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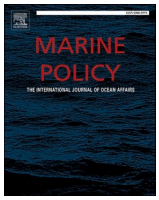

Assessments of expected MPA outcomes can inform and improve biodiversity conservation: Case studies using *The MPA Guide*

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A R T I C L E I N F O

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A B S T R A C T

Global, regional, and national targets have been set to protect and conserve at least 30 % of the ocean by 2030, in recognition of the important benefits of healthy ocean ecosystems, including for human well-being. Many of these targets recognize the importance of the quality, not just quantity, of areas that are included in the 30 %, such as marine protected areas (MPAs). For example, the Convention on Biological Diversity's Global Biodiversity Framework Target 3 calls for areas to be effectively conserved and managed, ecologically representative, well-connected, and equitably governed. Protecting a percent area is not the sole goal – protection must be effective and equitable. To better understand the quality of biodiversity conservation afforded, in addition to the quantity of area protected, we looked at MPAs across 13 studies that used *The MPA Guide* and related tools to track Stage of Establishment and Level of Protection as measures of expected biodiversity conservation outcomes across diverse locations, scales, and cultural, political, and conservation contexts. We show that standardized assessments of MPA quality can help to (1) evaluate and improve existing MPAs; (2) plan new MPAs; (3) compare the quality of MPA protection across various scales; (4) track MPA quality, including progress towards coverage targets; (5) enable clear communication and collaboration, and (6) inform actions needed to achieve policy targets and their underlying environmental and social goals, among others. We share common opportunities,

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challenges, and recommendations for tracking MPA quality at various scales, and using these quality assessments to measure progress towards global targets.

1. Introduction

The ocean faces urgent challenges, which can undermine its ability to support healthy and biodiverse ecosystems, regulate climate, and provide associated cultural, economic, nutritional, and other benefits to people [1,2]. In recognition of the need to improve ocean health, many countries and regions around the world have set percentage targets for area-based ocean conservation. Different targets have been set in different contexts, but many align with Target 3 in the Kunming-Montreal Global Biodiversity Framework (GBF), adopted in December 2022, which calls for effectively conserving and managing at least 30 % of coastal and marine areas by 2030 via Marine Protected Areas (MPAs) and Other Effective area-based Conservation Measures (OECMs), recognizing and respecting the rights of Indigenous Peoples and local communities including over their traditional territories [3]. These targets are not exclusively quantitative. Target 3 and many other targets in the GBF include the need for important qualitative aspects, such as effective conservation and management, equitable governance, representativeness, and connectivity.

MPAs are a key area-based tool for making progress towards conservation targets, yet there are many different types of MPAs that provide vastly different conservation outcomes based on their regulations, management, and other enabling conditions [4-6]. To gauge progress towards biodiversity conservation targets, it is crucial to assess not only the quantity of MPA coverage, but also the quality of MPAs therein [7]: e.g., what type of protection exists? Are these MPAs formally established and being effectively implemented? What are the expected conservation outcomes, including benefits for both people and the environment? Qualitative assessments of MPAs aim to answer these questions. These assessments may have diverse objectives, including to (1) evaluate and improve existing MPAs, with clear expectations grounded in science and reality; (2) plan new MPAs designed from the beginning to achieve their goals; (3) compare expected outcomes of protection for MPAs across local, national, regional, or global scales; (4) track MPA effectiveness, including progress towards protected area coverage targets; (5) enable clear communication and collaboration; and (6) inform the actions still needed to achieve policy targets and their underlying environmental and social goals, among others.

There are many existing tools for qualitative assessments of MPAs, along with different ways to understand and use the results. One such tool, *The MPA Guide*, is a science-based, clarifying framework for better understanding MPAs [8], which can be used to support the above objectives and outcomes. It provides unique information on the expected conservation outcomes of an MPA or MPA zone, using decades of scientific findings and traditional knowledge to summarize the impact that MPA design and management have on conservation outcomes.

The MPA Guide framework is composed of four elements: Stage of Establishment, Level of Protection, Enabling Conditions, and Expected Outcomes. The first three elements combine to define different types of MPAs according to key features: an MPA's management status (Stage of Establishment); the activities and impacts that are, or are not, occurring in the MPA or MPA zone [Level of Protection; modified from the Regulations-Based Classification System (RBCS) by Horta e Costa et al., 2016]; and the presence of social and ecological conditions for MPA effectiveness (Enabling Conditions). These three elements link to specific, research-based Expected Outcomes from different types of MPAs (see [8] for full definitions). When underpinned by key Enabling Conditions, MPAs that are at the Actively Managed Stage and the Fully or Highly Protected Level are expected to have the greatest biodiversity conservation outcomes, because these areas are more likely to protect and restore species and habitats, support ecosystem functioning and resilience (i.e., ability to recover after a disturbance), contribute to fisheries via larval supply and spillover [8,9], and support human well-being with healthy ocean ecosystems [10]. Without key Enabling Conditions in place, MPAs cannot achieve their goals. Minimally or Lightly Protected MPAs are expected to deliver fewer benefits of lower magnitude, and MPAs that are only at the Proposed/Committed Stage or Designated Stage cannot accrue biodiversity benefits until they are Implemented [8].Fig. 1

Since it was published in 2021, *The MPA Guide* has been used in a growing list of countries and regions around the world to build understanding of the biodiversity outcomes that can be expected from certain MPAs. Here, we highlight examples and lessons learned from completed assessments that use *The MPA Guide* (10 studies representing more than 800 MPAs), with additional insights from three studies that use the earlier-developed RBCS to measure protection level based on current regulations. These studies span different locations (Figure 1 A), in countries and regions at different points along their journey to achieving quantitative goals for ocean protection (Figure 1B). They represent more than 90 % of the total MPA area officially reported to the World Database on Protected Areas (WDPA, an official data repository for measuring progress towards GBF Target 3) as of February 2023 (Figure 1 C). These studies illustrate various ways in which standardized assessments of the quality of MPAs in a given area have different motivations (Fig. 2), different results, and different implications for conservation action (see Fig. 3 for an example *MPA Guide* assessment process). Examples of opportunities and lessons learned from these assessments are given in the following sections.

2. Gauging real progress towards international or national targets

In the rush to meet percentage targets, there is a risk of "counting" MPAs towards a target when they are unjust and not designed or implemented to deliver tangible conservation outcomes that benefit biodiversity and human well-being [12]. Qualitative assessments of MPAs are key to understanding the current status of ocean conservation, informing what should "count" towards these targets, and what types of areas are still needed.

In recent years, global MPA coverage reported to the World Database on Protected Areas has rapidly increased from <1 % to >8 % in an effort to meet the quantitative goals of global targets, such as the CBD's Aichi Target 11, United Nations Sustainable Development Goal 14.5, and the CBD's GBF Target 3. A recent study evaluated the quality of MPA protection globally to provide standardized baseline information and an understanding of meaningful progress towards meeting GBF Target 3 [11]. In this study, the authors assess the Stage of Establishment and Level of Protection for the world's largest 100 MPAs by area, which together encompass nearly 90 % of reported global MPA coverage (7.3 % of the global ocean by area). One-quarter of the assessed MPA area is not yet Implemented, and one-third is subject to high-impact human activities that are Incompatible with the conservation of nature, as defined by the IUCN [11]. Including these areas in accounting toward conservation goals results in an overestimate of progress. Fully and Highly Protected MPAs that are Implemented or Actively Managed account for one-third of the assessed area, but they are unevenly distributed across ecoregions, in part because some nations have designated large, Highly Protected MPAs in their overseas or remote territories (as described above).

