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The Kunming-Montreal Global Biodiversity Framework: what it does and does not do, and how to improve it

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The Kunming-Montreal Global Biodiversity Framework (GBF) marks one of the most ambitious environmental agreements of the 21st century. Yet despite the ambition, and the considerable change in approach since negotiating its predecessor (the 2025 Vision and Aichi targets), the many pressures, including working through a global pandemic mean that the final agreement, despite several years of delay, is weaker than might have been hoped for. The GBF provides a set of four goals, composed of 23 targets (and a series of supporting annexes) which explore the options for conservation, restoration and sustainable use of biodiversity, and the mobilisation of necessary resources to maintain life on Earth. In this perspective we systematically examine the composition of the GBF, exploring what the targets lack and what weaknesses exist in text. We also detail the link between the targets and the key indicators which can be used to track success toward fulfilling the targets. We offer key recommendations which could help strengthen the application of various targets, and show where the indicators could be improved to provide more detailed information to monitor progress. Furthermore, we discuss the association between targets and their indicators, and detail where indicators may lack the necessary temporal resolution or other elements. Finally, we discuss how various actors might better prepare for the successor to the GBF in 2030 and what has been learnt about the negotiating process, including lessons to help ensure that future agreements can circumnavigate issues which may have weakened the agreement.

KEYWORDS

convention on biological diversity, monitoring framework, diversity indicators, science-policy interface, conservation evidence

Introduction

The recently negotiated Kunming-Montreal Global Biodiversity Framework (GBF) represents a newly revised biodiversity agenda with specific targets within the 2030 mission, to prepare us better to fulfil the 2050 vision (CBD, 2022c). The importance of obtaining this agreement at the 15th Conference of the Parties (COP15) of the Convention on Biological Diversity (CBD) in Montreal in December 2022 cannot be overstated. Given a decade where the Aichi targets should have yielded success on reversing past declines, we still see continued losses in wildlife populations around the planet, with an average decline of 69% (WWF, 2022). Furthermore, there is increasing potential to exceed regional and global tipping points for ecosystem degradation and loss of ecosystem services, growing threats to food security, and less capacity to adapt to climate change (IPBES, 2019;

TABLE 1 Match between targets and indicators, and assessment of if indicators could enable the implementation based on SMART (Specific, Measurable, Ambitious, Realistic and Timebound) criteria. Note that whilst direct biodiversity targets (goals A and B) frequently have loopholes based on a lack of definitions of key terms, C-D (Goals C and D) often has limitations of scope or mismatches which prevent effective implementation or accurate measurement. Indicators available refer to the agreed upon headline indicators which already have a methodology. Scores (average/total) were given by scoring each SMART criteria (10 for Yes, 5 for semi/partial, 0 for No), and for if they matched the target (0 for high mismatch, 5 for partial, 10 for none). Both scores are given as some targets did not need to be spatially or taxonomically representative, but the total score gives a fuller range of variation in the strength and appropriateness of indicators.

Target	Target Aim	Indicators	Indicators available	S	M	A	R	T	Taxonomically representative	Spatially representative	Needs definitions	mismatch	Other issues	Goal	Score
1	Inclusive spatial planning	3	2	yes	semi	yes	semi	no	no	no	yes	partial		A-B	5/45
2	30% of areas under effective restoration	1	0	no	semi	yes	yes	yes	not specified	semi	yes	no		A-B	8/60
3	30% areas protected	1	1	yes	yes	yes	no	yes	not specified	semi	yes	no		A-B	8/65
4	Halt human induced extinction	2	2	semi	no	yes	no	no	no	semi	no	high		A-B	2/21
5	Sustainable wildlife trade	1	1	no	no	no	no	no	no	no	yes	very high		A-B	1/10
6	Invasive alien species	1	1	no	no	yes	no	no	no	semi	yes	no		A-B	4/35
7	Pollution risks	2	1	no	no	yes	no	no	NA	semi	yes	yes	No precautionary element	A-B	3/25
8	climate change	0	0	no	no	yes	no	no	NA	no	yes	no indicator		A-B	3/20
9	Sustainable wildlife trade	2	0	no	no	no	no	no	no	no	yes	very high		A-B	1/10
10	Sustainable agriculture and aquaculture	2	2	semi	semi	semi	no	no	NA	not factored in	yes	yes		A-B	4/25
11	Ecosystem services	1	0	no	no	yes	no	no	no	possible	yes	high	scope needs defining	A-B	3/21
12	connectivity	1	1	semi	no	yes	no	no	NA	no		high		A-B	2/16
13	DSI	2	0	semi	no	semi	semi	no	NA	yes		high		C-D	4/26

