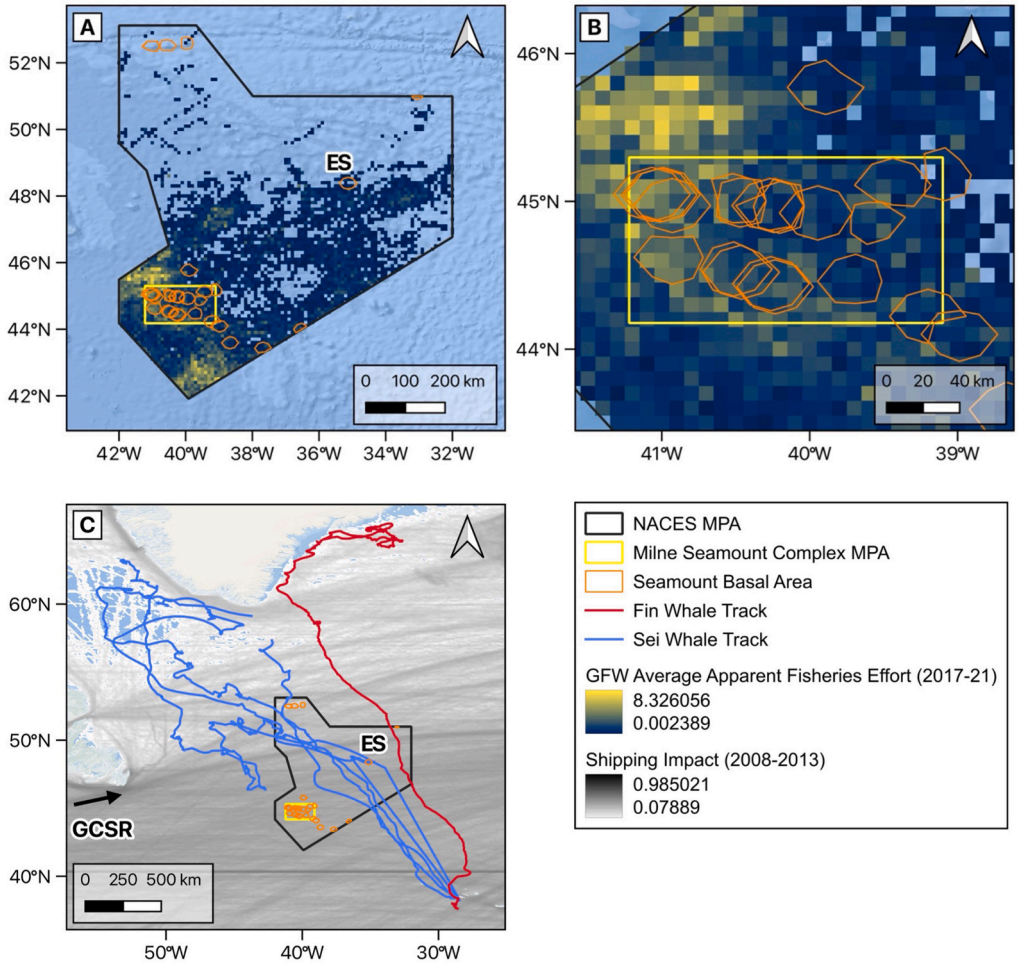


Fig. 3. Fisheries and shipping activities in the NACES and Milne Seamount Complex MPAs. (A) Global Fishing Watch (GFW) [17] average apparent fisheries effort data within the NACES MPA and Milne Seamount Complex MPA. Fisheries effort data are based on automatic identification system data for fishing hours averaged across 2017–2021 for pelagic fishing only. These values include hours of fishing vessels transiting through the MPAs, but the fishing detection accuracy is more than 90 % based on Kroodsma et al. [18]. Activity is higher in the southern sector, where there are also a higher number and density of seamounts represented as seamount basal area [19]. (B) GFW fisheries effort data for the Milne Seamount Complex MPA. (C) Overlaps between shipping lanes (impact values based on shipping stressor data collected between 2008 and 2013 and reported in Halpern et al. [20] and migration corridor tracks of six sei whale (*Balaenoptera borealis*) individuals and one fin whale (*Balaenoptera physalis*) individual passing through the NACES MPA based on data from the Azores Great Whale Satellite Telemetry Program [21–23]. One sei whale roamed over Evlanov Seamount (ES) before continuing north and crossing the great circle shipping route (GCSR) between Canada, the USA, and Europe. See Cleland et al. [14] for full references and data products.

best available science on vulnerabilities and sensitivities of similar species and habitats, and the ecological importance of processes that support them including benthopelagic coupling linking the sea surface to the seafloor.