This work highlights important actions needed to ensure the global system of MPAs is representative and at an appropriate quality to deliver the biodiversity conservation and human well-being benefits called for

in the GBF. Suggestions include strengthening the regulations of existing MPAs (particularly prohibiting highly destructive activities such as industrial-scale commercial fishing), dedicating sufficient resources to MPAs for active management, and strategically locating and designing new MPAs in poorly represented ecoregions and the high seas.

South Africa provides a useful example at a national scale of the importance of understanding not only quantity but quality when measuring progress towards targets, key information to support governments as they strive for expansion. National targets are currently undergoing reassessment to align with GBF Target 3. In the meantime, South Africa is making strides towards achieving its current protection targets outlined in the National Protected Areas Expansion Strategy, including protecting 10 % of the Exclusive Economic Zone (EEZ) in MPAs by 2036 and a longer-term target of protecting 20 % of the EEZ in MPAs, with no target date given [13]. Currently, 5.4 % of the continental EEZ (~1068,000 km^2; excluding the remote and isolated Prince Edward Islands MPA in the Southern Ocean) is protected in MPAs, of which 100 % is Implemented or Actively Managed and more than 70 %

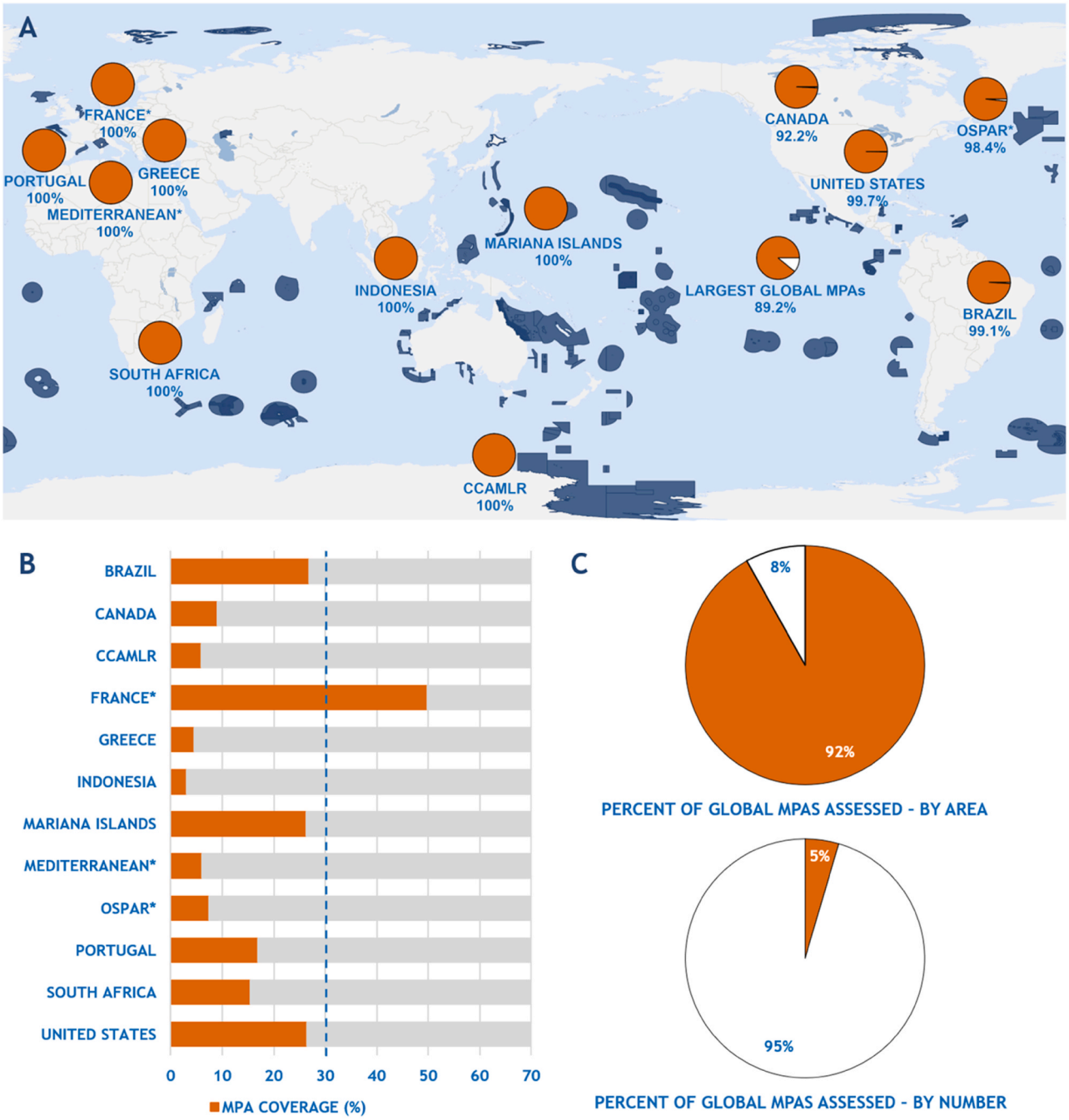

Figure 1. (A) Map of the location of case studies of MPA quality assessments using *The MPA Guide* or the Regulation Based Classification System (RBCS; indicated with an asterisk). Pie charts denote the proportion of total MPA area in a country or region that was assessed according to Stage of Establishment and Level of Protection (for *The MPA Guide* assessments) or Level of Protection (for RBCS assessments). The boundaries of the 100 largest MPAs globally, assessed in Pike et al. [11], are shown in dark blue. (B) Percent of EEZ in any type of MPA for each case study country or region, as reported to the World Database on Protected Areas as of February 2023, with line indicating 30 % coverage target. (C) Percent of global MPAs assessed using *The MPA Guide* for Stage of Establishment and Level of Protection, by area (top pie chart) and number of MPAs relative to the total more than 18,000 MPAs reported to the World Database on Protected Areas as of February 2023 (bottom pie chart).

is Fully or Highly Protected (Table 1). This area includes 20 new MPAs established in 2019 as part of Operation Phakisa [14]. The country plans to invest further resources in expanding the system of MPAs to protect a larger area. The recent *MPA Guide* assessment of Stage of Establishment and Level of Protection by Field et al. (*in review*) can help assess progress towards existing targets. This information can inform and encourage the approach to sustaining this level of protection in future MPAs (see Section 3).