(Continued on following page)

TABLE 1 (Continued) Match between targets and indicators, and assessment of if indicators could enable the implementation based on SMART (Specific, Measurable, Ambitious, Realistic and Timebound) criteria. Note that whilst direct biodiversity targets (goals A and B) frequently have loopholes based on a lack of definitions of key terms, C-D (Goals C and D) often has limitations of scope or mismatches which prevent effective implementation or accurate measurement. Indicators available refer to the agreed upon headline indicators which already have a methodology. Scores (average/total) were given by scoring each SMART criteria (10 for Yes, 5 for semi/partial, 0 for No), and for if they matched the target (0 for high mismatch, 5 for partial, 10 for none). Both scores are given as some targets did not need to be spatially or taxonomically representative, but the total score gives a fuller range of variation in the strength and appropriateness of indicators.

Target	Target Aim	Indicators	Indicators available	S	M	A	R	T	Taxonomically representative	Spatially representative	Needs definitions	mismatch	Other issues	Goal	Score
14	Biodiversity mainstreaming	0	0	no	no	yes	no	no	NA	semi		no indicator	the use of biodiversity in poverty alleviation strategies is linked to spillover, safeguards are needed. Standards are needed to avoid loopholes	C-D	2/15
15	Business and biodiversity	1	0	yes	semi	yes	semi	no	NA	semi		high	*15 has three subtargets so indicators do not cover them. Standards are needed	C-D	5/36
16	Sustainable consumption	0	0	yes	no	yes	no	no	NA	yes		no indicator	limited to food, should consider inventory and other elements of consumption	C-D	4/30
17	Biosafety	0	0	no	no	yes	no	no	no	no		no indicator	refers to older CBD articles which may need revisiting	C-D	1/10
18	Perverse incentives	2	2	no	semi	yes	no	semi	NA	no		minor	No precautionary element	C-D	4/28
19	Finance	3	2	yes	yes	no	semi	yes	NA	possible		*seven sub-targets, most lack indicators	Annual funding deficit is more than double that of the target	C-D	7/44
20	Capacity	0	0	no	no	no	semi	no	NA	no		no indicator	lacks aim on what	C-D	1/5
21	Accessible data	1	1	no	no	no	semi	no	no	no		high	definition and framework needed	C-D	1/6
22	Representative inclusion	0	0	yes	no	semi	no	no	NA	yes		no indicator		C-D	4/25
23	Gender equality	0	0	yes	no	semi	no	no	NA	yes		no indicator		C-D	4/25

Leadley et al., 2022a). We need urgent action to redress these trends, and a strong GBF can play a critical role in halting and reversing global biodiversity loss (Chan et al., 2022).

However, developing the GBF was by no means an easy task. While the overarching aims of the final GBF remain ambitious, the challenges of oft-delayed face-to-face negotiations throughout the COVID-19 pandemic means that there exist inevitable gaps within the framework, and removing the “human” component of in-person negotiations may have further decreased willingness to compromise in developing targets. These include elements that could not be agreed upon, vague language which may lead to targets that are misinterpreted or misused, and multiple mismatches between agreed headline indicators in the monitoring system and specific GBF targets (Hughes, 2023). The inherent challenges of negotiating international agreements led to many initial draft targets that simply could not be agreed on; 80% of the GBF text remained subject to discussion just days before final ratification (Hughes, 2023). Furthermore, while the GBF aimed to use a SMART (Specific, Measurable, Ambitious, Realistic and Timebound) approach in developing both targets and monitoring indicators, many of these still lack reliable measurements (CBD, 2022c) (Table 1). Several GBF targets lost stronger elements that were present in earlier drafts as a consequence of limited time and the need to achieve an agreement.