Next, we outline three lessons learned on international and regional capacity. These called for an MPA champion, sufficient time, and to reinforce the important roles that commissions established by RSCs play in the process.

3.4. Lesson 4: an MPA "champion" can accelerate the process

Allowing States and other ‘champions’, such as non-governmental organisations (NGOs), to observe meetings and contribute their knowledge assists in site selection processes, raises public awareness, and increases acceptance of MPA proposals [5,8]. BirdLife International led the initial identification and proposal of the NACES site, and continued to provide technical support throughout the revision and decision-making processes. OSPAR Contracting Parties France, Germany, and Sweden were early supporters of the MPA proposal. After 2021 the NACES roadmap was championed by co-leads from Germany, Sweden, Norway and the European Commission with active contributions from the Consultant Group to lead the workshops, compile and archive data, and draft the revisions to the nomination proforma. Later in this paper, it will becomes evident how closely linked Lesson 4 is to Lessons 5 and 7 with the MPA champion playing key roles in allowing sufficient time to gather and synthesise data across multiple sources, plan for revisions, all the while adhering to deadlines to meet targets.

3.5. Lesson 5: allow sufficient time

OSPAR has 16 Contracting Parties and more than 30 international governmental and NGOs as official observers to their processes. The Contracting Parties of OSPAR have experience of working together in different fora, which aids communication and understanding but, even across high-capacity countries of the North Atlantic, the capacity of Contracting Parties to engage in all decision-making processes is variable and it can take time to ensure all are comfortable with positions to reach consensus. The NACES MPA was first presented to OSPAR in 2016. The first nomination passed through three full meeting cycles (2017–2018; 2018–2019; 2019–2020) including stakeholder input and revisions until it gained the support of all Contracting Parties to move to designation. The roadmap to revise the evidence base and expand the

conservation objectives to include the seafloor allocated approximately 15 months for this to take place. Together, Germany took the lead with other parties as Co-Leads to meet the deadline (related to Lesson 7) without compromising the consensus. This was achieved through meetings to clarify and revise the nomination proforma with the Consultant Group appointed to lead the revision of the science and evidence base, which links to Lesson 1.

3.6. Lesson 6: regional seas commissions offer opportunities to engage in policy processes leading to establishing MPAs in ABNJ

Given the general obligations under the OSPAR Convention, the OSPAR Commission has a wide mandate when it comes to identifying and assessing specific areas within the OSPAR Maritime Area in need of protection. Critically, no other organisation has a mandate for establishing processes for site protection in ABNJ that can also consider human activities and their cumulative impacts, or establish conservation objectives and monitoring measures. Having legal status as a regional seas commission enables OSPAR to engage in such policy processes, which is a challenge for other organisations also with a wide ABNJ remit and biologically diverse and important ecosystems that could benefit from ABMTs such as MPAs, e.g., the Sargasso Sea Alliance [5], that evolved into the Sargasso Sea Commission to work through existing regional sectoral and international organisations to explore measures to conserve the Sargasso Sea.

The NACES MPA's designation, followed by iterative rounds of feedback and revision, and a re-nomination process demonstrated sustained cooperation between OSPAR, competent authorities and Contracting Parties. This approach adheres to Lesson 9 where we discuss this in more detail. RSCs play key roles as enablers of cooperation and collaboration to ensure any proposed expansion of conservation objectives do not undermine authorities of other bodies. For example, at least six species of tuna and billfishes occur in the MPA including swordfish (*Xiphius gladius*) and Atlantic bluefin tuna (*Thunnus thynnus*), the latter being on OSPAR's List of Threatened and/or Declining Species and Habitats. Animal tracking data showed that hotspots of large Atlantic bluefin tuna often co-occurred with mesoscale eddies including within the MPA boundary. Here, tuna spent extended periods at depths $>$ 200 m [24] where they are thought to be foraging on abundant mesopelagic fishes. The revised MPA did not propose species-specific conservation objectives for Atlantic bluefin tuna as OSPAR has no competency to do so. This falls under ICCAT's authority. ICCAT conservation and management measures include recommendations for the management of many species known to occur in the MPA including Atlantic bluefin tuna, and a recent ICES assessment concluded that within OSPAR's Region V (including the NACES MPA) this species was now in good status. However, OSPAR's modes of cooperation through dialogue and diplomacy in the renomination process were critical and considered ICCAT's measures to mitigate fisheries impacts, e.g., to reduce entanglements and bycatch of sea turtles and shortfin mako (*Isurus oxyrinchus*).