Measures of protected area quality are also being used in conservation policy via "two-tier" targets (i.e., two targets were defined: 10 % of area coverage in 'strict' protection and 20 % of area coverage in any type of MPA). Under the 2030 European Biodiversity Strategy, countries have committed to increasing protection in European Union (EU) waters both in protected area coverage—by achieving at least 30 % with MPAs by 2030—but also in protected area quality, by committing to 10 % of EU waters under 'strict protection'. In the Azores, the regional government has announced that, of the 30 % of its EEZ it plans to protect by 2023, at least 15 % will be in Fully Protected MPAs, with effectiveness of these areas supported by appropriate funding and procedures [26]. However, the definition of "what counts" towards these targets is not yet clear. Currently, countries have been asked to identify and submit sites to convert to, or designate as, 'strict protection'. Most countries have not yet submitted their pledges (https://europe.wetlands.org/news/eu-member-states-missed-the-extended-deadline-for-biodiversity-pledges/). A common definition of 'strict protection' is key to guide these pledges and the overall effort to improve the effectiveness of European MPAs. The recent guidelines released by the European Commission (SWD (2022) 23 final) mention: "The concept of strict protection is also present in the IUCN Guidelines for Applying Protected Area Management Categories, and it is often associated with the definitions of Categories Ia, strict

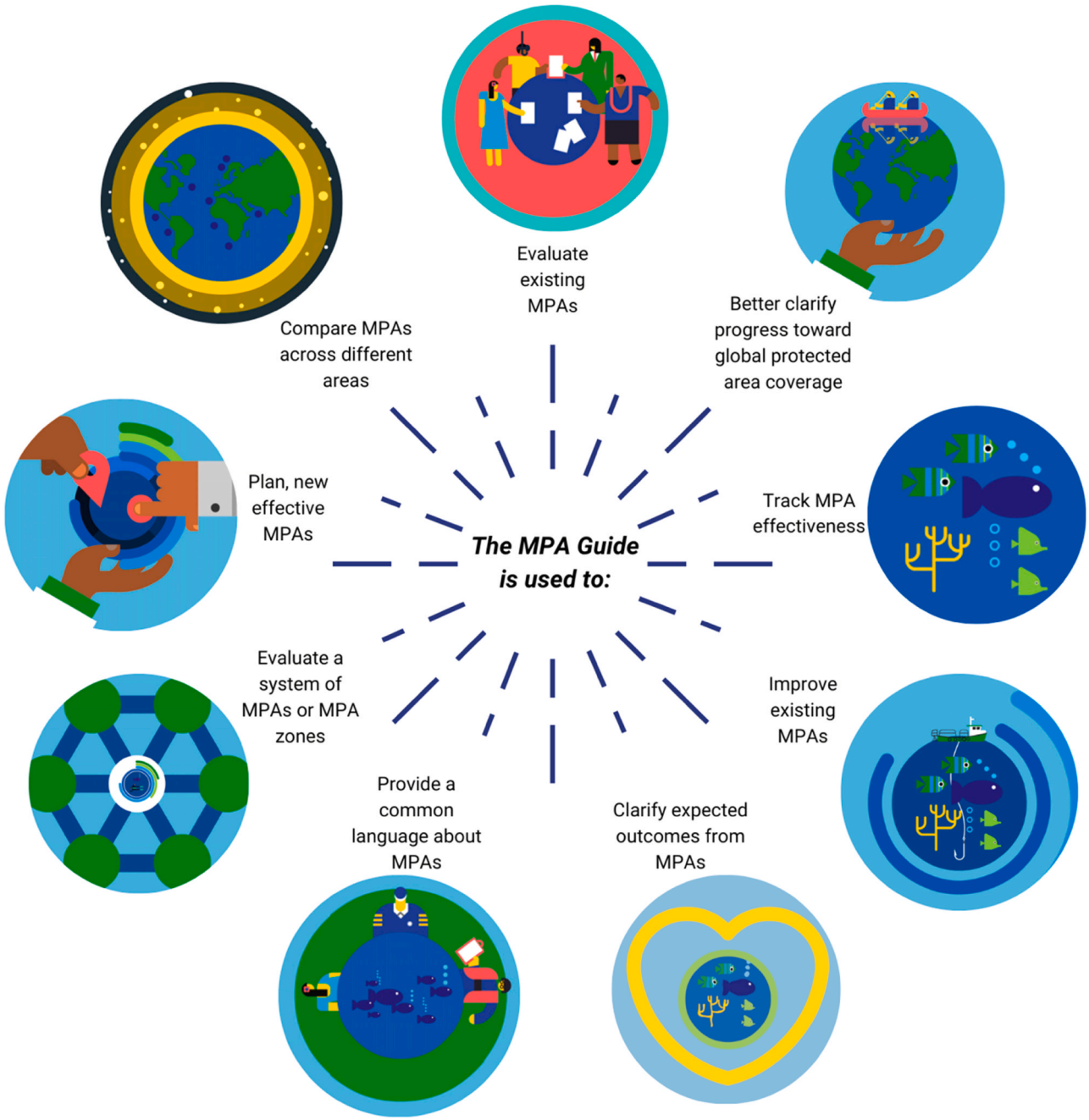

Fig. 2. Key ways *The MPA Guide* has been applied, based on the assessments of MPA effectiveness presented in this paper.