In addition to these negotiation challenges, the increased ambition of the GBF targets (compared to the preceding Aichi targets), combined with the sense that the biodiversity crises is accelerating while decision space is shrinking, likely added to fraught negotiations (Obura, 2023). Data shows that biodiversity actions cannot be limited to increasing the amount of global protected areas; goals must expand to genuinely mainstream biodiversity across all sectors; accommodate conservation in working lands (Grumbine and Xu, 2021a, Meng et al., 2023), link biodiversity targets with climate change actions (Portner et al., 2023), and address long-standing social and financial inequities between the Global North and the Global South (Rammelt et al., 2022). Whilst the Sharm-el-Sheikh to Kunming Action Agenda did this to some degree, better integrating these elements, and adding them as major components of the targets (with consistent approaches to enable monitoring) are still needed (Hughes et al., 2022). Collectively, these interrelated social-ecological system trends represent transformations in the global political *status quo* that likely influenced the capacity of Parties to the CBD to agree upon (if not strengthen) the GBF.

Exploring GBF goals and targets

The GBF is divided into four major goals and 23 targets. The targets encompass different dimensions of environmental stewardship to facilitate a transition to a more sustainable society. Most targets are associated with headline indicators (CBD, 2023), which all countries are strongly encouraged (though not mandated) to use to measure progress towards meeting the targets. These headline indicators are supported by secondary component and tertiary complementary indicators which Parties can use for extra support. However, only headline indicators were agreed upon by all Parties during COP 15 negotiations in Montreal; the use of component and complementary indicators will therefore vary between countries and so will not provide

standardised, comparable metrics to use between regions and ecosystems. It should also be noted that most indicators were selected from other existing and ongoing programs, and thus whilst it means that data does exist for many, it also means that many do not perfectly align with the targets they are paired with.

What did the GBF accomplish and what is missing from the agreement? In this paper, we evaluate each of the targets within the GBF, and how well it aligns with the parallel monitoring framework which is designed to support and track implementation. Below, we explore what each of the final agreed targets do, the gaps in each target, and how well the headline indicators align with the stated aims of each target. We also suggest ways in which scientists can act to strengthen aims of the GBF going forward, how to best use the current agreement, and also prepare for its successor in 2030.

Goal A: species and ecosystem conservation and governance

Goal A in the GBF focuses largely on ecosystems and species, and includes eight targets. Most of Goal A targets have headline indicators (with the exception of Target 8), and many include several headline indicators (in addition to a wide array of optional component and complementary indicators).

Target 1 focuses on inclusive spatial management for biodiversity in “all areas”. However, this target does not define what “inclusive spatial management” is, and the stated aim of reducing loss of biodiversity-rich areas to “close to zero” lacks a definition of what constitutes a high value area, or how “close to zero” one needs to get to meet this target. Definitions of high value ecosystems frequently lack scientific consensus, and of those that are more widely recognised (e.g., Key Biodiversity Areas (KBAs), many are disproportionately reliant on subsets of taxa (frequently birds in the case of KBAs) that do not reflect full biodiversity value (Langout, 2016). Inconsistencies in defining and assessing what constitutes “high priority” means that achieving Target 1 may be challenging for many Parties.

For monitoring, three headline indicators are associated with Target 1. The first indicator relies on the International Union for Conservation of Nature (IUCN) Red List of Ecosystems as a headline indicator; this index, however, only includes a small fraction of global ecosystems with descriptions for only 509 available globally, and no new ones uploaded since 2021 (IUCN, 2023). Given this lack of data for this headline indicator, and the need for expert training to create assessments, how are Parties expected to use it to successfully monitor Target 1, especially as the 28 targets of the GBF are meant to be completed by 2030?

