Received: 16 March 2020 | Revised: 6 January 2021 | Accepted: 8 January 2021

DOI: 10.1111/conl.12792

Conservation Letters
A journal of the Society for Conservation Biology
Open Access
WILEY

POLICY PERSPECTIVE

Essential indicators for measuring site-based conservation effectiveness in the post-2020 global biodiversity framework

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Abstract

Work on the post-2020 global biodiversity framework is now well advanced and will outline a vision, goals, and targets for the next decade of biodiversity conservation and beyond. For the effectiveness of Protected areas and Other Effective area-based Conservation Measures, an indicator has been proposed for "areas meeting their documented ecological objectives." However, the Convention on Biological Diversity (CBD) has not identified or agreed on what data should inform this indicator. Here we draw on experiences from the assessment of protected area effectiveness in the CBD's previous strategic plan to provide recommendations on the essential elements related to biodiversity outcomes and management that need to be captured in this updated indicator as well as how this could be done. Our proposed protected area effectiveness indicators include a combination of remotely derived products for all protected areas, combined with data from monitoring of both protected area management and trends in species and ecosystems based on field observations. Additionally, we highlight the need for creating a digital infrastructure to operationalize national-level data-capture. We believe these steps are critical and urge the adoption of suitable protected area effectiveness indicators before the post-2020 framework is agreed in 2021.

KEYWORDS

2011–2020 Strategic Plan for Biodiversity, biodiversity outcomes, indicators, management effectiveness, other effective area-based conservation measures, post-2020, protected areas

1 | INTRODUCTION

The United Nation's Strategic Plan for Biodiversity 2011–2020, developed under the Convention on Biological Diversity (CBD) and endorsed by all the biodiversity-related conventions, has been the main instrument of the international community's commitment to reverse biodiversity loss over the past decade (Rogalla von Bieberstein et al., 2019). Essential to the achievement of this Plan have been the 20 Aichi Targets, with Target 11 stating that "*By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape*" (Convention on Biological Diversity, 2010). There are now over 240,000 Protected Areas (PAs) and Other Effective area-based Conservation Measures (OECMs) that cover 16% of Earth's land surface and 7.7% of the global ocean (UNEP-WCMC & IUCN, 2020), and the establishment of over 100,000 new PAs over the last decade has been celebrated as a major political achievement. However, essential elements of Target 11—other than areal coverage—have seen much less progress (Secretariat of the Convention on Biological Diversity, 2020a) and fit-for-purpose indicators to track other elements—such as protected area effectiveness are lacking, even after 10 years of implementing the last strategic plan (Maxwell et al., 2020).

Work to formulate the framework for the next decade of biodiversity conservation and beyond has been ongoing for the past year. A key step was the release in September 2020 of an updated "zero draft" of the post-2020 global biodiversity framework (Secretariat of the Convention on Biological Diversity, 2020c). This draft framework sets out an ambitious plan for achieving the 2050 shared vision of "living in harmony with nature" and introduces a theory-of-change to operationalize the path forward that explicitly recognizes the scope of the challenge and the need for transformational change. Importantly, this draft has retained a stand-alone target (Target 2) on PAs and OECMs: "*By 2030, protect and conserve through well connected and effective system of protected areas and other effective area-based conservation measures at least 30 per cent of the planet with the focus on areas particularly important for biodiversity*."

Parties to the CBD have requested that before new targets are agreed for the post-2020 strategic plan, they should be linked to viable indicators. For the effectiveness of PAs and OECMs the CBD's open-ended working group on the post-2020 global biodiversity framework is proposing two indicators: (1) area of protected areas and other effective area-based conservation measures meeting their documented ecological objectives and (2) area in each of the four governance types (Secretariat of the Convention on Biological Diversity, 2020b). These are suggested to replace the current indicator which focused on number and areal coverage of sites that had undertaken an assessment of management effectiveness. The focus on meeting documented ecological objectives is a critical and welcomed new step. However, the information on what data-sources could be used at the national and global level to inform this indicator is less clear. Here we draw on experiences from the assessment of management effectiveness in previous strategic plans to provide recommendations on the essential elements related to biodiversity outcomes and management that need to be captured in this updated indicator, as well as how this could be done. Additionally, we highlight the need for creating the digital infrastructure to operationalize data-capture. We believe this will help countries deliver on their commitment to improve the effectiveness of PAs and OECMs toward 2030 and beyond.