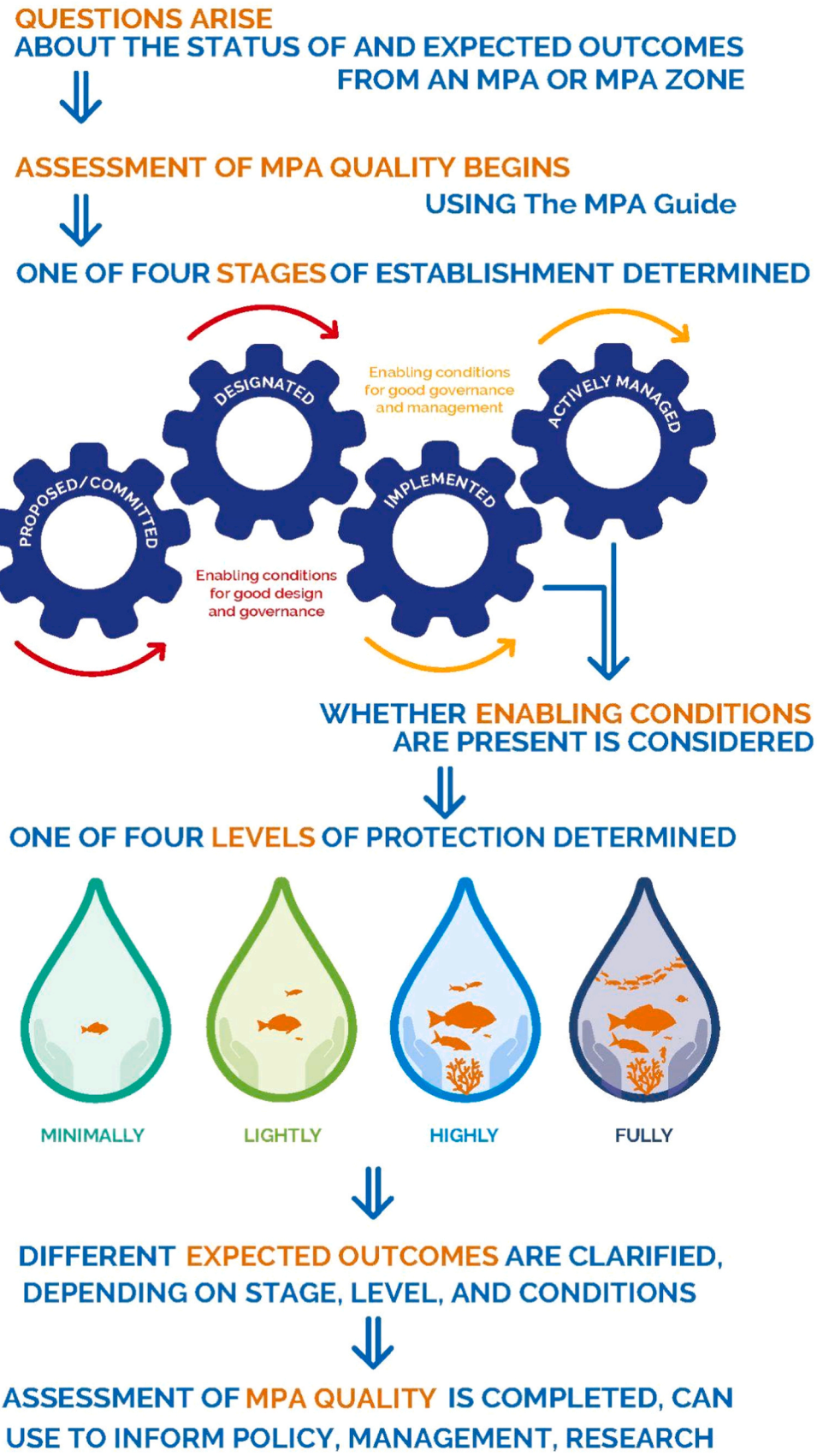

Fig. 3. Example of the process involved when undertaking an assessment of MPA quality using *The MPA Guide*. These assessments may be motivated by diverse needs – for examples, see Fig. 2.

Table 1
Summary details of Level of Protection and Stage of Establishment for countries' MPAs included in these analyses. Assessments with an asterisk used the Regulation-Based Classification System and thus did not report Stage of Establishment.

Assessment	Number MPAs assessed	MPA area assessed (km^2)	% MPA area		Reference
			Implemented + Actively Managed	Fully + Highly Protected	
100 Largest MPAs globally	100	26,382,926	74.6 %	35.7 %	[11]
Brazil	203	962,910	96.8 %	12.8 %	[15]
Canada- Federal MPAs	18	475,900	4.4 %	5.3 %	[16]
Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) MPAs	2	2136,047	100 %	79.6 %	[17]
France*	524	3435,052	N/A	1.6 %	[18]
Greece	160	22,885.55	15.3 %	1.9 %	[19]
Indonesia	148	231,464	55.4 %	2.8 %	[20]
Mariana Islands - all federal and territorial managed MPAs	18	247,313	0.02 %	17.2 %	[21]
Mediterranean*	1062	150,851	N/A	0.23 %	[22]
OSPAR*	551	100,823	N/A	0.03 %	[23]
Portugal	71 + 2 zones in the Extended Continental Shelf	250,623 (Territorial Seas + Exclusive Economic Zone + Extended Continental Shelf)	3.6 %	1.5 %	Horta e Costa et al., *in prep,* building on [24]*
South Africa	41 Continental MPAs	57,833	100 %	70 %	Field et al., *in review*
United States - 50 Largest MPAs	50	3177,840	100 % (Includes Pacific Remote Islands Marine National Monument, which is undergoing management planning)	96.9 % [includes the benthic-only protections in Mariana Trench Marine National Monument (MNM)]	[25]

nature reserve, Ib, wilderness area, and II, national park". However, the IUCN Management Categories indicate management objectives, not conservation outcomes, and do not directly correspond to Level of Protection (see below Section 7). Some European scientists and practitioners are asking that *The MPA Guide* be used for standardized language, including protection level, to support this conservation policy target [27,28].

National and international conservation targets not only include components of area percentage and effectiveness for biodiversity conservation, but also underlying requirements for equity and human rights-based approaches. In the United States, a national conservation target is outlined via the America the Beautiful (ATB) initiative, which President Biden implemented via an Executive Order [29]. One of the America the Beautiful targets calls for conserving at least 30 % of United States lands and waters by 2030 to achieve the triple goals of biodiversity conservation, climate resilience, and equitable access to nature. However, despite progress in achieving MPA quantity by area, there has been less progress towards the goals for climate, biodiversity, and equity (see description in Section 5; [25]). For example, according to a report by the Center for American Progress, only 10 % of the United States coast and Great Lakes have strong legal frameworks in place to ensure equitable public access [30]. In conjunction with the ATB initiative, the Biden administration launched the Justice40 Initiative, which mandates that 40 % of the overall benefits of certain Federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution and other stressors, including impacts caused by climate change. The vast majority of the United States MPA area, including Fully or Highly Protected area, is in the western and central Pacific Ocean (e.g., Papahānaumokuākea and Pacific Remote Islands Marine National Monuments) [25]. Resident communities and Indigenous Peoples of the western and central Pacific are amongst some of the most socioeconomically and politically disenfranchised populations in the United States (e.g., [31]), and proportionate amount of resources for establishing, monitoring, and actively managing MPAs is warranted. While a formal accounting of funding challenges and opportunities is beyond the scope of this paper, there is a need for increased social justice research programs in the United States and globally.

An application of *The MPA Guide* in Canada highlights a mismatch between the desire to "count" sites toward political commitments and the reality that some sites do not provide meaningful long-term protection [16]; see below Section 4). Between 2015 and 2019, Canada went from less than 1 % of its ocean protected to 13.8 % in an ambitious push to protect 10 % of coastal and marine areas by 2020 under the Aichi Biodiversity Targets. Canada counts over 900 sites (including some zones and overlapping designations) under 30 different designations [32]. The *MPA Guide* analysis of 18 sites established under the most comprehensive legal tools showed a strong tendency towards large MPAs at lower Levels of Protection, and much smaller MPAs at higher Levels of Protection [16]. Of the sites assessed, one site (Tallurutiup Imanga) is proposed, and one site (Tuvaijuittuq) has interim protection. Together, the two sites comprise 7.4 % of Canada's reporting and are part of an ongoing Inuit-led, regional, and integrated conservation approach in the Arctic [33]. In the case of Tallurutiup Imanga, the site is not yet listed under Canada's National Marine Conservation Areas Act. However, there is an agreement in place with the Inuit to protect the site, and funding attached to this agreement has been used to support Indigenous guardian programs that support "Active Management" of the area. The site has been counted towards Canada's Marine Protection Targets since 2019, even though there are no regulations because it is not yet legally designated. As the recognition and advancement of Indigenous-led conservation and Indigenous Protected and Conserved Areas increases in Canada, we anticipate changes in the establishment process from the current linear, sequential process of protected area designation under colonial legal systems and management by bureaucratic institutions, to non-linear and context specific processes that are focused more on "Active Management" through Indigenous law than designation under colonial law. However, in these cases, safeguards are needed to secure Indigenous Peoples and Governments' long-term rights, for example to enforce opposition to development and extraction in their territories. In addition, Indigenous science and knowledge is crucial for informing the impact of activities taking place in MPAs and assessments of Level of Protection. This work requires an integration of diverse knowledge sources and is an active area of investigation and priority for MPA managers and scientists globally.

3. Showcasing investments in MPA quality

Single-number metrics, such as percentage targets for conservation, can obscure progress and investments in effectiveness [34,35]. Assessments of MPA quality can shine a spotlight on not just the largest areas, but also MPAs that are in force in the water and actively managed, at a sufficiently high level of protection to meet conservation objectives, with attention to equity and other key social and ecological enabling conditions.