The second indicator for Target 1 is “extent of natural ecosystems” in a given country. This metric fails to account for ecosystem degradation and therefore may not be measurable for many ecosystems. For example, natural grasslands and savannahs can be overgrazed by livestock (which is challenging to monitor via remote-sensing), and understanding their ability to support biodiversity may be problematic. The third indicator covers both land and marine systems using percent of area covered by “biodiversity-inclusive spatial plans”, but this does not require demonstration of implementation or enforcement, and again lacks standards on how biodiversity is defined. Despite advances

in remote sensing technology that confer the ability to provide better indicators which can more accurately indicate the state and extent of ecosystems, Goal A's headline indicators lack sufficient precision for effective implementation and monitoring.

Target 2 focuses on effective restoration of degraded ecosystems. This is an important target since meeting overall CBD goals to 2050 cannot be done without restoring damaged lands (Future Earth & GEO BON, 2022). But Target 2 has no definitions for “effective restoration”, or distinctions between “restoration” and “rehabilitation”. This target requires such definitions to ensure that restoration is genuinely based on ecological principals to prevent, for example, Parties employing such targets to document a numerical increase in tree-cover using plantation monocultures instead of natural forests. The single headline indicator, “area under restoration”, lacks any methodology or core measures to render it operable, thereby failing to satisfy the criteria that were meant to be applied when selecting indicators. Either selecting a single, more narrowly defined type of restoration or rehabilitation (with ecological restoration being likely the most effective for conservation), or using a range of clearly specified types is necessary, and methodologies do exist to monitor progress if a consistent definition of what is within the scope of the target is included (Leadley et al., 2022b).

Target 3, with the goal of expanding lands and waters protection to 30% by 2030, has gained the most attention of any part of the GBF. This target is often framed as the “Paris target for biodiversity”; it was meant to be easy to communicate and measure, and simple enough to be comprehensible across sectors ranging from governments to businesses to the general public. However, meeting this target could be particularly challenging, since it has only one headline indicator (coverage of protected areas and Other Effective Area-based Conservation Measures (OECMs)). Even if it was easy to quantitatively define and measure extent of “coverage”, this metric by itself is insufficient to achieve conservation; ecosystems must also be well-represented, connected to other areas, and effectively managed (Gurney et al., 2021). However, there are no headline indicators to measure these three attributes (CBD, 2022b). Furthermore, the target is divided into terrestrial, marine, and freshwater and coastal ecosystems. This diversity of area types represents unique challenges, as delineating these systems (essential to measure spatial protection) is inherently challenging. For example, even if specific spatial delimiters were agreed upon, measurement would then have to grapple with land reclamation, pollution, and multiple kinds of near-coastal ecosystems—mangroves, marshes, rocky shores, kelp beds and reefs—all of which present their own challenges to protect and monitor. The inclusion of freshwater systems within Target 3, while necessary, is particularly challenging, since streams and rivers are narrow, measuring area-based protection is difficult, and existing river fragmentation from small and large dams represents major risks to biodiversity, even though such developments are often allowed within protected areas (Thieme et al., 2020).

High seas marine ecosystems also represent major challenges. The high seas represent 64% of the global ocean, and yet they fall outside the remit of the CBD and are covered instead under the United Nations Convention on the Law of the Sea (UNCLOS). But UNCLOS has few dedicated resources to monitor high sea

diversity, or enforce rules for protected areas in these regions (Hughes, 2023). The newly negotiated Biodiversity Beyond National Jurisdiction (BBNJ) treaty under UNCLOS will provide, for the first time, coordination of conservation measures for areas outside Parties' economic exclusion zones, and includes a mechanism to delineate and establish marine protected areas (Jones, 2023). This will certainly make the marine component of Target 3 less challenging; however, it is unclear whether ratification will occur in time to allow meaningful application of this treaty to influence Target 3 goals by 2030. Mechanisms and funding to enact this new treaty still need development.

Target 4 deals with preventing extinction of “known threatened species”, using the IUCN Red List as its main headline indicator. Yet the IUCN has not evaluated the majority of non-vertebrate species, and even within vertebrates, many species have outdated assessments (Hughes et al., 2021). Also, many data-deficient species are known to be vulnerable, but since they do not (yet) have “threatened” status, they fall outside the scope of Target 4. This target would be better worded by using “potentially threatened” for “species”, which would encompass organisms that share traits linked to vulnerability, in addition to those that are data-deficient or unassessed. In addition, all GBF indicators are meant to be assessed at least every 5 years, but Red List assessments are only defined as outdated if over 10 years old, and many existing assessments are currently outdated. Thus, at present, the Red List of species should not qualify as an indicator under CBD indicator guidelines.