2 | LEARNING FROM THE 2011–2020 STRATEGIC PLAN

Most assessments of progress toward achieving Aichi Target 11 were focused on PA areal coverage. One reason for this is that the World Database on Protected Areas (WDPA) has facilitated collation of data on PA extent, allowing countries and scientists to measure and report progress toward the coverage element of Target 11 (UNEP-WCMC & IUCN, 2020). The spatial attributes of PAs captured in the WDPA have also allowed for crucial assessments of the global PA network in relation to some aspects of ecological representation, coverage of some areas of importance for biodiversity (especially Key Biodiversity Areas), connectivity, and the potential contribution of PAs to the maintenance of some ecosystem services (Gannon et al., 2019; Maxwell et al., 2020; Secretariat of the Convention on Biological Diversity, 2020a; UNEP-WCMC & IUCN, 2020). However, capturing information on the effectiveness of PAs, and hence assessing the achievement of this element of Target 11, has remained challenging (Coad et al., 2015).

The Global Database on Protected Area Management Effectiveness (GD-PAME) was developed as the official repository for reporting on PA effectiveness to the CBD, but it has been populated with data that were not specifically collected or targeted for use as an indicator for Target 11. Thus, it is problematic that the GD-PAME is presently the only data-source suggested to inform the post-2020 biodiversity framework on PA and OECM effectiveness. Currently, the GD-PAME only records whether an assessment of management effectiveness has been undertaken—with