Finally, we outline five lessons learned relating to institutional barriers. These called for targets/deadlines, synergies, cooperation, political will, and monitoring, control, and surveillance (MCS) plans.

3.7. Lesson 7: targets and deadlines are essential to motivate action

OSPAR's goal of a representative network of MPAs by 2012 and the planning of the OSPAR Ministerial Meeting in 2010 provided a clear target for the CGFZ and other ABNJ sites, which spurred scientific evidence gathering and addressing legal and technical issues to build political will. Designating the NACES MPA in 2021 helped OSPAR achieve their Aichi target of 10 % protection. The Ministerial Meeting in 2021 (a year later than scheduled due to the covid pandemic) provided added impetus to achieve the Aichi target of 10 % protection by 2020. At the same meeting, OSPAR's North-East Atlantic Environment Strategy 2030 (NEAES2030) was adopted and set a target for MPAs and other effective area-based conservation measures to cover at least 30 % of the OSPAR maritime area across all five OSPAR regions by 2030.

The NACES roadmap was adopted alongside the MPA designation as a compromise because agreement to include the seafloor in the MPA could not be reached during the 2021 meeting. However, this timebound roadmap (linking closely to Lesson 1) provided for an evidence review process to strengthen evidence for the designation of the seafloor and additional conservation features. The roadmap set out the time frame for the OSPAR Commission meeting in June 2023 to take a decision on extending protection of the NACES MPA and the prior decision points that needed to be met.

In a transformative step, OSPAR's policy route to revise the nomination adopted an ambitious roadmap. Evidence-gathering, synthesis, expert workshops, public consultations, subsequent revisions, and peer review took place over less than 15 months and on time to coincide with the OSPAR Commission's Regular Meeting in June 2023. The process was highly coordinated and guided by the roadmap. This reinforces the essential lessons of having a roadmap to guide the science to policy process, having MPA "champions", and allowing sufficient time even under tight deadlines. As we will see next, targets and deadlines are very closely linked to Lesson 8 on synergistic policies driving positive momentum.

3.8. Lesson 8: synergistic policy drivers and momentum can have significant positive effects

OSPAR's Decision 2021/01 to establish the NACES MPA recalled the World Summit on Sustainable Development held in 2002, including OSPAR's commitments to establishing MPAs consistent with international law and based on scientific information including representative networks by 2012. It also recalled UNGA resolution A/RES/75/239 adopted in 2020 reaffirming the need for States to continue and intensify efforts to develop and facilitate the use of diverse approaches and tools for conserving and managing vulnerable marine ecosystems (VMEs) including establishing MPAs. For the revised nomination, the parallel Convention on Biological Diversity's (CBD) policy process to describe the Mid-North-Atlantic Frontal System as an EBSA in 2022 opened up important sources of initial data and knowledge about the ecosystems, processes, and other species in addition to seabirds.

Several transformative policy drivers then created momentum and helped OSPAR establish the revised MPA. These are closely linked to Lesson 7 on having targets and deadlines. OSPAR's Decision 2023/01 recalled OSPAR's commitments to Target 3 of the CBD's Kunming-Montreal Global Biodiversity Framework (GBF) adopted in 2022; Target 3 is that at least 30 % of coastal and marine areas are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of MPAs, and that sustainable use is fully consistent with the MPA's conservation outcomes. Decision 2023/01 also welcomed the adoption of the BBNJ Agreement and Part III of the Agreement, in particular to conserve and sustainably use areas requiring protection including through establishing ecologically representative and well-connected MPA networks. While not explicitly referenced in OSPAR 2023/01, the UN Ocean Decade launched in 2021 catalysed global momentum in data-sharing under Challenge 8, "Create a digital representation of the ocean". In keeping with this challenge, the Consultant Group ensured that the revised NACES MPA was accompanied by an open access geographical information systems project archived with PANGAEA [14], enabling users to freely access, visualise, and create their own mapped products.