Target 4 also explicitly mentions “restoring genetic diversity” but it does not provide a baseline. An effective population size of 500 is used as a headline indicator here, but population data is lacking for most species (Moussy et al., 2022). Furthermore, there is no indication of how genetic diversity will be restored (and where that genetic diversity might come from) or monitored, all of which are critical to this target. Target 4 has no population monitoring-based indicators, and population assessments are needed to provide a realistic indicator of species health, including genetic health. Yet as statistics on population decline are used to highlight the magnitude of the issues faced by species, better assessments are needed (i.e., Puurtinen et al., 2022; Murali et al., 2022; Leung et al., 2022; Hoban et al., in review).

Target 5 focuses on wildlife trade, aiming to ensure that all trade “is sustainable”. Yet since most wildlife trade falls outside of the purview of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, it is not subject to monitoring. So, we have almost no data on what species are being traded nor volumes of trade, let alone what impact trade is having on wild populations (Hughes et al., 2023). To purportedly capture *all* wildlife trade, the single headline indicator for this target only focuses on fish stocks. Even wildlife population trends used by IUCN are mostly based on assumed trends rather than data. Of course, the goal of sustainable use can only be met if sufficient data exists and is used to monitor both harvest rates and population trends, as both are needed to assure sustainability. Furthermore, there are statements that “impacts on non-target species should be minimised”, yet since the capture of non-target species is not monitored, this is challenging or impossible to assess and better indicators are needed.

In addition, Target 5 seeks to “respect and protect customary sustainable use by indigenous peoples and local communities” (CBD, 2022d). While the inclusion of such rights is important, care will be needed to ensure that these practices are in fact customary *and* sustainable given that many wildlife populations have decreased and may not be able to sustain historical levels of harvest. Over-exploitation is one of the major drivers of wildlife decline, but mechanisms to understand what is sustainable, and how to develop mechanisms to monitor it are needed (IPBES, 2022). Target 5 also has a complementary annex associated with it (CBD 2022b), however this annex only notes the importance of the target, but lacks additional instrumentation or definitions; this target will be very challenging to implement or monitor.

Target 6 addresses alien and invasive species, yet again the standards for measurement are likely insufficient (Vicente et al., 2021). The sole headline indicator, “rate of invasive alien species establishment”, fails to provide any real framework for monitoring. Most of this target focuses on known “high priority” invasive species, but does not attempt to identify or inventory potential invasive species. Target 6 also aims to reduce rates of introduction and establishment of invasive species by 50% within the next 7 years, but there are no indicators to measure or monitor current rates of establishment. There is also little control of the trade of wild plants or soil in many regions; this means that the movement of potentially invasive plants and soil fauna continues virtually unmonitored. Some regions have programs to attempt to monitor the trade of species to reduce the risk of invasive species and pathogen spread (such as the European Union Traces program), but these programs are quite limited (https://food.ec.europa.eu/animals_en).

Target 7 focuses on pollution, noting risks from a wide variety of sources. It states that pollution should be contained below “harmful levels”, but does not define what level is considered harmful, how to determine that level, and how to measure the impacts. This target also lists “highly hazardous chemicals” without defining what is highly hazardous. Additionally, the goal of “halving” the use of harmful chemicals does not seem to be in keeping with the ambitious tone of the GBF; if chemicals are known to be harmful, then removing them altogether should be the goal.

The two headline indicators for Target 7 focus on pesticide concentration and coastal eutrophication, but provide no basis for measurement. These indicators also provide insufficient information for monitoring progress towards such a broad-based pollution target. Finally, this target has no headline indicator for monitoring reduction in nitrogen use in global food systems, though this pollutant plays a critical role in agricultural and climate impacts on biodiversity and is relatively easy to measure (Rosa and Gabrielli, 2022). Furthermore, there are no proactive targets to prevent the use of new potentially harmful chemicals. Humans have continued to use new chemicals (especially herbicides, pesticides and fungicides) with no proactive measures to assess what ecosystem impacts there might be, and as has been evident with recent neonicotinoid impacts on insects, proactive rather than reactive measures are called for if any agrochemical target is to be effective.

