https://doi.org/10.1038/s44183-025-00172-z

Five key opportunities to enhance the effectiveness of area-based marine conservation

R. R. E. Stanley[1] ✉, A. Abad-Uribarren[2], A. Belackova[3], A. Belgrano[4,5], U. Bergström[5], K. Boerder[6], T. Blenckner[7], A. Colaço[8], A. Himes-Cornell[9], B. Horta e Costa[3], J. Jacquemont[10], L. H. Jurrius[11], R. Langton[12], T. Noble-James[13], M. Ohanna[14], E. M. Olsen[15], E. M. Rubidge[16,17], E. C. E. Sacre[5], E. V. Sheehan[18], M. Sköld[19], V. Stelzenmüller[20], D. P. Tittensor[6], T. C. Vallina[21], S. Villasante[22] & J. Claudet[14]

Effective area-based conservation is central in global efforts to reverse marine biodiversity loss and safeguard ecosystem functioning. Here, we identify five key opportunities to maximize conservation potential as nations progress towards the Convention on Biological Diversity's 2030 area-based management targets. These include enhancing accountability, elevating conservation in spatial planning, implementing adaptive management, coordinating conservation efforts across scales, and reconciling design with expected outcomes. Addressing these collectively will advance global marine conservation and maximize its contributions to biodiversity protection and human society.

Area-based conservation tools, including marine protected areas (MPAs) and other effective area-based conservation measures (OECMs), play a pivotal role in safeguarding marine ecosystems and the ecosystem services they provide[1,2]. OECMs, such as community-managed fisheries areas in the Western Indian Ocean, fisheries closures in the northwest Atlantic, or sustainable use zones in the Seychelles, demonstrate how biodiversity conservation can be achieved outside formal MPA systems[3–5]. Such tools are now central to global conservation commitments, with the area covered serving as one of the few quantitative metrics to track progress towards marine biodiversity goals. However, implementing networks of conservation measures that are effective, well-connected, representative, and resilient, principles collectively referred to as ecological coherence, remains a major challenge for ocean governance, particularly when these networks must also support local communities[6] and contribute to a sustainable blue economy[7].

Recent strides have been taken towards defining core principles for designing effective MPAs[8] and OECMs[9–14]. Target 3 of the Convention on Biological Diversity's (CBD) Kunming-Montreal Global Biodiversity Framework (GBF), and the EU Biodiversity Strategy for 2030[15], both incorporate spatial targets to achieve 30% ocean coverage in effectively conserved and well-managed areas. Nonetheless, key opportunities for improvement remain, as the global MPA network still falls short of maximizing its potential benefits for biodiversity, climate, and food security[16]. There also remains uncertainty on how to apply the effectiveness criteria for OECMs. The few remaining years leading up to 2030 present a crucial opportunity for capitalizing on the potential of area-based conservation.

Recognizing this urgency, we identify and address five key opportunities for enhancing area-based marine biodiversity conservation by 2030: (1) adopt common standards to enhance accountability; (2) elevate

[1]Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, NS, Canada. [2]Centro Oceanográfico de Santander (COST-IEO), Santander, Cantabria, Spain. [3]Centre of Marine Sciences of the Algarve (CCMAR/CIMAR LA), University of Algarve, Faro, Portugal. [4]Swedish Institute for the Marine Environment (SIME), University of Gothenburg, Gothenburg, Sweden. [5]Swedish University of Agricultural Sciences, Department of Aquatic Resources, Uppsala, Sweden. [6]Dalhousie University, Halifax, NS, Canada. [7]Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden. [8]University of the Azores, Institute of Marine Sciences - OKEANOS, Horta, Portugal. [9]Fisheries and Aquaculture Division, Food and Agriculture Organization of the United Nations, Rome, Italy. [10]National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA, USA. [11]Monash University, Melbourne, VIC, Australia. [12]The Marine Directorate of the Scottish Government, Aberdeen, Scotland. [13]Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, UK. [14]National Center for Scientific Research, PSL-EPHE-UPVD, CRIOBE, Paris, France. [15]Institute of Marine Research, Flødevigen Research Station, Arendal, Norway. [16]Institute of Ocean Sciences, Fisheries and Oceans Canada, Sidney, BC, Canada. [17]Department of Forest and Conservation Sciences, University of British Columbia, Vancouver, BC, Canada. [18]School of Biological and Marine Sciences, Faculty of Science and Engineering, University of Plymouth, Plymouth, UK. [19]Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Marine Research, Lysekil, Sweden. [20]Thünen Institute of Sea Fisheries, Bremerhaven, Germany. [21]Wageningen Marine Research, Wageningen University & Research, IJmuiden, The Netherlands. [22]CRETUS – University of Santiago de Compostela, A Coruña, Spain. ✉e-mail: Ryan.Stanley@dfo-mpo.gc.ca