3.9. Lesson 9: cooperation between competent authorities is essential for MPA designation and future management

Under Annex V Article 4 of the OSPAR Convention, no programme or measure relating to the management of fisheries or maritime transport

can be adopted but the OSPAR Commission can draw actions to the attention of the authority or competent body and endeavour to cooperate. During the development of the NACES MPA, authorities and competent bodies involved in workshops and public consultations were followed by meetings with OSPAR to resolve issues and clarify the proforma, including re-affirming competencies and authorities of others e.g., ICCAT, NEAFC, the International Seabed Authority (ISA), the International Maritime Organization (IMO), and the North Atlantic Salmon Conservation Organization (NASCO). This closely links Lesson 9 with Lessons 1 and 3, in that a clear and transparent science to policy process based on an agreed nomination proforma using technical criteria to be met with agreed objectives are key components that help to focus site nomination and build trust among actors [5,8].

Much of this cooperation with OSPAR is facilitated by having a Memorandum of Understanding (MoU) in place, or bilateral agreements including Collective Arrangements. OSPAR has had MoUs with ICES since 2006, with ISA since 2010, with NASCO since 2013, and with the IMO since 2018 on matters relating to the London Convention and London Protocol. A more general bilateral cooperation agreement between OSPAR and the IMO has also existed since 1999. A Collective Arrangement between OSPAR and NEAFC was adopted in 2014 as 'a formal agreement between legally competent authorities managing human activities' in ABNJ in the North-East Atlantic [25]. The Collective Arrangement builds on a previous MoU from 2008, with the intention being to expand participation in the Collective Arrangement to other organisations with regulatory powers in the region. The ISA, IMO and ICCAT were invited to subscribe to the Collective Arrangement, but to date these organisations have not exercised this through any formal arrangement, but they have participated in meetings of the Collective Arrangement. In 2019, the North Atlantic Marine Mammal Commission (NAMMCO) announced its intention to conclude an MoU with OSPAR and then consider subscribing to the Collective Arrangement but at the time of writing, this MoU has not been concluded. During the 29th meeting of the ISA, it was agreed that bilateral meetings between the ISA and the OSPAR Commission should be more regular, and that the ISA secretariat would also participate, when appropriate, to relevant work of the OSPAR Commission including the collective arrangement.

The biggest transformation in the policy route to establish MPAs in ABNJ has been OSPAR's Collective Arrangement with NEAFC, with the route to MPA revision being greatly facilitated by strong diplomacy and recognition of the intent of the Collective Arrangement. However, pelagic fisheries taking place in MPAs in ABNJ continue to pose challenges in terms of entanglements and bycatch, issues that are compounded by a lack of data-sharing and transparency; Davies et al. [13] proposed that in future a more context-specific approach be taken that considers sensitivities of the conservation features and the ability to achieve the conservation objectives.

3.10. Lesson 10: strong political commitment and willingness are required

The Ministerial Declaration from OSPAR's Ministerial meeting 2021 aimed to recommit Contracting Parties to their obligations under the OSPAR Convention. It signalled the OSPAR Ministers' and the EU Commissioner's agreement to adopt, implement and resource OSPAR's new strategy, NEAES 2030. Additionally, OSPAR's experience of accommodating Portugal's continental shelf submissions in 2010 was critical in giving OSPAR institutional capacity to deal with Portugal's submission of an addendum to this claim in 2017 that now overlapped with the NACES MPA boundaries being proposed in 2023. Coastal States' extended continental shelf claims create legal and political uncertainty; without political willingness, such complexities can deter engagement and delay progress. Notably, OSPAR's recommendation to establish the revised MPA notes Portugal's commitment to establish programmes, measures, and agreements concerning the adjacent seafloor necessary for achieving the conservation objectives of the NACES MPA.

A key transformation, and at the same time a synergistic policy driver (Lesson 8), was the launch of the Galway Statement between the European Union (EU), Canada and United States, followed by the Belém Agreement between the EU, Brazil, and South Africa. These high-level political statements by governments paved the way for pan-European and trans-Atlantic research, innovation, and cooperation programmes through the EU's Horizon 2020 framework. This funded the ATLAS and iAtlantic projects generating scientific data and knowledge (Lesson 3) that were used extensively in the revised nomination proforma to meet criteria. Such new information included the high-resolution oceanographic modelling that resolved mesoscale eddy activity in the NACES area, larval tracking models, and discoveries made from deep-sea research expeditions such as 'IceDIVA2' (Henry et al., submitted).