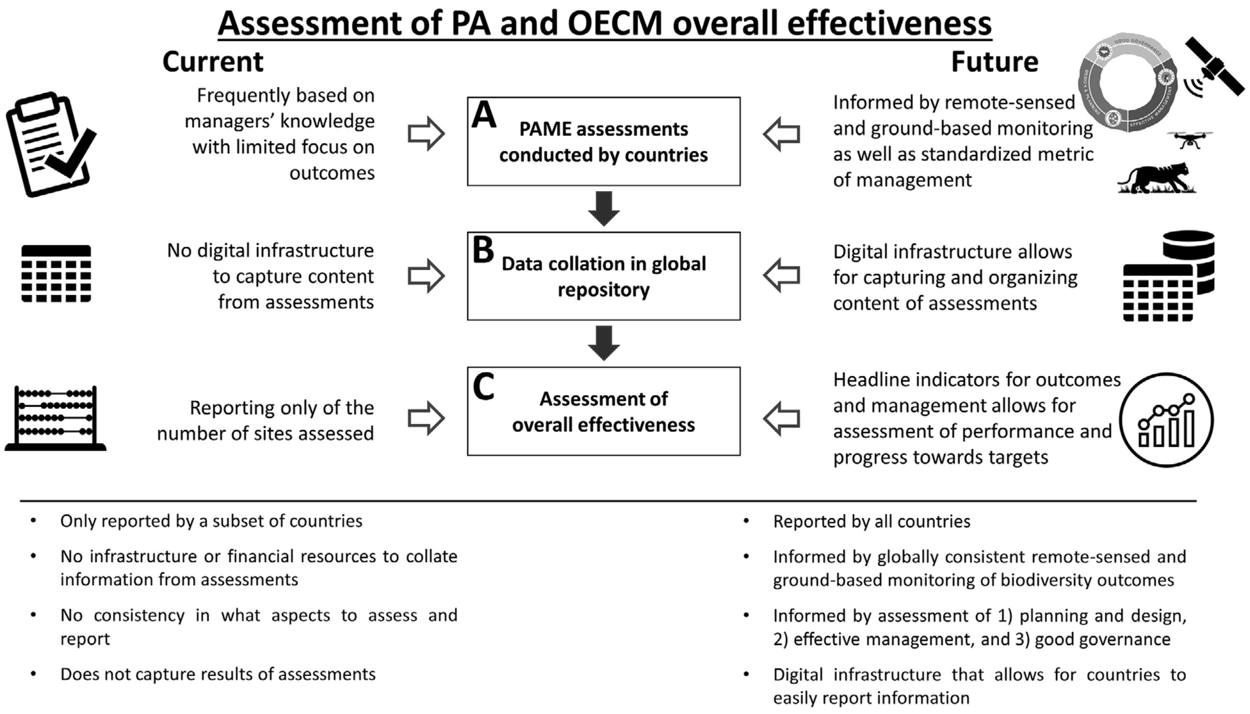

FIGURE 1 The steps from assessing effectiveness in the field to reporting toward international targets (center) with the current process for reporting management effectiveness under Aichi Target 11 (left) and the suggested improvements needed to capture effectiveness in the post-2020 framework (right)

no information about whether the site is effective in terms of management processes, financial- and staff-adequacy, or, most importantly, outcomes for the biodiversity features for which the site is important. This is analogous to measuring progress on poverty alleviation by counting the number of people with a bank account rather than whether they have the resources to sustain themselves. It is worth noting that even this basic information on whether an assessment has been undertaken is only available for ca. 10% of sites recorded in the WDPA (UNEP-WCMC & IUCN, 2020). We recognize that reporting on effectiveness and performance of PAs and OECMs is far more difficult than simply reporting area under protection. This is both due to a lack of data on trends of biodiversity, and because there is a lack of guidance on how to measure and report the effectiveness of PAs and OECMs. Consequently, the global community has not been able to track whether the PA estate has achieved its conservation objectives in an effective manner over the past 10 years and lessons must be learnt so we can create more effective indicators.

3 | PUTTING OUTCOMES AT THE CENTRE OF MEASURING SITE-BASED EFFECTIVENESS

Documenting the delivery of biodiversity outcomes must be an explicit part of any future assessment of effectiveness if PAs and OECMs are to play their intended role in diminishing human pressures on nature. Importantly, this means that well designed indicators of biodiversity outcomes, as a key element of effectiveness, are essential (Visconti et al., 2019). This was not the case for Aichi Target 11 and the same mistake risks being made for indictors of the proposed Target 2 of the draft post-2020 global biodiversity framework. We therefore see the need for a two-pronged approach to put in place fit-for-purpose indicators before the new CBD framework is agreed.

First, building on the impressive advances made in remote sensing and other technologies we need to develop consistent indicators of change that measure the state of biodiversity and the degree of anthropogenic influence across sites, that can be rolled out across all PAs and OECMs in a globally consistent manner (Figure 1a; Table 1). This would allow for assessing the contribution of PAs and OECMs in maintaining natural habitat as well as reducing threatening processes at the global level (Figure 1c). The satellites to deliver such data are already in orbit and existing efforts are providing an important foundation for near-future development of a comprehensive ecosystem-classification, which goes beyond forests to cover all ecosystems and biomes—including freshwater and marine (Bland et al., 2019; Kissling et al., 2018; Miloslavich et al., 2018). Likewise, research efforts are highlighting ways to map the impact of anthropogenic

TABLE 1 Overview of proposed indicators for measuring effectiveness of PA and OECMs in delivering biodiversity outcomes

		Indicator	Important considerations	Requirements	Challenges
GLOBAL	**OUTCOME**	Remote sensing of change in state of biodiversity due to PAs/OECMs	Will allow for independent assessment of the effectiveness of the global PA and OECM network Need to capture both cover and integrity of ecosystems/landscape-types Technology mainly exists in terms of satellites and computation Data from both inside and outside protected sites allows for more rigorous impact assessments	Interpretation for all ecosystems required Temporally updated data at least annually Global coordination and knowledge transfer between countries. Well-functioning remoting sensing units in countries for national validation Reporting protocols included in CBD National Reports and NBSAPs	Well-established for some ecosystems (i.e., forest) but largely lacking for other terrestrial ecosystems as well as for freshwater and marine Funding required to develop and validate beyond existing ecosystems Lack of expertise at national level in some countries Funding for maintenance and distribution of data to NBSAPs
		Remote sensing of change in human pressure due to PAs/OECMs	Data more readily available from many different sources and important work already ongoing to develop change measure for some pressures Shorter lag-time between action and observed change than with ecosystem measure Data from both inside and outside protected sites allows for more rigorous impact assessments	Global coordination and knowledge transfer between countries. Temporally updated data at least annually Reporting protocols included in CBD National Reports and NBSAPs	Does not capture all pressures on biodiversity Relationship between pressure and biodiversity not necessarily comparable spatially Available data not sufficiently temporally updated Funding required to develop and validate beyond existing pressures Funding for maintenance and distribution of data