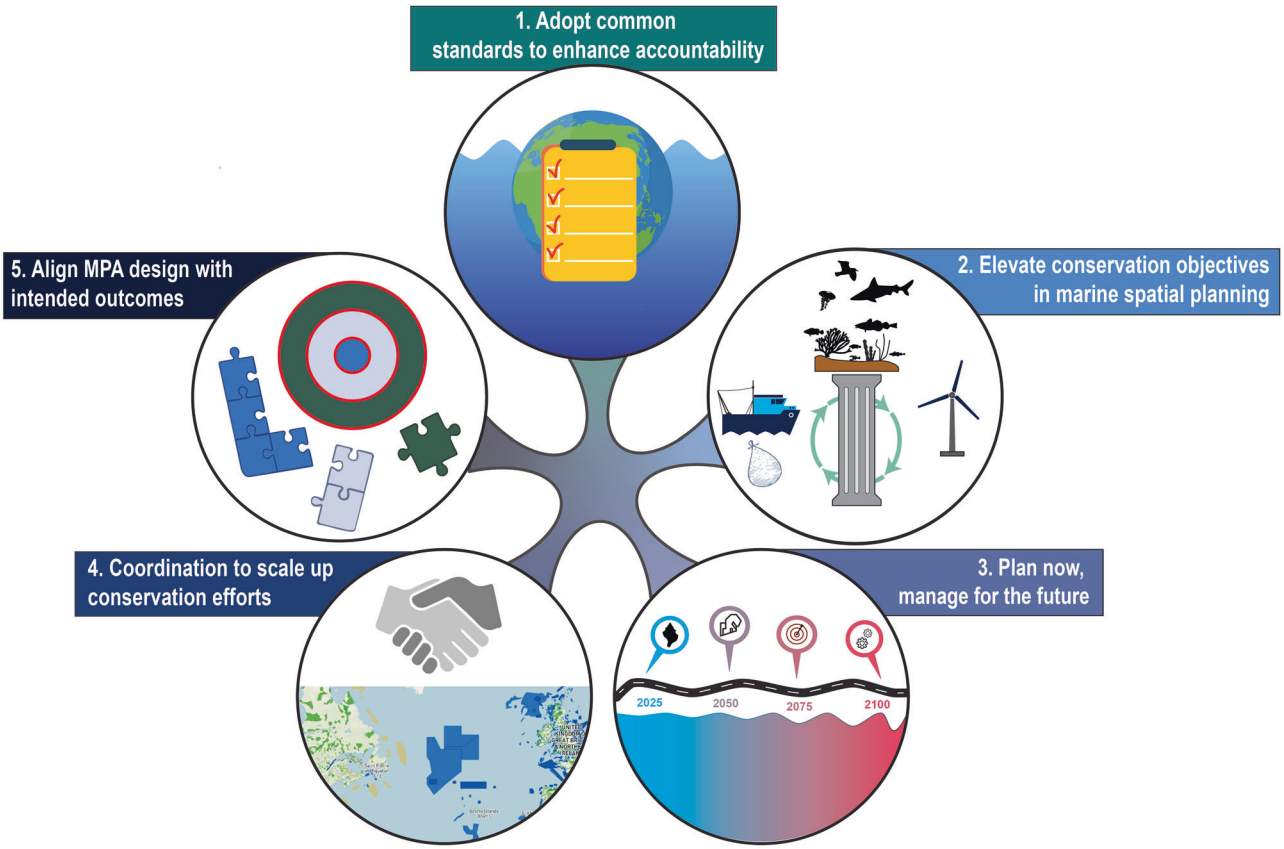

Fig. 1 | Five key opportunities to improve the effectiveness of area-based marine conservation. All elements were created using Adobe Illustrator and incorporate open-source graphics and data, including marine protected area shapefiles from the Protected Planet Database and organism silhouettes sourced from PhyloPic (http://phylopic.org), licensed under Public Domain or compatible Creative Commons licenses.

conservation objectives in marine spatial planning (MSP); (3) plan now while managing for the future; (4) coordinate to scale up conservation efforts; and (5) align MPA design with expected outcomes (Fig. 1). These opportunities were identified through expert knowledge and experience gathered during multiple week-long workshops held between researchers, fisheries scientists, government agency representatives, and FAO members, as part of the International Council for the Exploration of the Sea Working Group on Marine Protected Areas and other Spatial Conservation Measures. These opportunities build on longstanding ideas but are framed here as an interconnected set of leverage points that address recurring challenges preventing marine area-based conservation tools from reaching their full potential. Rather than offering an exhaustive or prioritized list, these levers are presented as mutually reinforcing and interdependent, reflecting that meaningful progress in area-based conservation would be best achieved if these elements were collectively advanced in an integrated manner. Together, these levers have the potential to strengthen the coherence and effectiveness of MPA and OECM networks at local, regional, and global scales, maximizing their contributions to nature and human well-being.

Opportunity 1 - Adopt common standards to enhance accountability

A critical challenge to the success of area-based conservation strategies is the absence of globally-adopted standardized criteria and nomenclature to track conservation efforts and outcomes, in particular with regard to what should count towards targets, despite existing available standards[8]. Indeed, measuring the success of international agreements like the GBF and the Sustainable Development Goals (i.e., SDG 14.5), and ultimately holding participating nations accountable necessitates clear language, precise definitions, and comprehensive indicators[17].

Currently, area coverage is the only indicator for Target 3 (30% of the global ocean in effective MPAs or OECMs by 2030), with no required measure of quality. Despite the lack of defined indicators, effectiveness remains a key component of Target 3, as emphasized in the CBD Parties' decision on the definition and characterization of OECMs[9]. Understanding the effectiveness of area-based conservation measures is critical as their capacity to attain intended ecological outcomes is contingent on their level of protection and the management systems implemented[8,18–20]. While high protection yields stronger biodiversity results, this level is often seen as limiting for local socio-economic interests, leading to the frequent implementation of lower-protection measures[21,22], which are less effective and thus can reduce public confidence in the capacity of MPAs to deliver ecological benefits (see Opportunity 5). The variable definition and application of 'high protection' between nations complicates consistent tracking and reporting of conservation progress. Therefore, it is imperative that countries adopt clear, standardized nomenclature - such as those provided by the MPA Guide[8], complementing the IUCN protected area categories to ensure effective monitoring and accountability. However, the inconsistent application of both of these classification systems across countries underscores the ongoing need for clearer global guidance and validation mechanisms[8,22].

The European Union (EU) offers a paradigm for area-based conservation targets with a two-tier approach, aiming for 30% of EU waters as MPAs by 2030, with 10% under "strict" protection[23]. However, despite this clear framework, its implementation has been inconsistent across member states[22]. Over 80% of EU MPAs minimally regulate human activities[22], while 86% of EU and UK MPAs allow high-risk fishing activities[24], and some "protected" areas are more heavily trawled than unprotected zones[25]. While the EU defines "strict protection" as "full protection" in principle, with prohibitions on extractive and other damaging activities[26], countries like France have adopted their own standards (e.g., 'protection forte'[27]). Others,

such as Portugal and Germany, may follow the EU guidelines without their own formal definitions, while still others may be reluctant to implement this non-binding measure. Lack of uniformity in how protection levels are applied complicates the ability of countries and international bodies to track and achieve consistent conservation outcomes.