Target 8 (climate change) is one of the empirically weakest of all GBF targets. It has no headline indicator and many elements of the target are unlikely to be realisable. For example, Target

8 states the need to “increase the resilience of the ocean to climate change’, yet without geoengineering, this may be impossible for many ocean ecosystems, though reduction of fishing intensity could boost ocean resilience in some regions (Sumaila and Tai, 2020). However, much of this target is impractical as written and, in general, not measurable or actionable; even dealing with the more achievable elements (such as ending overfishing) requires more detailed guidance. Additionally, it makes no mention of multiple complementarities between climate and biodiversity goals, and whilst some parties may prefer keeping these goals separate, nature-based solutions require synergies, and failing to recognise these can lead to a failure to effectively mitigate changing climate or maintain biodiversity (Zhu et al., 2021; Portner, et al., 2023).

Goals B & C: sustainable use and management of biodiversity and genetic resources

Goal B focuses on sustainable use and management of biodiversity, and includes four targets, all of which include at least one headline indicator.

Target 9 complements Target 5, by looking at the sustainable management and use of wild species. The focus here, however, is on human “sustainable use of resources”. But again, no definition of “sustainable” is provided (or indeed exists; Hughes et al., 2023) and, *in lieu* of this, Parties may provide their own which may facilitate greenwashing under the guise of sustainability. The lack of rigorous and comprehensive criteria is also demonstrated by the two associated headline indicators. One focuses on “benefits from sustainable use of wild-species” with no measures to assess this. The other aims to monitor “percentage of the population with “traditional” occupations; this lacks any real link to ecology or any definition on what constitutes “traditional” (before considering the fact that people should be able to decide on their own descriptors, and that such a target could be regarded as neo-colonial). Given that overharvest is one of the greatest threats to biodiversity (IPBES, 2022), these lacunae in the headline indicators mean that consistent data is unlikely to be collected by Parties, nor negative trends detected. Sustainability should be defined as harvest/collection which does not drive a net loss in the wild population, or population fitness of a species and therefore falls under the maximum-sustainable yield (MSY) of the species. Assessing and implementing the MSY would require the databasing of trade or collection of wildlife (which rarely exists at a national level for species not included within CITES) and population data to monitor populations (Hughes et al., 2023).

Sustainable management, including agriculture, aquaculture, fisheries, and forestry production, is covered by Target 10. This target is particularly important—agriculture, for example, is a primary driver of biodiversity loss and also results in 29% of global greenhouse gas emissions (Delabre et al., 2022). But while this target is critical, it lacks several key definitions including “sustainable intensification”, and “resilience”, making it vulnerable to greenwashing. The two headline indicators also lack definitions of what constitutes “productive and sustainable agriculture” and “progress” toward goals, rendering these

indicators impossible to measure and monitor. For Target 10 to be successfully implemented, a glossary is needed (see [supplements](#)), and more of the intersectional elements between sustainable management and biodiversity protection such as increasing the amount and connectivity of natural habitat within and between agricultural areas are needed as well ([Garibaldi et al., 2020](#); [Grumbine and Xu, 2021b](#)).

Ecosystem services (nature's contributions to the people) are the focus of Target 11. But the single headline indicator, "services provided by ecosystems", lacks a definition and monitoring methodology, rendering it vague and non-quantitative. While the array of services included in this target is ambitious, the lack of quantitative measures make it challenging to implement. This harks back to why many of the Aichi targets were not met ([CBD, 2020](#)). To make this target work effectively, what services are included should be better defined so appropriate measures can be developed. The provision of pollination services, for example, requires different pre-conditions and, of course, very different measures than for slope stabilisation, climate buffering or clean water. Thus, discussions to identify a selection of indicator services would be crucial for this target to work.