(Continues)

TABLE 1 (Continued)

SITE LEVEL	In situ monitoring of change in state of biodiversity due to PAs/OECMs	Needs to be linked to species and ecosystems for which the site is designated, ideally identified in the management plan Can build on already existing monitoring for some PAs and OECMs Provide a level of detail on the change in state of biodiversity not captured by global measures Often closer linked to management decisions	For monitored sites, identification of species, ecosystems and ecological processes linked to the site's objectives Effective long-term monitoring and reporting systems for species, ecosystems, and ecological processes Reporting included in CBD National Reports and NBSAPs and global infrastructure to capture the data	Lack internationally agreed protocols on reporting Major capacity building needed in countries Achieving sufficient coverage to assess countries progress toward targets without straining spending for conservation action Not linked to CBD reporting and funding needed for a digital infrastructure to capture the data Building data gathering systems including citizen science platforms	
	MANEGEMENT	Site-level management assessment of PAs/OECM	Needs to capture whether (1) ecological values, threats, and objectives have been identified, (2) adequate resources and capacity to implement management system exist, and (3) governance is equitable A wide range of tools already exist for on-site governance and management assessment	Headline indicators across the three main element for reporting on-site assessment nationally/internationally. Global infrastructure for collating information from assessment toward CBD reporting Reporting protocols included in CBD National Reports and NBSAPs	More capacity needed to develop on-site assessment systems and standards Simple headline indicators across the three main elements are missing Lack of internationally agreed protocols on reporting results Not linked to CBD reporting and funding needed for a digital infrastructure to capture the data

Listing of the four suggested indicators covering both global-level indicators and site-based across outcomes and management inputs.
NBSAP = National Biodiversity Strategies and Action Plans.

pressures on some ecosystems (Grantham et al., 2020; Halpern et al., 2019), and these efforts are being greatly up-scaled in the near future (Runting et al., 2020). While not a comprehensive assessment of all biodiversity features (given they are, by definition, proxies), such data-products would introduce an independent outcome measure that could provide an overall account of effectiveness of the global PA and OECM network (Figure 1c). In developing remote-sensed indicators, appropriate resolution in time (updated at least every year) and space (< 1 km^2), data quality, and open-access will be important (Joppa et al., 2016). It will also be necessary to validate available data (as much of the data now coming online lack any quality control) (Watson & Venter, 2019). We see a clear role for countries in this validation process, which would not only facilitate the integration of local knowledge but also preserve national sovereignty in the assessment process. In addition, this approach would minimize the dependency on subjective assessment by managers (Watson & Venter, 2019). A globally consistent approach would also permit better knowledge transfer between countries as well as enable technical support to countries where capacity to implement and analyze such data is limited or entirely lacking. While admittedly generating such an approach is a major undertaking, we recommend that the post-2020 global biodiversity framework—and the associated indicator framework—recognizes the mission-critical values of such remote-sensed data and calls for the funding for and development of scientifically robust products toward this end.