This variability in the application of terms like "strict protection" points to a broader challenge in global conservation efforts, particularly as nations work toward commitments under the GBF. While the GBF offers a monitoring framework for evaluating progress, its success relies on Parties adopting and consistently applying harmonized definitions in their National Strategy Action Plans. Key barriers include limited technical capacity to implement consistent classifications, political hesitancy to adopt stricter or externally defined standards, and the voluntary or non-binding nature of many definitions and targets[28,29]. As a result, significant divergence in interpretation persists, undermining both accountability and the comparability of national-level reporting. Overcoming these barriers and adopting universally recognized and validated nomenclature in conservation commitments would enhance clarity, accountability, and tracking of biodiversity goals, ultimately strengthening area-based conservation efforts worldwide.

Opportunity 2 - Elevate conservation objectives in marine spatial planning

In many countries and regions, marine conservation goals and targets are distinct from broader sustainable management goals[30]. There is therefore a need to identify the trade-offs and synergies between various conservation measures and the management of sustainable use. On one end of the spectrum, MPAs are by definition designed to prioritize biodiversity conservation. On the other hand, marine spatial planning (MSP) is a governance process that aims to achieve multiple objectives, such as sustainable extractive use or energy production (e.g., offshore wind). Although the overarching societal goals of MSP are often broader than conservation, these goals could ideally be supported by measures that synergistically promote biodiversity conservation (see Opportunity 1). However, because biodiversity objectives are rarely integrated into MSP objectives from the outset, environmental and conservation targets are frequently sidelined, leading to suboptimal socioeconomic and ecological outcomes[31,32] (Opportunity 5). Policy trends, such as the rapid adoption of Blue Growth initiatives, further complicate these dynamics by incentivizing economic objectives often at the expense of long-term biodiversity conservation[33]. This disconnect reflects the broader challenge of reconciling CBD GBF targets: while Target 3 mandates the effective conservation of 30% of ecosystems, Target 1 promotes integrated spatial planning to reduce biodiversity loss, and Target 10 encourages sustainable practices across sectors like fisheries and aquaculture to enhance biodiversity resilience and long-term sustainability. While these targets address distinct but related aspects of marine management, their alignment is often lacking, particularly in the connection between national MPA designation processes and MSP[34]. The need to integrate both conservation and sustainable use objectives into MSP processes is recognised[31,33,35], and should result in a focus on sustainable use outside of conservation areas, interdependent with safeguarding and restoring biodiversity within them. This integration would lead to better support of global conservation efforts with conservation-focused MPAs nested within a sustainably managed ocean, benefiting both ecosystems and people.

The lack of practical guidance on how to integrate ecosystem-based management principles into MSP processes has recently been addressed through the provision of comprehensive and operational assessment tools for ecosystem-based MSP[36,37]. The EU Marine Strategy Framework Directive[38], for example, underscores the need for Member States to achieve a "good environmental status" for their territorial waters, relying on robust MSP processes to address the cumulative adverse impacts of human activities. Despite its contextual specificity, MSP often employs spatial zonation schemes that reflect diverse priorities and legally binding sectoral usage, which entails the prioritization of certain human activities over others. In practice, many MSP processes lack dedicated monitoring to evaluate in depth environmental and socio-economic impacts[39] and may overlook how these impacts spread across space and depth[40]. To effectively address the gap between biodiversity conservation and other forms of human activity regulation, it is imperative to position biodiversity conservation priorities as a cornerstone of sustainable management, in addition to being an end unto itself. This entails integrating directed biodiversity conservation measures, such as ecologically coherent conservation networks, into MSP frameworks directly[41], alongside regional ecosystem conservation measures (e.g., ecosystem-based approaches for management)[42]. The integration of core concepts for conservation planning into MSP, such as spatial planning for ecosystem connectivity in addition to sectoral management, could leverage these potential benefits to improve system-wide biodiversity, thereby more effectively aligning with and contributing to conservation targets[31]. This integrated approach can serve to enhance nature-based solutions that improve environmental conditions while contributing to CBD GBF Targets 1, 3, and 10.

Opportunity 3 - Plan now, manage for the future

Area-based conservation tools, acknowledged for bolstering social and ecological resilience to climate change[43], face a challenge due to their traditionally static design and legal implementation, which risks diminishing conservation outcomes as climatic conditions and ecosystems change over time[44,45]. While adaptive management is important for ensuring the long-term effectiveness of conservation measures, practical gaps remain[46–48]. These include the significant financial resources required for monitoring and the development and implementation of adaptive management strategies that can effectively respond and keep pace with a changing climate[48–50]. Even when adaptive management mechanisms are available, high monitoring costs, difficult-to-detect biological responses, attribution issues (see Opportunity 5), and delays in translating changes into actions[51], can collectively limit the integration of climate adaptivity into management[52,53]. The lack of clear guidance and flexibility in the management of protected areas and protected area networks, most often designed to be static by nature, further constrains adaptivity[54,55], leading to reactive adjustments after failed measures with ultimately higher economic and social costs, rather than systematic scientific evidence-based modifications.

Though addressing climate change remains a challenge, there are opportunities for improvement by leveraging a growing field of predictive tools and adaptive management frameworks[46,56]. Proactive management strategies, such as employing scenario planning informed by geophysical, natural, and social sciences, can help predict future climatic, ecological, and social conditions, ensuring proposed MPA networks and area-based management tools remain effective under both present and future conditions[57–59]. However, adaptive management in MPAs is often hindered by rigid legal and institutional frameworks, insufficient funding, and limited stakeholder consultation[55,60,61]. A step forward would be to develop adaptive management principles with concrete actions and objectives co-designed with resource users and other stakeholders that enable resilience to climate change, expanding their application from individual to regional networks of area-based conservation measures. Achieving stakeholder agreement and regulatory flexibility for adaptive management remains challenging, requiring structured processes such as MSP (see Opportunity 2) and ongoing engagement. Greater integration and objective alignment across scales (see Opportunities 2 and 4) can help enable adaptive governance and effective conservation.