3.11. Lesson 11: monitoring, control, and surveillance (MCS) plans combined with political and social will for compliance are essential

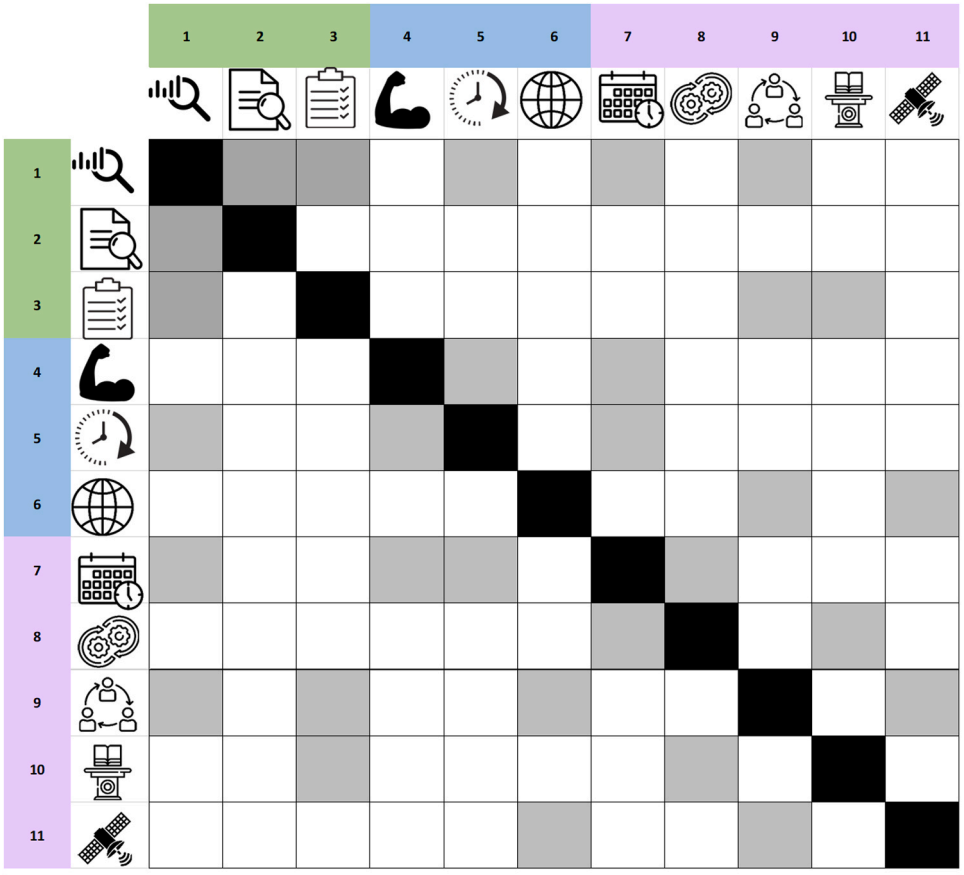
As noted by Lessons 6 and 9, diplomacy and dialogues underpinned by a Collective Arrangement helped confer a high degree of acceptability of the revised MPA conservation objectives, which will facilitate compliance.

The use of GFW data, which uses maritime tracking data based on automatic identification system (AIS) combined with machine learning algorithms to determine if a vessel is either apparently fishing or not, provided independent and fine-scale estimates of potential fisheries effort within the MPA. This gave a new perspective into where pelagic fisheries were most likely operating and how these overlapped with conservation features, and so can assist with designing MCS plans. Using GFW data provided much needed transformation in scientific data and knowledge on practical MCS considerations of the MPA and the potential for management measures to be successful in the nomination proforma, although management measures are yet to be developed. For example, GFW data showed locally higher areas of apparent pelagic fishing effort over the Milne Seamount Complex. The complex is not only a hotspot of seamounts and an MPA in its own right, but it's also a shortfin mako hotspot where tracking data suggest they are feeding [26] and a foraging area for juvenile loggerheads [27]. Shipping vessel density was also estimated for the proforma using AIS data and demonstrated some areas of high overlap with sei whales (Fig. 3), reinforcing the opportunities afforded by AIS and other forms of remote sensing to help implement MCS plans.