An assessment using *The MPA Guide* in South Africa revealed high Levels of Protection and advanced Stages of Establishment among the 41 existing MPAs (Table 1). In fact, 70 % of South Africa's MPAs are either Fully or Highly Protected (Field et al., *in review*). Further, all South African MPAs are either Implemented or Actively Managed, indicating that regulations are active in the water. In many cases where there is active management, local communities are engaged and periodic management evaluations support adaptive management to better achieve conservation goals, although funding and personnel shortages may compromise expected conservation outcomes (Field et al. *in review*). The assessment indicates that high Levels of Protection and resource use are not mutually exclusive in multi-zone MPAs, as many areas allow low-impact human uses in certain zones. Historically, MPA evaluation in South Africa has focused on extent and management effectiveness; this approach leaves out the impact of human activities and thus the expected conservation outcomes that are associated with Level of Protection.

A recent study of the Stage of Establishment and Level of Protection of all 196 MPAs in Indonesia as of 2019 showed that 39 % of MPA area is Actively Managed, highlighting which MPAs have the greatest potential to achieve conservation goals [20]. The assessment also documented that, although less than 5 % of Indonesia's MPA extent was Fully or Highly Protected, newly Proposed and Designated MPAs are incorporating more Fully and Highly Protected zones [20]. Disaggregating data beyond a single percent area brings more information to the accounting of MPAs, which in Indonesia is divided between multiple government ministries and has historically focused more on MPA extent than measures of quality [36]. *The MPA Guide* assessment provided useful insight for the Government of Indonesia and partners to identify case studies of well-performing MPAs to learn from as part of a 2030 visioning exercise, which informed priorities and pathways to improve both the number and quality of Indonesia's MPAs [37].

4. Improving MPA alignment with conservation goals

Beyond highlighting success stories, an understanding of MPA quality can help reveal mismatches between desired conservation outcomes and the management and activities that are taking place in a given area. Often, an MPA's Level of Protection is too low to achieve stated conservation goals, or the protection is ineffective as it is not yet in force. Many of these examples exist in different contexts, including in countries that have committed to achieving a "30×30" target that provides effective conservation by recovering and sustaining biodiversity (see Table 1).

For example, the importance of protecting Canada's ocean for generations to come is emphasized in official statements, including those that recently announced minimum protection standards for all federal MPAs to prohibit trawling, oil and gas activities, mining, and dumping [38]. In 2021, the Canadian Parks and Wilderness Society (CPAWS) used *The MPA Guide* to conduct a pilot assessment of 18 federally established MPAs (Table 1; [16]), ranging in size from 2 km^2 to 320,000 km^2 and covering 8.3 % of Canada's ocean estate (475,900 km^2) and more than 90 % of Canada's reported total MPA area. Of the total area assessed, 6.9 % was Fully or Highly Protected, while 88.7 % was Lightly or Minimally Protected and 4.4 % was considered Incompatible with the conservation of nature, as defined by the International Union for Conservation of Nature (IUCN) [39]. The experience of applying *The MPA Guide* in Canada underscored the challenges of interpreting the patchwork of overlapping jurisdictions, opaque legislation, and selective regulations, aligned with long-standing concerns about the protection standards of Canadian MPAs [40]. MPA legislation in Canada often delegated authority over activities like fishing and shipping to other legal tools, and only a few MPAs had detailed management plans that provided a summary of allowable and prohibited activities [16] (CPAWS, 2021). *The MPA Guide* assessment, particularly if expanded to include all of Canada's MPAs, shows the limited positive outcomes expected across Canada's current federal MPA estate if protection levels remain low. This information can inform dialogue about necessary changes to better achieve long-term conservation goals.

Similarly, in Brazil, the vast majority of the EEZ area in MPAs (27 % of the 3.6 million km^2 EEZ) is assessed as Incompatible with the conservation of nature (22.1 % of EEZ) based on the large impact of extractive or destructive activities occurring inside certain MPAs. The two largest Brazilian MPAs, which were created in 2018 and represent 81.8 % of Brazil's MPA area, are subject to highly destructive fishing activities (and mining activities in one of them, the Área de Proteção Ambiental do Arquipélago de Trindade e Martim Vaz). These MPAs have had their effectiveness criticized, including as a result of poor design, lack of regulations for high-impact activities, and top-down governance without adequate participation in the planning process [41,42]. Only just over 3 % of Brazil's EEZ is Fully or Highly Protected ([15]; Table 1). The regions that concentrate the highest cumulative human impacts [43] are covered by only 0.17 % of Fully or Highly Protected MPAs [15]. Despite these challenges, Brazil has indicated a commitment to achieving a 30 % target. Clear understanding of the biodiversity outcomes that can be expected, or not, from Brazilian MPAs can inform conservation actions to increase effectiveness in existing, as well as new, protected areas.

Analyses have shown effective biodiversity conservation expected in certain areas of MPA management and opportunity for improvement in others. In Indonesia, approximately 40 % of the MPA area is Actively Managed, as mentioned above, but much of this area is Minimally Protected (59 % of national MPA extent) or Lightly Protected (36 %) [20]. Along with the other 60 % that is not yet Actively Managed, these areas likely have low conservation benefit [20] and are focal points for increasing investments. Many of Indonesia's MPAs are designed to promote sustainable fisheries in addition to biodiversity conservation, based on local contexts and equity for all stakeholders. Yet, low Levels of Protection in Indonesian MPAs indicate that allowed activities may compromise biodiversity conservation outcomes, jeopardizing fisheries sustainability. *The MPA Guide* assessment highlights areas and activities that may be reassessed to facilitate adaptive management and achieve conservation goals where desired outcomes from MPAs are not occurring [20].

In some countries, there is a tendency towards large, offshore MPAs, many of which are not Implemented and still require investments to reach Active Management [11]. For example, in Portugal, most MPA coverage is Minimally Protected, due to very large offshore MPAs that are not yet Implemented *de facto* and have weak protection measures in the water column (Horta e Costa et al., *unpublished data,* based on [24]). In these areas, regulations are not only decided by Portugal but also the EU Common Fisheries Policy (in the EEZ) and to the ocean law applicable to extended continental zones, which has jurisdiction only in the bottom and sub-bottom. Further, only 1.5 % of the area covered by Portuguese MPAs is Fully (~1 %) or Highly (~0.5 %) Protected (Table 1). Most of this area is in small zones of nearshore MPAs (Horta e Costa et al., *unpublished data,* based on [24]) and the remote Selvagens Islands MPA, which is Actively Managed and was recently expanded to become the largest Fully Protected area in the North Atlantic [44]. MPA quality, and the resources needed to achieve that quality, can vary across jurisdictions within a single region – these assessments are relevant to guide decision-makers in prioritizing management and/or protection levels, depending on the jurisdiction.