While complex, these efforts are essential and must occur at spatial scales matching ecological processes in a rapidly changing environment[62]. Balancing the long-term benefits of area-based conservation measures with the ability to make adjustments over time is crucial for enhancing the conservation value of existing networks[63]. By integrating adaptive management principles into area-based conservation networks, managers can prioritize site management decisions based on their contribution to broader regional objectives and the conservation efficiency of the network, effectively addressing the scale of changes expected in marine ecosystems due to climate change and changing human uses. For ecological processes operating

across jurisdictional boundaries, multi-regional coordination (see Opportunity 4) becomes critical for ensuring enduring conservation in the face of a changing climate[64]. Careful planning, clear objectives, coordination, and a focus on conservation efficiency can serve to support the resilience of a changing ocean.

Opportunity 4 - Coordination to scale up conservation efforts

National efforts to meet global conservation agreements have coalesced in increasing interest in designating protected areas and identifying OECMs. However, effective global biodiversity conservation requires more than just increasing the coverage of conserved areas; it demands strategic coordination within and across jurisdictions to achieve representativity, replication, connectivity, adequacy, and ecological coherence[64,65]. Multilateral Environmental Agreements (MEAs), such as the CBD, establish transboundary frameworks that facilitate collective action. The monitoring framework of the recently adopted GBF emphasizes the need for integrated and coordinated approaches to area-based conservation by requiring Parties to implement and report on cross-jurisdictional measures[9,15]. Despite such overarching agreements, meaningful progress remains hindered by insufficient practical coordination within and among nations, particularly in building robust transboundary networks of conserved areas[65,66]. While some intergovernmental bodies, such as HELCOM and OSPAR, have successfully coordinated efforts, there remain opportunities to further strengthen practical, on-the-ground coordination among existing international networks of managers and practitioners[67,68]. Enhancing coordination between nations with disparate capacities could yield transformative gains in efficiency and biodiversity conservation[69], but care should be given to advance equity at the same time[70]. Addressing equity is particularly important, as poorly implemented MPAs can adversely impact vulnerable communities and Indigenous peoples through forced removals, restricted access to traditional areas, or threats to food security, health, and livelihoods[71]. For conservation to succeed, these social dimensions must be considered alongside ecological goals, ensuring initiatives support both biodiversity and human well-being.

Extending this need for collaboration, the challenge of conservation coordination now reaches beyond national jurisdictions, calling for collective action at the scale of ocean basins and shared ecosystems. One emerging avenue is the Agreement 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 (BBNJ Agreement)[64], which provides a mechanism for enhancing cooperation in areas beyond national jurisdiction. More broadly, promoting transboundary coordination can help to address representativity gaps, especially where MPAs and conservation efforts are presently biased towards areas with fewer existing activities, such as parts of the deep ocean or offshore areas (e.g., [40,59,72]), as well as overseas territories[73]. The current absence of incentives or accounting mechanisms for coordinating efforts hinders the achievement of representativeness and effectiveness (see Opportunity 1) in the global network of conserved areas, which is a clear component of Target 3 in the GBF.

Enhancing bilateral or multilateral coordination between States and supranational entities like the EU, along with intergovernmental organizations and regional programs, is essential for operationalizing transboundary conservation. Adequate funding and support for participation in regional and international forums are needed to enable practical, deliverable outcomes for conservation planning and practitioner networks. Formalizing ecological representativity benchmarks globally through a hierarchical stratification (e.g., Marine Ecoregions[74]) and reporting for qualitative conservation targets is also crucial. Notably, intergovernmental organizations like HELCOM, OSPAR, and the Barcelona Convention have been established to coordinate conservation planning and objectives in European regions (Baltic, Northeastern Atlantic, and Mediterranean Sea, respectively), showcasing successful intergovernmental planning with established ecological coherence assessments[75–77]. Ultimately, moving from high-level commitments to effective outcomes requires practical coordination, accountability (Opportunity 1), integration with broader spatial planning efforts (Opportunity 2), adaptive capacity (Opportunity 3), and equitable processes (Opportunity 5). Enhancing regional coordination between national and high seas area-based conservation efforts, particularly in regions where mechanisms already exist (e.g., OSPAR, regional fisheries management organizations), represents a significant untapped opportunity. Such synergy is key to fulfilling the ambitions of the GBF and other MEAs, ensuring coordinated conservation delivers real benefits for multiple scales.

Opportunity 5 - Align MPA design with intended outcomes

Despite the established capacity of well-designed, regulated, enforced, and managed MPAs to deliver social-ecological benefits[8] (Opportunity 1), mismatches can arise between a MPA design and the feasibility of obtaining intended outcomes, especially regarding the recovery of ecosystem components, functions, and services. Similarly, there can be mismatches between the intended outcomes and those that are actually realized over time. Indeed, the benefits delivered by MPAs depend on multiple factors, including their design, the socio-economic context in which they are embedded[78], and their management, including planning, monitoring, and levels of compliance[79]. While significant recovery can occur post-MPA establishment, particularly in strictly protected areas[8,19], rarely will conservation benefit all species or ecosystem components simultaneously – success is not guaranteed[80,81]. Further, some ecological and social responses may be difficult or impractical to monitor, such as changes in resilience or in ecosystem functioning[82]. Public support for area-based conservation frequently hinges on expectations of fisheries benefits and habitat recovery and often focuses on commercially valuable or charismatic species. Disconnects between design and expectations may lead to a decline in support for MPAs when specific anticipated outcomes, or the expected outcomes based on public understanding of MPA benefits, fail to materialize[83,84]. Ultimately, overlooking the variation in MPA design, management, and objectives can lead to overestimating the conservation outcomes of individual MPAs and the global network as a whole[73].