Davies et al. [13] reflected on how monitoring the NACES MPA was also important given the prospect of potential future exploitation of resources such as mesopelagic fish and seabed minerals, even when sites currently experience low anthropogenic pressures. Picking up on their recommendation, a second transformative aspect was that the revised proforma explicitly considered potential future threats that could be posed by mesopelagic fisheries and seabed minerals exploitation, which would require close cooperation between OSPAR and relevant competent authorities. Potential impacts of climate change were also explicitly mentioned in the revised proforma including potential threats posed by changes in seawater carbonate chemistry, water temperature, food and prey availability, all of which are highly likely to affect MPA conservation outcomes.

4. Discussion

By documenting and comparing OSPAR's policy route to establish MPAs in ABNJ pre- and post-2012, we revealed several transformations that enabled the establishment and revision of the NACES MPA. A synoptic view of these is provided in Fig. 4. Notably, the synoptic view revealed how many lessons are not mutually exclusive but instead are often interdependent. We discuss these interdependencies, and follow this with emergent themes in the transformations that took place including the use of big data, AI, and other sources of scientific data and knowledge more generally as well as perspectives on RSCs in enabling



Transformations in scientific data and knowledge

- the roadmap initiated a unique evidence review process that included a new step to engage a lead consultant group
- the revision process initiated early, wide, and inclusive expert and public consultation procedures
- the consultant group championed a multidisciplinary approach that established a rigorous scientific evidence base for "data-poor" ABNJ

Transformations in overcoming institutional barriers

- OSPAR's policy route to revise the MPA adopted an ambitious roadmap
- multiple concurrent policy drivers created significant momentum (e.g., GBF, BBNJ, UN Ocean Decade)
- OSPAR's Collective Arrangement with NEAFC greatly facilitated revisions and adoption of the revised MPA
- high-level political statements such as the Galway Declaration and the Belém Statement resourced and promoted international scientific collaborations
- AIS data transformed the spatial and temporal scales of human activities that have practical MSC considerations for the MPA
- the revised proforma considered future threats to emphasise the need for current monitoring

Fig. 4. Correlation map illustrating links between the 11 lessons learned from establishing MPAs in ABNJ. Lessons are organised across three high-level challenges of scientific data and knowledge (in green), international and regional capacity (in blue), and institutional barriers (in pink) and listed as they appear in the present study. Cells in black represent the same lesson; cells in grey represent correlations between a pair of lessons; cells in white indicate that no immediate correlation between lessons could be found. Key transformations in the policy route along the way to establishing the revised NACES MPA are listed below the correlation map; note that no transformations relating to international and regional capacity were immediately apparent.

cooperation. We conclude with considerations of recurrent challenges in establishing MPAs in ABNJ including climate change, sectoral processes, and institutional capacity.

4.1. Interdependencies and the vulnerability of the MPA process in ABNJ

Lesson 1, adopt a clear and transparent science to policy process, was most frequently linked to other lessons. This reflects the importance of conducting and using sound scientific approaches to meet agreed

technical criteria in a clear and transparent selection process, with agreed MPA conservation objectives. Roadmaps to adopt such an approach were instrumental, and all of this helps build trust among actors [5,8]. Lessons 7 and 9, on having targets and deadlines and strong collaborative mechanisms were also well correlated, having links to four others. Recognising these interdependencies can strengthen the policy route to establishing MPAs in ABNJ when all lessons are adopted; but equally, should even one of these well-correlated lessons be only weakly applied, this opens many vulnerabilities of the policy route.

4.2. Emergent themes of big data, AI, and diverse knowledge systems

Big data and AI will play increasingly important roles in providing the underpinning evidence base for an MPA proposal and governance more generally in ABNJ [28]. Big data and AI can also open doors to dialogue for ensuring more sustainable use of the MPA without necessarily restricting activities, depending on the activity and the impact on the conservation features. The use of AIS data including those used by GFW have been transformative for understanding human activities such as fisheries on the High Seas [18]. For the NACES MPA, data from GFW provided further opportunities for engagement and highlighted areas of the MPA that could benefit from further dialogue. For example, dialogue with ICCAT is important to understand true fisheries effort in the area especially given the space use exhibited by shortfin mako and sea turtles; discussions with IMO are critical to consider overlap of vessel traffic with cetaceans such as sei whales (Fig. 3).