Similar trends were found in an assessment of MPAs in the United States' Territory of Guam and the Commonwealth of the Northern Mariana Islands in the western Pacific [21]. This analysis shows a discrepancy in the Stage of Establishment and Level of Protection between large, offshore, federally managed MPAs (covering 25.4 % of the total EEZ) and the smaller MPAs in territorially managed waters up to 12 nautical miles from shore (covering 0.83 % of Guam and 0.07 % of Commonwealth of the Northern Mariana Islands, excluding area in the federally managed Mariana Trench MNM). The Mariana Trench MNM published a final management plan in June 2024, which was under development since 2009 [45]. Many of the territorially managed MPAs are smaller in size, but all have been Actively Managed over a longer time period. Some of these smaller coastal MPAs are Lightly Protected, due to high impact from tourist activity or species-specific management that does not provide a high level of comprehensive biodiversity conservation. The authors concluded that investments are required, but should be nuanced according to jurisdictional context. For example, investments in Stage of Establishment were needed to finalize a management plan for the Mariana Trench MNM and actively manage the MPA, including both the benthos and the water column. Similarly, investments in increasing Level of Protection are needed for some territorially managed MPAs, for example via increasing protection of Lightly Protected MPAs, e.g., to align with socioeconomic objectives from the tourist sector.

Lack of implementation also exists in MPAs close to shore and near population centers. For example, the majority of the Natura 2000 sites throughout Europe currently lack management plans and need investments at the national scale to be implemented and accrue biodiversity benefits [46,47]. In Greece, over 150 MPAs have been designated, but less than 10 % of these have official regulations and even fewer are Implemented or Actively Managed ([19]; Table 1). Less than 2 % of Greece's MPAs are Fully or Highly Protected, and 88 % are Incompatible with the conservation of nature, primarily because unregulated, high-impact fishing occurs within these areas. In his speech at the IUCN World Conservation Congress in Marseille in 2021, Greece's Prime Minister Kyriakos Mitsotakis committed to the goal of protecting 30 % of the Mediterranean Sea by 2030. Moreover, he stated: "And beyond the ambition to protect 30 % of marine and coastal areas, we must work… to ensure that marine protected areas or MPAs are no longer paper parks. We must aim for effectively managed networks of MPAs, with defined conservation measures" [48]. *The MPA Guide* assessment of Greek MPAs provides a pathway to achieve this ambition [19]. A report to the Prime Minister outlines results, conclusions, and suggestions on how Greece could benefit (both in ecological and socio-economic terms) from increased effective protection. The authors conclude that a first step is to increase the Level of Protection and change the Stage of Establishment from designated to actively managed for MPAs in Greek seas [19].

Finally, the process of planning new or expanding MPAs can also use information from existing assessments of MPA quality in a site or a region. In France, the RBCS assessment of French MPAs facilitated an understanding of the positive outcomes of Fully and Highly Protected areas, and the conservation investment in their establishment. Consequently, when discussion started to expand the Cerbère-Banyuls MPA, care was given to ensure that enough new Fully Protected zones were proposed to maintain the relative proportions of these Levels of Protection in the MPA and the benefits provided by those higher Levels of Protection.

5. Improving national or regional representativeness in effective MPAs

Assessments of the expected conservation outcomes from MPAs across a country or region can also highlight places where MPA protection is unevenly distributed, without ecosystem representation or equitable access for communities. For example, Sullivan-Stack et al. [25] assessed the Level of Protection and Stage of Establishment of the 50 largest MPAs in the United States, which comprise 99.7 % of the total MPA area in the United States (Table 1). The United States ocean estate encompasses a broad spectrum of biodiversity and habitats across diverse ocean ecosystems spanning the Arctic to the Caribbean to the tropical central and western Pacific. However, this study revealed that 99 % of the Fully or Highly Protected United States MPA area is in the central and western Pacific ocean, and only 1.9 % of marine area outside this region is protected in any kind of MPA, with most area Lightly or Minimally Protected [25]. These results highlight that the United States system of MPAs is not representative or equitable, leaving many important species and habitat types unprotected by MPAs while concentrating the vast majority of the conservation burden of achieving effective MPAs on communities and governance structures in one region of the US.

Similar results were found in three studies that used the RBCS. Claudet et al. [18] used the RBCS to assess the regulations in France's 524 MPAs, both in continental waters and overseas territories. The authors showed that France's MPA area, including that which is Fully or Highly Protected, is unevenly distributed across territories and ecosystem types. Although 31.8 % of France's EEZ is covered by an MPA, regulations are not stronger inside the MPA than outside for 12.5 % of these areas. Only 1.6 % of the EEZ is Fully or Highly Protected, and 97.4 % of this full and high protection is concentrated in the uninhabited French Austral and Antarctic territories and some remote reefs of New Caledonia [18]. In Portugal, MPA area is 9.4 times higher when including the extended continental shelf, as compared to only national waters (EEZ and territorial seas), but all MPA area in the extended continental shelf is Designated with management plans in development and high-impact activities occurring [24]. A recent review showed that only 16 % of EU MPAs in the Mediterranean and Black Seas have baseline and monitoring studies and can thus be considered actively managed [46]. In the Mediterranean Sea, 72 % of the 1062 MPAs lack regulations that reduce human impacts on biodiversity, and the most effective levels of protection in the RBCS (similar to Highly and Fully Protected) represent only 0.23 % of the basin and are unevenly distributed across ecoregions [22]. Those results were used in a report by the European Court of Auditors [49] criticizing European marine environment protection.

Throughout these examples, the authors conclude that increased Level of Protection and more representative distribution of MPAs across political boundaries and ecoregions would be more effective in delivering tangible benefits for biodiversity conservation, and more equitable distribution of MPA costs and benefits to local communities.

6. Providing guidance for effective MPA protection in the high seas

The newly adopted High Seas Treaty [50], which provides a framework for establishing MPAs in areas beyond national jurisdiction, provides a unique opportunity to provide meaningful protection for the high seas. However, there is also a risk that MPAs will be designated opportunistically in areas of low economic importance given strong lobbying against reducing commercial activities that compromise biodiversity conservation in specific areas [51]. Further, given that the High Seas Treaty (per Article 4) will likely rely on coordination with current legal frameworks for resource extraction (e.g., Regional Fisheries Management Organizations, the International Seabed Authority), there is a risk that high seas MPAs will be multi-use areas with destructive activities that are Incompatible with the conservation of nature [52].

Two governance regimes have established MPAs in international waters and can provide insights. The first is through the Oslo and Paris (OSPAR) Commission, which has created a network of MPAs in the high seas of the Northeast Atlantic. Currently, these high seas MPAs rely on a Memorandum of Understanding with the North-East Atlantic Fisheries

Commission, and although some areas ban bottom fishing gears and impose management measures to fishing members, they generally allow various uses, which in such distant areas are typically at industrial scales and thus Incompatible with the conservation of nature per the IUCN. Additionally, the management of the OSPAR MPAs is fragmented, with various bodies managing the wide array of current and emerging activities [53]. An assessment of 476 of the 551 MPAs in the OSPAR database using the RBCS showed that only 0.03 % of the network is Fully or Highly Protected, and approximately 70 % allow high impact and damaging activities to an extent that would be considered Minimally Protected or Incompatible with the conservation of nature in *The MPA Guide* [23]. Similarly, although not all in the high seas, many of the largest 100 MPAs included in the assessment by Pike et al. [11] are in remote, offshore areas. Human activities occurring in these areas tend to be industrial scale, i.e. requiring large vessels, by IUCN's definition [54], because these areas are otherwise difficult and unsafe to access, and thus Incompatible with biodiversity conservation, undermining the effectiveness of the areas that contribute the majority of area towards global targets [55].