The ability to attribute changes in biodiversity to the implementation of conservation measures is influenced by various factors. The magnitude and rate of change associated with the establishment of an MPA will be directly related to how much change in existing pressures follows regulatory measures[72]. For instance, MPAs located in areas with prevalent pressures, such as industrial fishing activities and offshore oil and gas exploration, but with little regulation of these activities within their borders post-establishment, may yield limited ecological responses, if any, and these responses may be slow to manifest[19]. Conversely, MPAs designated in previously unimpacted regions may show correspondingly minimal change, but are intended to maintain the health of existing ecosystems, rather than promote their recovery or cause change[82]. Pressures that are not manageable at the MPA scale, such as ocean warming, pollution, or fishing pressures outside the MPA, may alter dynamics and constrain envisaged recovery[85]. For many MPAs and networks, there is insufficient data to detect anything but the most obvious changes (e.g., changes in fish abundance and size), as environmental monitoring can be logistically and financially prohibitive, particularly in large or offshore MPAs[86]. Even when data are available, a perceived lack of change may occur for features that recover slowly due to slow growth rates (e.g., cold-water corals) or regime shifts following trophic group recovery (e.g., large predatory fishes). Moreover, zoning and regulatory measures within MPAs can add another layer of complexity to the detection of change, especially for partially protected areas (e.g., variation in ecological response associated with vertical zonation regimes[87]).

The apparent gap between design, expectations, and outcome presents an opportunity for establishing clear, context-specific success criteria that align with on-the-ground social-ecological contexts[88]. This approach can help to ensure that MPA objectives, siting, and funding are tailored to maximize social and ecological benefits. Achieving this requires consistent and transparent communication with stakeholders, clearly defining desired outcomes/objectives and compatible uses in management and monitoring

plans. Optimizing MPA performance also involves setting realistic expectations, considering social and institutional contexts, and collaborating closely with stakeholders[89,90]. Approaches such as MSP (Opportunity 2), can facilitate transparent stakeholder communication, integrating diverse perspectives into management objectives[34], and enhancing the alignment between MPA design and intended outcomes. Monitoring key indicators within and outside of MPAs is crucial to evaluate progress towards achieving ecological and socio-economic objectives, integrating knowledge across disciplines and MPA planners, managers, and stakeholders[91].

Ultimately, scaling up adaptive management (Opportunity 3) and collaborative and integrated planning (Opportunities 2 and 4) will be essential for achieving broader objectives of biodiversity conservation. Additionally, assessing ecological and human well-being outcomes at the network scale rather than single sites can also help address potential mismatches between ecological and socio-economic systems when evaluating success[92]. Emphasizing accessible communication of expected outcomes for ecosystems and their associated services can also foster a broader understanding of societal benefits. Finally, incorporating pluralistic values into MPA design considerations and decision-making processes can ensure that diverse stakeholder perspectives are considered, enhancing support and compliance[1,93].

Conclusion

Efforts to mitigate biodiversity loss have increasingly focused on expanding area-based conservation measures, as reflected in key milestones such as GBF Target 3. Despite progress, the global ocean is less than one-third of the way toward this objective (~8% in 2024)[77], providing an opportunity to enhance the global conservation network and improve the return on conservation investment. The five interconnected opportunities we outline are presented as synergistic approaches that, when collectively addressed, can strengthen effectiveness across scales. We recognize these are not the only challenges or opportunities in area-based conservation, and that progress will also depend on complementary actions such as addressing external threats, incorporating ecosystem restoration and conservation stewardship (e.g., [94]). By framing these opportunities as an integrated set, we aim to provide practical guidance for improving area-based conservation effectiveness, in line with broader calls for integrated approaches to halt biodiversity loss[95].

Fostering coordination across jurisdictions and reconciling MPA design with intended outcomes remain essential to realizing these opportunities. Prioritizing equity, by recognizing the responsibility of nations with greater resources to support those with less, will be crucial to ensure that collective efforts, leveraging the opportunities such as those recommended here, lead to positive biodiversity conservation outcomes. More broadly, this integrated approach supports a transition from quantitative target-setting to effective, coherent, and equitable marine conservation strategies that benefit both nature and the communities that depend on it.

Data availability

No datasets were generated or analysed during the current study.

Received: 6 December 2024; Accepted: 12 November 2025;
Published online: 10 December 2025