As recognised in the BBNJ Agreement, traditional knowledge held by Indigenous Peoples and local communities (IPLC) can also provide relevant information to the process of establishing MPAs in ABNJ. Such knowledge includes understanding of marine connectivity and best management practices; but it also includes awareness of, e.g., ocean currents, wave patterns, productivity and aggregation hotspots gained through traditions of seafaring and long-distance navigation [29]. Gutierrez et al. [30] noted that particularly for small islands such as those in the Macaronesia region, finding ways to incorporate cultural and spiritual values into the process of establishing and managing an MPA in ABNJ is essential. The views and expectations of local communities and the sharing of ideas across the wider maritime community is also important [30]. Knowledge learning and sharing of information across a wide range of stakeholders also allows for a more iterative approach to decision-making in ABNJ [31], which commissions established by RSCs can help to facilitate, as we outline next.

4.3. Regional seas commissions as enablers of cooperation

The findings of the present study promote many of the BBNJ Agreement's implementing mechanisms for international cooperation and coordination across multiple fronts including through the use of roadmaps, public consultations, expert review processes, and MoUs with existing institutions, frameworks, and bodies competent authorities (IFBs). Our findings also reinforce and centre the importance of RSCs as enablers of such cooperation.

OSPAR's roadmap and review processes facilitated cooperation, collaboration, and communication among Contracting Parties, existing IFBs in the region, observers, the academic community worldwide, and the public. The process to revise the MPA nomination through formalised review mechanisms and transformative expert and public consultations also speaks to the potential for adaptive capacity called for under the BBNJ Agreement. While the BBNJ Agreement carries a duty not to undermine existing IFBs, its new Scientific and Technical Body and Conference of the Parties would enable a hybrid approach that enables and strengthens regional and global cooperation including that exercised by OSPAR and other RSCs [12].

Commissions have the opportunity to create MoUs and Collective Arrangements with other bodies, which strike a balance between conservation and sustainable use. In the case of the NACES MPA, this helped ensure dialogue and diplomacy in establishing this MPA on a precautionary basis. Brooks et al. [32] noted that in the Southern Ocean for the Ross Sea MPA, prohibitions and restrictions coordinated through CCAMLR alongside active management, research, monitoring and enforcement of the Ross Sea region MPA showcase how CCAMLR and Member States can manage and enforce MPAs in ABNJ. However, Brooks et al. [32] also noted that compromises were made along the way such as allowing fisheries to take place in some areas including special research fishing zones.

Tang et al. [33] considered the OSPAR Commission as a "cooperative initiator" in the region: the "initiator" resolves conflicts, fills governance gaps, and can urge other relevant agencies, Contracting Parties and non-Contracting Parties to cooperate in managing marine ecosystems and resources in the MPA. Tang et al. [33] found that this cooperation likely enabled by overlap in OSPAR and many sectoral bodies' Contract Parties and their geographic areas of competence, as well as the shared role of ICES as a key scientific advisor to these organisations.

Although successfully showcasing itself as a cooperative initiator *sensu* Tang et al. [33], OSPAR and agencies with overlapping jurisdictions have Contracting Parties from developed countries with financial support, and seemingly have consensus about several issues relating to area-based management and conservation in ABNJ. With such enabling conditions missing across large parts of ABNJ the cooperation demonstrated by OSPAR may be a challenge for other RSCs to achieve in many other parts of the "High Seas". Furthermore, measures established for MPAs in ABNJ are only directly binding on Contracting Parties, creating a significant recurring challenge for commissions established by RSCs, but also a potential opportunity when Contracting Parties are shared across different competent bodies

4.4. Recurrent challenges in establishing MPAs in ABNJ

4.4.1. Climate change and equity in scientific data

Related to scientific data and knowledge under Lesson 3 on using a nomination proforma for MPA selection, there is a recurrent challenge related to climate change but also equity of access to scientific data. The extent to which climate change will impact the physical oceanography and eddy activity, biological carbon pump, and benthopelagic coupling in the NACES MPA is not known but these could substantially alter the marine food web and species' distributions in the area. Related to this, Hannah et al. [34] called for a more equitable shared scientific understanding of how species' ranges may shift under climate change to ensure the MPA and any management measures are effective in the long-term. They noted that such data and models are based mainly in high income countries and that outputs are not always freely available. The Consultant Group and participating scientists ensured as much of the data that underpinned the revised NACES MPA was made open access (see the geodatabase compiled by Cleland et al. [14]), but more must be done to unlock and make open access maps of projected future changes in species distributions and ranges under different climate change scenarios [34].