Second, we recommend that these high-quality remotely-sensed global data should be complemented by site-level data of the changing state of nature based on finer-scale biodiversity inventories that can capture changes that more coarse-scale remote-sensed measures cannot (e.g., empty forest syndrome; Redford, 1992; Figure 1a; Table 1). Site-level monitoring needs to focus on the core conservation objectives of the site-based efforts and capture the condition of the key biodiversity elements for which the site is valued, drawing from resources such as the World Database of Key Biodiversity Areas, and ideally against a counterfactual reference value to allow for the assessment of impact (Baylis et al., 2016). The extent of site-level monitoring could vary depending on the objectives of the PAs and OECMs, as well as the capacity and capability of the countries and organizations involved. Monitoring would not always need to cover all PAs and OECMs in a country, provided sampling designs are appropriate. In some cases, assessments of site-level condition might be expert-based, drawing on knowledge from professional scientists, citizen science and traditional ecological knowledge, and connected to assessments of other management elements. Increasingly, new approaches, such as eDNA, camera trapping, acoustic monitoring, and volunteer collected data (i.e., citizen science) are also helping to provide cheap powerful data for strengthening management practices. For example, the SMART tool (designed to facilitate PA compliance and enforcement) is now used in over 750 sites across the world in collaboration with more than 115 government partners to help managers improve real-time responses to infractions (SMART Partnership, 2018). In addition, many countries have detailed site-monitoring schemes for biodiversity which, if linked together, could provide the basis for a global system to determine PA and OECM outcomes (Figure 1c).

Putting in place such systems will not be easy and will require individual countries to commit additional funding for monitoring. While many countries have the resources to prioritize such efforts, others do not. It is likely that this will result in different qualities of biodiversity monitoring if the CBD post-2020 framework does not put in place a mechanism for cost-sharing (Figure 1b). While we recognize that agreeing on such a mechanism will be politically challenging, this could also help facilitate more explicit knowledge-sharing about streamlining monitoring, through judicious use of indicator species, access to satellite monitoring and standardized reporting formats. Given the global significance of the biodiversity values of many developing countries we see good grounds for ensuring such mechanisms be explicitly integrated into the CBD post-2020 framework.

4 | CAPTURING SITE-BASED DATA ON PLANNING AND MANAGEMENT

While delivering biodiversity outcomes is the fundamental purpose of PAs and OECMs, understanding why some site-based conservation approaches are more effective than others is critical to improving our conservation responses (Figure 1a). This requires indicators that track not only biodiversity outcomes but also management inputs (Table 1). We recommend that management indicators for the next CBD Global Biodiversity Framework need to capture the key aspects that have been shown to correlate with site management effectiveness: (1) whether a plan that identifies the ecological values, threats, and objectives is in place and being implemented; (2) whether sufficient resources and capacity to implement the necessary management actions are available; and (3) whether governance is equitable (e.g., all relevant stakeholders are fully involved in decision-making processes, not just the area within different governance types) (Barnes et al., 2016; Geldmann et al., 2013; Geldmann et al., 2018; Gill et al., 2017). In addition, management information needs to be up to date.

The post-2020 framework must call for countries to report across these three elements to ensure that progress on the essential enabling conditions for success are monitored and reported on by Parties to the CBD (Figure 1b). This will help to ensure that countries develop specific monitoring frameworks, appropriate to local context, that outline for each PA or network of PAs the key values (biodiversity and others) to be monitored as well as a set of relevant management indicators that are monitored over time. The IUCN Green List for Protected and Conserved Areas Standard (Hockings et al., 2019) covers all three elements, in addition to biodiversity outcomes, and provides a holistic framework that can help countries navigate this process. This will help to ensure that, while countries likely have different specific needs and solutions, they all adhere to the same overarching structure and headline indicators. We are not suggesting that all PAs should work toward getting "green-listed" due to the high resource burden of achieving official Green List recognition, but that the four pillars of the Green List Standard provide a conceptual foundation that should be used in developing headline-indicators for the effectiveness of PAs and OECMs. In addition, the Green List standard can be used directly by site managers as a guide to good management practice.

Implementing a system that allows for both national-level flexibility and that can be used for a globally consistent reporting toward the post-2020 biodiversity framework, represents a significant challenge both politically and practically. However, if built on assessments that are already part of the management cycle and accounting already undertaken by many countries, we believe this challenge can be overcome. In Europe, for example, data and information on management as well as biodiversity outcomes are routinely compiled for use in national and EU-level stocktaking. Similarly, Canada, South Africa, India, Bhutan, Colombia, and Indonesia among others have mandated assessments as part of the official management processes to promote best practice and ensure cost-effective use and allocation of sparse resources. However, the absence of a fit-for-purpose global data-capture mechanism directly linked to CBD processes, with clear workflows and processes, has prevented such site-level data from being used to track progress toward management effectiveness at the global scale (Figure 1b). A global data-repository will require funding. Experiences from more comprehensive databases on PA effectiveness have demonstrated that collating these data required substantial resources and continual supervision and to date such databases have not been maintained (Coad et al., 2015). Thus, we call on parties to the CBD to prioritize sufficient resources to develop, maintain, and manage the data as well as ensure that it can be made available for stocktaking and research at both regional and global level (Figure 1b). Additionally, a well-structured global database, such as GD-PAME expanded to include qualitative data from assessments, can promote knowledge exchange and provide a common language for sharing best practices.