References

1. Villasante, S. *Oceans and Human Health (Second Edition) (Eds* Lora E. Fleming et al.). (Academic Press, 2023).
2. Gurney, G. G. et al. Biodiversity needs every tool in the box: use OECMs. *Nature* **595**, 646–649 (2021).
3. Estradivari. et al. Marine conservation beyond MPAs: Towards the recognition of other effective area-based conservation measures (OECMs) in Indonesia. *Mar. Policy* **137**, 104939 (2022).
4. Beazley, L., Kenchington, E., Korabik, M., Fenton, D. & King, M. Other effective area-based conservation measure promotes recovery in a cold-water coral reef. *Glob. Ecol. Conserv.* **26**, e01485 (2021).
5. The Commonwealth. Case Study: Seychelles – Using Marine Spatial Planning to Meet the 30 Per Cent Marine Protected Areas Target. 5. https://thecommonwealth.org/case-study/case-study-seychelles-using-marine-spatial-planning-meet-30-cent-marine-protected-areas (2021).
6. Nowakowski, A. J. et al. Co-benefits of marine protected areas for nature and people. *Nat. Sustain.* **6**, 1210–1218 (2023).
7. Bax, N. et al. Ocean resource use: building the coastal blue economy. *Rev. Fish Biol. Fish.* **32**, 189–207 (2022).
8. Grorud-Colvert, K. et al. The MPA guide: A framework to achieve global goals for the ocean. *Science*. **373**, (2021).
9. Convention on Biological Diversity. Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity. *Conf. Parties to Conv. Biol. Divers. Fourteenth Meet. Sharm El-Sheikh, Egypt, 17–29 November. 2018* 1–19. https://www.cbd.int/doc/decisions/cop-14/cop-14-Dec-08-en.pdf (2018).
10. Dudley, N. et al. The essential role of other effective area-based conservation measures in achieving big bold conservation targets. *Glob. Ecol. Conserv.* **15**, 1–7 (2018).
11. Claudet, J., Loiseau, C. & Pebayle, A. Critical gaps in the protection of the second largest exclusive economic zone in the world. *Mar. Policy* **124**, 104379 (2021).
12. Claudet, J. et al. Avoiding the misuse of other effective area-based conservation measures in the wake of the blue economy. *One Earth* **5**, 969–974 (2022).
13. Food and Agriculture Organization. *A Handbook for Identifying, Evaluating and Reporting Other Effective Area-Based Conservation Measures in Marine Fisheries*. https://doi.org/10.4060/cc3307en (2022).
14. Himes-Cornell, A. et al. Reaching global marine biodiversity conservation goals with area-based fisheries management: a typology-based evaluation. *Front. Mar. Sci.* **9**, 1–15 (2022).
15. European Commission & Directorate-General for Environment. *EU Biodiversity Strategy for 2030 – Bringing Nature Back into Our Lives*. (Publications Office of the European Union, https://doi.org/10.2779/677548 2021).
16. Arneth, A. et al. Making protected areas effective for biodiversity, climate and food. *Glob. Chang. Biol.* **29**, 3883–3894 (2023).
17. Ulloa, A. M., Jax, K. & Karlsson-Vinkhuyzen, S. I. Enhancing implementation of the Convention on Biological Diversity: A novel peer-review mechanism aims to promote accountability and mutual learning. *Biol. Conserv.* **217**, 371–376 (2018).
18. Edgar, G. J. et al. Global conservation outcomes depend on marine protected areas with five key features. *Nature* **506**, 216–220 (2014).
19. Zupan, M. et al. Marine partially protected areas: drivers of ecological effectiveness. *Front. Ecol. Environ.* **16**, 381–387 (2018).
20. Turnbull, J. W., Johnston, E. L. & Clark, G. F. Evaluating the social and ecological effectiveness of partially protected marine areas. *Conserv. Biol.* **35**, 921–932 (2021).
21. Claudet, J., Loiseau, C., Sostres, M. & Zupan, M. Underprotected marine protected areas in a global biodiversity hotspot. *One Earth* **2**, 380–384 (2020).
22. Aminian-Biquet, J. et al. Over 80% of the European Union's marine protected area only marginally regulates human activities. *One Earth* **7**, 1–16 (2024).
23. European Court of Auditors. Marine environment: EU protection is wide but not deep. *Eur. Court Audit. Spec. Rep*. **26**, 74pp. https://www.eca.europa.eu/lists/ecadocuments/sr20_26/sr_marine_environment_en.pdf (2020).
24. Perry, A. L., Blanco, J., García, S. & Fournier, N. Extensive use of habitat-damaging fishing gears inside habitat-protecting marine protected areas. *Front. Mar. Sci.* **9**, 1–9 (2022).
25. Dureuil, M., Boerder, K., Burnett, K. A., Froese, R. & Worm, B. Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot. *Science* **362**, 1403–1407 (2018).
26. European Commission. Criteria and guidance for protected areas designation. **28.1**, 28 https://environment.ec.europa.eu/publications/