Another example of international MPAs is through the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). CCAMLR has established two MPAs to date: the South Orkney Islands Southern Shelf MPA, which is Highly Protected; and the Ross Sea region MPA, which is ~80 % Highly Protected and ~20 % Lightly Protected [17]. This showcases CCAMLR's commitment to implement meaningful MPAs with strong conservation targets. However, the governance of activities in the Southern Ocean is also fragmented to some degree, relying on several different bodies for comprehensive protection across different activity types [17]. Further, CCAMLR has allowances for research fishing within all MPAs. While research fishing is strictly regulated, it supports commercial fishing rather than ecological research – the research is focused on assessing the stock and is conducted from commercial vessels, and the catch is commercially sold. If not constrained, this research fishing could compromise the conservation value of the MPA. This fragmentation and allowance for research also highlights that the protection status may not be permanent. Additionally, management bodies such as CCAMLR did not meet key social and ecological Enabling Conditions for MPA effectiveness outlined in *The MPA Guide* – such as transparency, accountability, and sustainable financing [17].

7. Complementing, leveraging, and expanding the scale of existing assessment systems

Many countries already use the IUCN Categories for Management Objectives and Governance Types of an MPA [39]. The IUCN categories and *The MPA Guide* are complementary frameworks that provide different information [8]. The IUCN categories group MPAs based on their management objectives [39], whereas *The MPA Guide* provides an understanding of expected outcomes [8]. An understanding of both of these aspects – a site's objectives and the outcomes it is likely to achieve – can help managers and other decision-makers understand if goals are likely to be met and what actions should be taken to improve MPA effectiveness. Indeed, analyses have shown that IUCN categories do not map onto *The MPA Guide* Level of Protection in a one-to-one comparison. In a recent analysis of the largest 100 MPAs globally, only about one-third of MPA coverage reported as Category Ia (strict nature reserve), Ib (wilderness area), or II (national park) was Fully or Highly Protected [11]. In Brazil, 57.9 % of MPAs in the EEZ are considered IUCN Category VI, "Protected area with sustainable use of natural resources"; however, using *The MPA Guide* framework, several of these MPAs are considered Incompatible with conservation of nature based on highly destructive activities that are happening therein [15]. Understanding the management objectives of an area via the IUCN categories is not replaced, but complemented, by an understanding of the quality of protection via an *MPA Guide* assessment.

There are many different assessment systems and tools for understanding the management and effectiveness of MPAs [e.g., the Management Effectiveness Tracking Tool [56], the IUCN Green List (https://www.iucn.org/resources/conservation-tool/iucn-green-list-protected-and-conserved-areas)]. These vary in purpose and in information requirements, and when used disjointedly can create confusion. However, using complementary assessment systems can help clearly outline goals, resources needed, and outcomes of protections. Many assessments require monitoring data that take many years to compile to provide evidence of conservation benefits from MPAs. As a complement to more data-intensive assessment tools, *The MPA Guide* provides "expected" conservation outcomes, grounded in evidence from scientific studies and summarized in Grorud-Colvert et al. [8] but without extensive resources or time requirements. For that reason, it can be coupled with more time and resource-intensive tools and used as a first step, to identify areas where tangible conservation benefits are likely to be recorded through monitoring data, areas where additional capacity is needed to achieve effectiveness, or areas where dialogue about updating MPA design and management practices could bring improvements. While global resources such as the Global Database on Protected Area Management Effectiveness (GD-PAME; https://www.protectedplanet.net/en/thematic-areas/protected-areas-management-effectiveness-pame) compile information about whether effectiveness assessments have been undertaken, most of the 18,000+ MPAs globally have not been assessed. Complementing these with *MPA Guide* mid-level assessments, categorizing by Stage of Establishment and Level of Protection to indicate expected effectiveness of biodiversity conservation, can identify areas where additional capacity could be shared to activate resource-intensive approaches to then verify effectiveness based on monitoring data or other sources of in-the-water evidence.

In some cases, it is possible to leverage existing information from datasets used for national- or regional-level assessment tools and facilitate an even faster assessment using *The MPA Guide*. For example, research in Indonesia (described in Sections 3 and 4) integrated nationally collected management effectiveness datasets, including Management Effectiveness Tracking Tool findings, with *The MPA Guide* – demonstrating the feasibility of this method to expedite evaluations [20]. This study also showed that *The MPA Guide* assessment provided a unique means of recognizing marine portions of protected areas designated with terrestrial protected area legal instruments, which are often overlooked in regular reporting due to their official classification as 'terrestrial' protected areas [36]. In Indonesia, several 'terrestrial' protected areas encompass both land and sea, resulting in a substantial expanse of ocean under active management [36].

For countries and regions without an assessment system in place, *The MPA Guide* can be a useful tool. For example, the Government of the Hellenic Republic of Greece, like other EU states, is required to submit a list of its protected areas every year to the European Environmental Agency, but there is no assessment of the Level of Protection of these areas. To use the Stage of Establishment and Level of Protection for this official reporting, *The MPA Guide* framework would need to be adopted by the EU and requested by member States. This is true in other contexts as well; for example, the United States American Conservation and Stewardship Atlas, currently under development to support the America the Beautiful commitment to conserve 30 % of US waters by 2030 [[29]], could incorporate Stage of Establishment and Level of Protection in its tracking.

8. Facilitating clear communication and collaboration

Assessments using *The MPA Guide* have brought people and organizations together using the same language to navigate complex conversations about MPAs, from meeting global targets to meeting the conservation needs of a specific place. This common language for MPA quality can continue to serve as a valuable tool to guide effective protection of biodiversity and meet local and global marine conservation

targets.

As described in the case studies above, assessments of MPA quality using *The MPA Guide* allow comparison of MPAs across different contexts and geographies. Data from assessments facilitate clear comparison across different jurisdictions that use different terminology, languages, legal instruments, and national assessment frameworks as our analyses show. These standardized data demonstrate that not all MPAs are the same in terms of expected outcomes for biodiversity and human well-being, and provide a shared understanding and vocabulary for the different ways MPAs can be used to reach conservation goals.

Following the Mariana Islands *MPA Guide* assessment [21], the authors held a public seminar and interviews on local radio and television networks. MPAs remain contentious with opposition from local fishing communities and apprehension from Indigenous rights groups who view MPAs as an extension of ongoing colonialism that restricts access to marine resources. The authors found that *The MPA Guide* assessment provided a simple, useful framing for distilling the comprehensive and often complex science of MPAs. Many community members have a view that all MPAs are Fully Protected, with no fishing allowed based on assumptions of what "protected" means when an area is called an MPA. While Fully Protected areas are most likely to lead to the strongest positive biodiversity conservation outcomes [57], they are not the only type of MPAs and are not the most common, a detail that has historically been poorly communicated. Clear language and definitions around partial protection can inform previously contentious interactions that operate with undefined and generalized terms. In the context of the Mariana Islands, *The MPA Guide* assessment helped showcase that better collaboration across jurisdictional authority would assist with moving MPAs from the Designated to Implemented Stage, informing a conversation about government agencies taking responsibility for active management.