4.4.2. Lengthy sectoral review processes and capacity challenges

Also related to Lesson 3 was a separate recurrent challenge noted much earlier by Freestone et al. [5], who referred to a "gauntlet" of sectoral review processes that must consider scientific evidence and expert reviews gathered externally outside of their own organisations. This can considerably delay the MPA process without sustained cooperation and political willingness. In the present study, the Collective Arrangement with NEAFC and independent expert review by ICES, a shared scientific advisory body with NEAFC, helped progress the renomination process but as noted earlier by Tang et al. [33], this is not always the case in less well-funded regions.

The gauntlet of sectoral review processes noted by Freestone et al. [5] is also related to another recurrent high-level challenge concerning international and regional capacity. Gjerde et al. [6] and many others

have also noted this lack in capacity with significant governance gaps in RSC coverage worldwide in ABNJ, though the BBNJ Agreement will alleviate some of the issue. Gjerde et al. [6] suggested sectoral bodies such as the IMO, ISA, and regional fisheries management organisations (RFMOs) require more willingness to expand and exercise their mandates to adopt ABMTs including MPAs but also VMEs, and particularly sensitive sea areas (PSSAs) for example. Meanwhile new or expanded RSCs may be needed to fill these gaps.

Freestone et al. [5] further noted the time and effort needed to undertake the process of establishing MPAs in ABNJ. This remains a recurrent challenge for RSCs with mandates to establish MPAs in ABNJ; but, having MPA champions, targets and tight deadlines, and cooperation, the NACES MPA was designated and revision was adopted. However, it will be a challenge particularly to a State Party or parties that lack capacity to nominate MPAs under the BBNJ Agreement if and when it enters into force.

Part V of the BBNJ Agreement makes many provisions for capacity-building and the transfer of marine technology (CBTMT) that would significantly improve capacity to establish MPAs in ABNJ for State Parties. Part V promotes enhanced cooperation that assists Parties and developing States particularly, if calls for modalities for capacity-building and the transfer of marine technology, and it calls for institutional support through a new CBTMT Committee alongside financial mechanisms to support the implementation of Part V. Capacity remains a huge hurdle for many regions and countries, and local communities, and there is still much to consider around how the Agreement would resolve this. For example, Harden-Davies et al. [35] called for needs assessments to be conducted, a metric-based CBTMT review process, representation on the Committee from diverse voices beyond State representatives, ways in which information will be shared and how this will be resourced, and ways of addressing financial shortcomings.

4.4.3. *Data-sharing and transparency*

A recurrent institutional challenge relating to Lesson 9 on cooperation was already noted by Hannah et al. [34], who further called for accelerating and coordinating efforts in data-sharing across fisheries management, scientific, and governance bodies. To achieve an effectively managed NACES MPA that was established by OSPAR on a precautionary basis, cooperation is needed with other competent authorities, including data-sharing and reporting of human activities occurring within the MPA. This would require dialogue between ICCAT, IMO, and OSPAR, and help monitor progress in meeting the MPA's conservation objectives.

A global assessment of High Seas fisheries governance by tuna RFMOs found that current approaches to research and data transparency were insufficient to mitigate bycatch of sharks and rays, and called for improving the quality and availability of data [36]. The authors used ICCAT's Shark check Sheet as a case study to demonstrate ICCAT's enforcement of a binding prerequisite upon countries wanting access to a fishery to submit and make publicly available their data on, e.g., use of observers, electronic monitoring, discards, etc. [36]. Such data could be used to start or continue dialogue with RSCs who have mandates to establish and monitor MPAs in ABNJ.

5. Conclusions

Having the BBNJ Agreement in force would establish mechanisms for MPA proposals in regions without RSCs. The lessons we summarised in the present study can offer many suggestions on process going forward under the Agreement and we hope stimulate more transformations as MPA proponents navigate the new route. The challenges we identified can also transcend regions beyond the North Atlantic; this is true in particular for climate change, which will radically alter deep and open ocean ecosystem function and thus reduce the effectiveness of ABMTs [37–39]. The Agreement's mechanisms for sustained international cooperation and CBTMT are therefore imperative to help future-proof ABMTs.

CRediT authorship contribution statement

Janos Hennicke: Writing – review & editing, Supervision, Investigation. **J. Murray Roberts:** Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Tammy Davies:** Writing – review & editing, Supervision, Project administration, Investigation, Funding acquisition. **Jason Cleland:** Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis. **Lea-Anne Henry:** Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Richard Emmerson:** Writing – review & editing, Supervision, Resources, Methodology. **Anna Gebruk:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology.

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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.2025.106785.

Data availability

Data will be made available on request.

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