criteria-and-guidance-protected-areas-designations-staff-working-document_en (2022).
27. Claudet, J. France must impose strict levels of marine protection. *Nature* **570**, 36–37 (2019).
28. Maxwell, S. L. et al. Area-based conservation in the twenty-first century. *Nature* **586**, 217–227 (2020).
29. Katsanevakis, S. et al. Twelve recommendations for advancing marine conservation in European and contiguous seas. *Front. Mar. Sci.* **7**, 1–18 (2020).
30. Trouillet, B. & Jay, S. The complex relationships between marine protected areas and marine spatial planning: Towards an analytical framework. *Mar. Policy* **127**, 104441 (2021).
31. Reimer, J. M. et al. Conservation ready marine spatial planning. *Mar. Policy* **153**, 105655 (2023).
32. Rife, A. N. et al. Long-term effectiveness of a multi-use marine protected area on reef fish assemblages and fisheries landings. *J. Environ. Manag.* **117**, 276–283 (2013).
33. Rilov, G. et al. A fast-moving target: achieving marine conservation goals under shifting climate and policies. *Ecol. Appl.* **30**, 1–14 (2020).
34. Stantos, C. F. et al. Marine Spatial Planning and marine protected area planning are not the same and both are key for sustainability in a changing ocean. *npj Ocean Sustain.* **4**, 23 (2025).
35. Obura, D. O. On being effective, and the other 90%. *ICES J. Mar. Sci.* **75**, 1198–1199 (2018).
36. Galparsoro, I. et al. Assessment tool addresses implementation challenges of ecosystem-based management principles in marine spatial planning processes. *Commun. Earth Environ.* **6**, 1–12 (2025).
37. Reimer, J. M. et al. The Marine Spatial Planning Index: a tool to guide and assess marine spatial planning. *npj Ocean Sustain* **2**, 1–8 (2023).
38. European Parliament & Council of the European Union Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environment policy (Marine Strategy Framework Directive) *J. Eur. Union* **164**, 19–40 (2008).
39. Stelzenmüller, V. et al. Evaluation of marine spatial planning requires fit for purpose monitoring strategies. *J. Environ. Manag.* **278**, 111545 (2021).
40. Jacquemont, J., Loiseau, C., Tornabene, L. & Claudet, J. 3D ocean conservation: Fisheries reach deep but marine protection remains shallow. *Nat. Comm*. **15**, 1–25 (2024).
41. Holness, S. D. et al. Using systematic conservation planning to align priority areas for biodiversity and nature-based activities in marine spatial planning: A real-world application in contested marine space. *Biol. Conserv*. **271**, 109574 (2022).
42. Long, R. D., Charles, A. & Stephenson, R. L. Key principles of marine ecosystem-based management. *Mar. Policy* **57**, 53–60 (2015).
43. Jacquemont, J., Blasiak, R., Le Cam, C., Le Gouellec, M. & Claudet, J. Ocean conservation boosts climate change mitigation and adaptation. *One Earth* **5**, 1126–1138 (2022).
44. Lewis, S. A., Stortini, C. H., Boyce, D. G. & Stanley, R. R. E. Climate change, species thermal emergence, and conservation design: a case study in the Canadian Northwest Atlantic. *Facets* **8**, 1–16 (2023).
45. Predragovic, M. et al. Up to 80% of threatened and commercial species across European marine protected areas face novel climates under high emission scenario. *npj Ocean Sustain* **3**, 1–9 (2024).
46. Tittensor, D. P. et al. Integrating climate adaptation and biodiversity conservation in the global ocean. *Sci. Adv.* **5**, 1–15 (2019).
47. O'Regan, S. M., Archer, S. K., Friesen, S. K. & Hunter, K. L. A global assessment of climate change adaptation in marine protected area management plans. *Front. Mar. Sci.* **8**, 1–16 (2021).
48. Corelli, V., Boerder, K., Hunter, K. L., Lavoie, I. & Tittensor, D. P. The biodiversity adaptation gap: Management actions for marine protected areas in the face of climate change. *Conserv. Lett.* **17**, 1–10 (2024).
49. Rouphael Tony, A. B. Adaptive management in context of MPAs: Challenges and opportunities for implementation. *J. Nat. Conserv.* **56**, 125864 (2020).
50. Predragovic, M. et al. A systematic literature review of climate change research on Europe's threatened commercial fish species. *Ocean Coast. Manag*. **242**, 106719 (2023).
51. Kaplan, K. A. et al. Setting expected timelines of fished population recovery for the adaptive management of a marine protected area network. *Ecol. Appl.* **29**, 1202–1220 (2019).
52. Lopazanski, C. et al. Principles for climate resilience are prevalent in marine protected area management plans. *Conserv. Lett.* **16**, 1–14 (2023).
53. White, J. W. et al. Measurements, mechanisms, and management recommendations for how marine protected areas can provide climate resilience. *Mar. Policy* **171**, 106419 (2025).
54. Whitney, C. K. et al. Imprecise and weakly assessed: Evaluating voluntary measures for management of marine protected areas. *Mar. Policy* **69**, 92–101 (2016).
55. Giakoumi, S. et al. Revisiting 'success' and 'failure' of marine protected areas: A conservation scientist perspective. *Front. Mar. Sci.* **5**, 1–5 (2018).
56. Wilson, K. L., Tittensor, D. P., Worm, B. & Lotze, H. K. Incorporating climate change adaptation into marine protected area planning. *Glob. Chang. Biol.* **26**, 3251–3267 (2020).
57. Bryndum-Buchholz, A. et al. A climate-resilient marine conservation network for Canada. *Facets* **7**, 571–590 (2022).
58. Rubidge, E. M. et al. Evaluating the design of the first marine protected area network in Pacific Canada under a changing climate. *Facets* **9**, 1–18 (2024).
59. Keen, L. H., Stortini, C. H., Boyce, D. G. & Stanley, R. R. E. Assessing climate change vulnerability in Canadian marine conservation networks: implications for conservation planning and resilience. *Facets* **9**, 1–15 (2024).
60. Watson, J. E. M., Dudley, N., Segan, D. B. & Hockings, M. The performance and potential of protected areas. *Nature* **515**, 67–73 (2014).
61. Hopkins, C. R., Bailey, D. M. & Potts, T. Perceptions of practitioners: Managing marine protected areas for climate change resilience. *Ocean Coast. Manag.* **128**, 18–28 (2016).
62. Vigo, M. et al. Dynamic marine spatial planning for conservation and fisheries benefits. *Fish Fish* **25**, 630–646 (2024).
63. Bryce, K. & Hunter, K. L. Enhancing climate change planning and adaptive management in marine protected areas through targets, thresholds, and social-ecological objectives. *Front. Mar. Sci.* **11**, 1–14 (2024).
64. Hannah, L. et al. To save the high seas, plan for climate change. *Nature* **630**, 298–301 (2024).
65. Assis, J. et al. Weak biodiversity connectivity in the European network of no-take marine protected areas. *Sci. Total Environ.* **773**, 145664 (2021).
66. Mackelworth, P. C. et al. Geopolitics and marine conservation: synergies and conflicts. *Front. Mar. Sci.* **6**, 1–17 (2019).
67. Ban, N. C. et al. Systematic conservation planning: A better recipe for managing the high seas for biodiversity conservation and sustainable use. *Conserv. Lett.* **7**, 41–54 (2014).
68. Costello, C. & Molina, R. Transboundary marine protected areas. *Resour. Energy Econ.* **65**, 101239 (2021).
69. Mason, N., Ward, M., Watson, J. E. M., Venter, O. & Runting, R. K. Global opportunities and challenges for transboundary conservation. *Nat. Ecol. Evol.* **4**, 694–701 (2020).
70. Claudet, J. et al. Advancing ocean equity at the nexus of development, climate and conservation policy. *Nat. Ecol. Evol.* **8**, 1205–1208 (2024).
71. Pereira, L. M. et al. Equity and justice should underpin the discourse on tipping points. *Earth Syst. Dyn.* **15**, 341–366 (2024).
72. Devillers, R. et al. Reinventing residual reserves in the sea: Are we favouring ease of establishment over need for protection?. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **25**, 480–504 (2015).
73. Pike, E. P. et al. Ocean protection quality is lagging behind quantity: Applying a scientific framework to assess real marine protected area progress against the 30 by 30 target. *Conserv. Lett.* **17**, 1–15 (2024).