We acknowledge that management information is often sensitive in that it is linked to funding opportunities or may be seen as critical of individual managers or agencies who often do outstanding work in very challenging sociopolitical and environmental contexts. Global databases can and should be managed to guard these site sensitivities. Scorecard methods, where managers and other stakeholders collectively assess the effectiveness of management practices, are already applied widely across the world (Coad et al., 2013) allowing stakeholders to assess the adequacy of the key management elements. Such approaches can be adapted to national requirements and contexts. Whilst not without their challenges (Cook & Hockings, 2011; Mascia et al., 2014), these methods can be effective at capturing site- or PA network-level information (Fox et al., 2014; Stolton et al., 2019). Combined with an improved data-capture infrastructure and ensuring that assessments cover the four main elements detailed above (Figure 1b), we thus, believe that such tools can still play an important role for assessing the effectiveness of PA and OECMs (Figure 1c).

5 | BEING BOLD IN MEASURING EFFECTIVENESS BEYOND 2020

The coming year is critical in setting the agenda and ambitions for biodiversity conservation over the next decade and beyond, and it will be crucial to roll out a system for measuring progress using credible indicators as soon as possible. We urge that any site-based post-2020 target explicitly recognizes the urgent need to deliver biodiversity outcomes through sufficient resources and effective management, sound and equitable governance, and proper planning and design. Importantly, this will also require the formulation and development of fit-for-purpose indicators, and associated data-products, that capture biodiversity outcomes as well as management inputs. We recommend that such indicators build on remote-sensed products and other technologies that can provide an independent measure of the state of nature, linked to quantitative information from site-level biodiversity monitoring that covers species and ecosystems. Additionally, indicators need to capture management covering aspects of good governance, sound design and planning, and effective management. We do not suggest that improved indicators on the effectiveness of PAs and OECMs should replace existing metrics of progress on coverage, representation, and connectivity. Rather, they should complement these, to allow for a more holistic assessment of the role of protected and conserved areas in safeguarding biodiversity.

Multilateral commitment is essential to bolster national-level reporting, and to deliver fit-for-purpose indicators that can be used to drive improved conservation action. Thus, we strongly urge that Parties to the CBD come together to support existing efforts to develop high-quality and freely available remote-sensed products that can track changes in conservation outcomes. These need to be rolled out from 2021 and for the next 10 years to 2030 to measure progress toward the next global plan for biodiversity and can also help with reporting toward the Sustainable Development Goals. Similarly, support for and resources to develop a digital infrastructure to collate and store information on management and governance from Parties will be vital for the CBD; this could potentially build on the existing GD-PAME and be linked to the WDPA. If these elements are put in place, we believe this would be a significant contribution to reversing the decline of nature and starting to move the world toward the 2050 Vision of the CBD in terms of "Living in Harmony with Nature."

ACKNOWLEDGMENT

This work is supported by Aage V. Jensen Naturfond in Denmark.

AUTHOR CONTRIBUTIONS

The manuscript represents the collective views of all coauthors. JG led the writing with substantial contributions from all coauthors.

ETHICS STATEMENT

The manuscript contains no content for which ethics approval was necessary.

DATA ACCESSIBILITY STATEMENT

The manuscript contains no original data.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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How to cite this article: Geldmann J, Deguignet M, Balmford A, et al. Essential indicators for measuring site-based conservation effectiveness in the post-2020 global biodiversity framework. *Conservation Letters*. 2021;*14*:e12792. https://doi.org/10.1111/conl.12792