A similar case played out in Indonesia where MPAs are managed by two distinct ministries – the Ministry of Marine Affairs and Fisheries and the Ministry of Environment and Forestry [36]. While both ministries share a common primary objective of safeguarding marine biodiversity through MPAs, variations exist in the mechanisms and implementation strategies employed, including different approaches to evaluating MPAs [36]. This poses a significant challenge in assessing the progress and outcomes of MPAs nationally and facilitating mutual learning among different regions/MPAs. *The MPA Guide* assessment in Indonesia was conducted by a group of scientists in collaboration with policymakers from the Ministry of Marine Affairs and Fisheries using available data provided by each MPA manager [20]. The findings proved valuable in capturing the attention of policymakers and stakeholders, stimulating discussions regarding the overall progress of MPAs across the nation, and highlighting the need and priorities for future investment, ultimately influencing discussions about the 2030 MPA vision of the Ministry of Marine Affairs and Fisheries [37].

9. Discussion: lessons learned and recommendations

There is real momentum and urgency across the globe to protect the ocean, driven by diverse motivations such as percentage targets, renewed commitments in countries and organizations to social and environmental justice, a desire to mitigate and adapt to climate change using ocean-based solutions, and increasing understanding of the risk that the biodiversity crisis poses for the future of humanity [1]. However, many MPAs are not designed or managed to produce these positive outcomes. We found that assessments that focus on MPA quality and outcomes, such as those using *The MPA Guide*, can inform planning, design, and evaluation of MPAs and help optimize decision making to achieve scientific, societal, and policy priorities. A single number reporting MPA coverage omits valuable information and can be a perverse incentive to achieve target numbers without investment in communities and effective management. Although each of the assessments presented here had different results and implications for decision making, they each provide clear, consistent, and actionable information on the extent of protections provided by MPAs in an area, helping to inform adaptive management actions.

Many of these case studies address multiple different types of uses (Fig. 2); for example, understanding the Level of Protection and Stage of Establishment of the 100 largest MPAs globally [11] not only helps to better understand progress towards global area coverage targets, but also to track effectiveness and clarify the expected outcomes from the global system of MPAs. Decision makers can consider places where these MPAs may be improved to better deliver conservation outcomes, as well identify areas where new MPAs are needed. Another important use highlighted by the breadth of these case studies is the ability to compare MPAs across different countries or areas in a standardized approach. Examples given here illustrate how metrics of quality are useful when applied and compared across contexts, to identify what is consistent and what varies according to country, region, or other scale.

Vital to all assessments of MPA quality and effectiveness is not only an understanding of *what* is happening in an MPA, but *how* management is carried out and *who* that MPA is affecting. These include social principles such as recognition of pre-existing rights, tenure, and resource use, and attention to just impact- and benefits-sharing, as well as ecological guidance on size, spacing, location, connectivity, and representation. The presence of key Enabling Conditions is fundamental to the effectiveness of MPAs and a key element of *The MPA Guide* [8], yet these remain difficult to assess systematically. The vast majority of *The MPA Guide* assessments described above have focused on Stage of Establishment and Level of Protection, but have not yet used a standardized methodology to comprehensively assess and identify key Enabling Conditions. This information is crucial for effectiveness, and represents an important step for improving assessments [58,59]. Certain completed assessments have used government funding appropriations as a proxy for portions of Enabling Conditions (e.g., dollars dedicated to coral reef conservation in the Commonwealth of the Northern Mariana Islands; [21]). Nocito et al. [17] indicated the presence or absence of Enabling Conditions in the CCAMLR MPAs, but this context differs from most other national, regional, and local contexts which have more diverse and numerous rightsholders, resource users, and other interested parties relevant to the MPA.

It is also important to consider who is undertaking these assessments. The existing *MPA Guide* assessments described in this paper cross-cut large geographic areas. These assessments were completed by various types of groups including academics, non-governmental organizations, and national-level government agencies. In all MPA assessments regardless of the tool used, and especially when led by a party that is external to the MPA, it is crucial to consider the activities actually happening in an area, not just those outlined as allowed or prohibited in regulations and management plans. Further, it is important to ensure the assessments are communicated respectfully back to the governing bodies and relevant management groups so assessing MPAs is not done in isolation as an academic exercise. *The MPA Guide* was designed to be used by, or in close collaboration with, experts that are intimately familiar with a given focal MPA, such as local managers or members of the surrounding communities, with a firm understanding of local use and priorities.

As we have shown here, conducting assessments of MPA quality at national, regional, and global scales can offer improved understanding of the potential outcomes and benefits associated with MPAs, and thus the global progress towards a biodiverse and productive ocean. This approach surpasses the narrow focus on a single percentage area or a target, measured in a single number of millions of hectares or km^2, and instead emphasizes the holistic examination of an MPA system to improve decision making and achieve intended biodiversity conservation goals. We suggest that it is important to broaden the use of assessments of MPA quality, and incorporate these metrics as indicators of progress toward global conservation targets.

Summary Box: lessons learned and new understanding from assessments

of MPA quality

1. **Embed quality assessments in a broader policy, management, and social context.** Assessments of MPA quality, such as via *The MPA Guide*, are most useful when they consider and are relevant to the broader policy, management, social, and other context in an area. As noted below, assessments led by local leaders are most effective and useful when they provide insight into questions that could improve MPA effectiveness for biodiversity and human well-being.
2. **Use this established system to provide definitions, metrics, and indicators towards existing conservation goals and priorities**. For example:
   a. The Level of Protection and Stage of Establishment according to *The MPA Guide* could be added as Target 3 component indicators in the GBF monitoring framework.
   b. The quality-related "second tier" of two-tier area-based conservation targets (e.g., the EU Biodiversity Strategy) must be defined and could be based on *The MPA Guide*. For example, a target of 10 % "strictly protected" within the overall 30 % target could correspond to Fully and Highly Protected areas that are Actively Managed and have key Enabling Conditions in place.
   c. Assessments of quality could be incorporated as indicators for national-level targets, such as the Conservation and Stewardship Atlas in the United States.
3. **Rely on local expertise to understand expected MPA effectiveness.** Assessments that are purely academic and do not incorporate understanding from local knowledge holders are unlikely to provide an accurate assessment of the impacts in a given area. Further, it is important to connect with people who are charged with making management decisions in a given protected area or region (see #4 below).
4. **Highlight the primacy of key Enabling Conditions**. Investing in understanding and supporting monitoring of Enabling Conditions can provide managers with the detailed information needed to improve MPA performance. This may facilitate addressing ineffective and inequitable practices in MPAs, such as inadequate staffing, misappropriated funding, lack of transparency regarding management activities, etc. These processes have important implications not only for social goals but also for ecological goals for biodiversity conservation. In fact, in a recent review of the impact of management processes on fish populations, staff and budget capacity were identified as the strongest predictors of conservation outcomes [60].
5. **Communicate findings clearly and inclusively.** Beyond the typical methods of disseminating scientific findings, it is important to consider the ways in which assessments of MPA quality, and the insights and recommendations that arise, can be most clearly communicated to those who can use them. For example, sharing the report on the quality of Greece's MPAs directly with the Prime Minister of Greece can help to inform Greece's conservation priorities and actions [19]. Following the publication of the assessment of the 50 largest MPAs in the United States, co-authors spoke with key government decision makers to share the results of the assessment and recommendations for improving the United States system of MPAs to achieve the United States' stated goals. More examples are given above in Section 8, including from the Mariana Islands.

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Data Availability

Data are available via references

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