74. Spalding, M. D. et al. Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. *Bioscience* **57**, 573–583 (2007).
75. OSPAR. 2018 Status Report on the OSPAR Network of Marine Protected Areas. *OSPAR Commission Biodivers. Ecosyst. Ser*. **8**, 80 (2018).
76. Helsinki Commission Marine protected area network in the Baltic Sea. *Balt. Sea Environ. Proc.* **148**, 74 (2016).
77. UNEP-WCMC and IUCN. Cambridge, UK: UNEP-WCMC and IUCN. (2024).
78. Nickols, K. J. et al. Setting ecological expectations for adaptive management of marine protected areas. *J. Appl. Ecol.* **56**, 2376–2385 (2019).
79. Cormier, R. et al. The science-policy interface of risk-based freshwater and marine management systems: From concepts to practical tools. *J. Environ. Manag.* **226**, 340–346 (2018).
80. Varnes, B. K. & Olsen, E. M. Fish community dynamics in a coastal no-take marine protected area compared to a harvested area before and after protection from fishing. *ICES J. Mar. Sci.* **80**, 1462–1471 (2023).
81. Micheli, F. et al. Trajectories and correlates of community change in marine reserves. *Ecol. Appl.* **14**, 1709–1723 (2004).
82. Morris, C. J., Nguyen, K. Q., Neves, B., de, M. & Cote, D. Monitoring data for a new large offshore marine protected area reveals infeasible management objectives. *Conserv. Sci. Pract.* **6**, 1–17 (2024).
83. Chaigneau, T. & Brown, K. Challenging the win-win discourse on conservation and development: Analyzing support for marine protected areas. *Ecol. Soc*. **21**, 36 (2016).
84. Yates, K. L., Clarke, B. & Thurstan, R. H. Purpose vs performance: What does marine protected area success look like?. *Environ. Sci. Policy* **92**, 76–86 (2019).
85. Griffiths, L. L. et al. A data-driven approach to multiple-stressor impact assessment for a marine protected area. *Conserv. Biol.* **38**, 1–13 (2024).
86. Wilhelm, T. A. et al. Large marine protected areas - advantages and challenges of going big. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **24**, 24–30 (2014).
87. O'Leary, B. C. & Roberts, C. M. Ecological connectivity across ocean depths: Implications for protected area design. *Glob. Ecol. Conserv.* **15**, e00431 (2018).
88. Claudet, J. Six conditions under which MPAs might not appear effective (when they are). *ICES J. Mar. Sci.* **75**, 1172–1174 (2018).
89. Pendleton, L. H. et al. Debating the effectiveness of marine protected areas. *ICES J. Mar. Sci.* **75**, 1156–1159 (2018).
90. Horta e Costa, B., Gonçalves, J. M. S. & Gonçalves, E. J. UN Ocean Conference needs transparent and science-based leadership on ocean conservation. *Mar. Policy* **143**, 105197 (2022).
91. Cardoso-Andrade, M. et al. Setting performance indicators for coastal marine protected areas: an expert-based methodology. *Front. Mar. Sci.* **9**, 1–17 (2022).
92. Ban, N. C. et al. Well-being outcomes of marine protected areas. *Nat. Sustain.* **2**, 524–532 (2019).
93. Pennino, M. G. et al. The missing layers: integrating sociocultural values into marine spatial planning. *Front. Mar. Sci.* **8**, 1–8 (2021).
94. Wilson, A. M. W. & Forsyth, C. Restoring near-shore marine ecosystems to enhance climate security for island ocean states: Aligning international processes and local practices. *Mar. Policy* **93**, 284–294 (2018).
95. Leadley, P. et al. Achieving global biodiversity goals by 2050 requires urgent and integrated actions. *One Earth* **5**, 597–603 (2022).

Acknowledgements

We thank members of the International Council for the Exploration of the Sea (ICES) Working Group on Marine Protected Areas and Other Spatial Conservation Measures (WGMPAs) for their input and scoping of this work. We also acknowledge Andrew Cooper, Genevieve Faille, and Timothy O'Higgins for their comments on a previous draft. AC was supported by the FCT-IP Programme Stimulus of Scientific Employment (CEECIND/00101/2021). AC also acknowledge funds through the FCT—Foundation for Science and Technology, I.P., under the project OKEANOS UIDB/05634/2023 and UIDP/05634/2023. BHC acknowledges the support of MARHAB (EU HORIZON, grant no. 101135307), MarPlus2024 (Algarve 2030, ALGARVE-FSE+-01177700) projects. BHC and AB also thanks the support the Portuguese national funds from FCT - Foundation for Science and Technology through projects UID/04326/2025, UID/PRR/04326/2025 and LA/P/0101/2020 (DOI:10.54499/LA/P/0101/2020) to CCMAR. DPT acknowledges support from the Jarislowsky Foundation and NSERC. R.R.E.S and E.M.R. were supported by the MCT program with DFO. SV gratefully acknowledges the financial support from EQUALSEA (Transformative adaptation towards ocean equity) project, under the European Horizon 2020 Program, ERC Consolidator (Grant Agreement # 101002784) funded by the European Research Council. TB acknowledges funding from the Biodiversa+ project RESOLVE and the European Union's Horizon project ACTNOW (No. 101060072).

Author contributions

This manuscript was developed by the participating members of ICES WGMPAs, with all authors contributing to the scoping, content, and opportunities presented. Conceptualization, R.R.E.S., J.C., E.V.S., A.AU., A.B., A.B. (Belgrano), U.B., K.B., T.B., A.C., A.H-C., B.HC., J.J., L.H.J., R.L., T.NJ., M.O., E.M.O., E.M.R., E.C.E.S., M.S., V.S., D.P.T., T.C.V., S.V.; Writing – original draft, R.R.E.S.; Infographic design, R.R.E.S., T.C.V., J.C.; Writing – review and editing, R.R.E.S., J.C., E.V.S., A.AU., A.B., A.B. (Belgrano), U.B., K.B., T.B., A.C., A.H-C., B.HC., J.J., L.H.J., R.L., T.NJ., M.O., E.M.O., E.M.R., E.C.E.S., M.S., V.S., D.P.T., T.C.V., S.V.; Project administration, R.R.E.S., J.C., E.V.S.

Competing interests

S. Villasante serves as an Associate Editor for npj Ocean Sustainability but was not involved in the editorial review or decision-making process for this manuscript.

Additional information

Correspondence and requests for materials should be addressed to R. R. E. Stanley.