Target 12 aims to increase the amount and connectivity of green and blue spaces within densely populated areas. Increases in ecological connectivity across landscapes are important ([Hughes et al., 2022a](#)), but, again, there are few definitions of terms and no quantitative element here. A focus on equitable access for a wide range of people is also missing from this target. Without clear metrics, measuring any form of success is likely to be challenging, especially as the headline indicator does not provide data to bridge these gaps.

Target 13, Digital Sequence Information (DSI) is the sole target in Goal C ([CBD 2022e](#)) and was expected to be one of the most problematic GBF targets based on earlier discussions ([Hughes et al., 2022b](#)). The two headline indicators (monetary and non-monetary benefits) may prove to be challenging to measure. One of the reasons for this is that while the Nagoya Protocol aims to ensure the equitable sharing of benefits from genetic resources, it was designed during a time when materials were physical, and thus the transport of such resources was easier to monitor and manage. Yet the present-day potential for patenting and profits could preclude populations from using, let alone receiving benefits from their own genetic resources. DSI negotiators set out to find a mechanism to allow the transfer of digital sequence information, while protecting the financial and cultural interests of nations and communities where such data originates. Digital sequences form a crucial element of biodiversity monitoring, and are an ever-growing area of research, but the potential for patenting or loss of access to benefits means this target was one of the most challenging to negotiate. Finding a solution is imperative, since improvements in sequencing technology and access to the volume of available data are only going to increase. Target 13 is accompanied with an annex of its own to break down the dimensions behind it, and will be revisited at CBD-COP16. Significant further work is needed to develop the appropriate mechanisms to share the results of these resources, and protect the communities which risk losing out. The current text for this target does not detail mechanisms to accomplish this only providing a placeholder for further discussions at COP16.

Goal D: Enabling conditions and providing resources and capacity

Goal D focuses on capacity and resources to meet the aims of the GBF. This section of the GBF is the most complex with ten targets and ten sub-targets, yet, despite this complexity, only four of ten targets have headline indicators.

Target 14 focuses on integrating, or 'mainstreaming' biodiversity values across policies, regulations, environmental assessment, and planning of all kinds ([Whitehorn et al., 2019](#)). This target emphasizes cross-sectoral integration to prevent the loss of biodiversity as a consequence of development. Target 14 specifically focuses on environmental accounting, and yet, mechanisms for such accounting still lack consensus and therefore provide another opportunity for greenwashing. The rest of this target is vague; there are no quantitative elements and no description of mechanisms to align financial flows with targets of the framework. No headline indicator is provided to measure this target. Overall, this target is essential but, lacking clear standards or requirements around impact assessments, it is difficult to see how it can be effectively implemented (see [Trouwloon et al., 2023](#)).

Financial accounting and monitoring by private sector businesses to ensure regular and transparent assessment of "risks, dependencies and impacts on biodiversity" are key components of Target 15 ([CBD, 2022b](#)). This includes disclosure of nature-related dependencies, provision of information to promote sustainable consumption by the public, and reporting on compliance with access and benefit sharing regulations. This target creates new and ambitious reporting standards for large companies and financial institutions and was supported by many businesses during discussions at COP15 ([White et al., 2023](#)). Yet while the wording of this target appears to be strong, no standardized mechanisms to support these novel disclosures are offered, language is vague, and no timelines are provided. As is the case with many GBF targets, this lack of detail sets up a situation where businesses can use their own terms to define how to implement this target which, at both national and global scales, is likely to create an unruly plethora of implementation pathways. Yet, despite the complexity (and importance) of this target (and sub-targets), only a single headline indicator, number of companies reporting disclosures, is employed.

Given the new realities of the need to extend biodiversity protection beyond conservation lands to include the lifeways and consumption behaviours of people, Target 16 ambitiously promotes sustainable behaviour through education and policies to equitably reduce humanity's global consumption footprint. However, two of the most important behaviours that could reduce this footprint, promoting dietary changes and promulgating national nutrition standards ([Willet et al., 2019](#)), were deleted from the text of this target during final negotiations in Montreal. Target 16 does include reducing food waste by 50% by 2030, but there is no headline indicator to track this, or any other aspect of this target. There are several component indicators that could be moved over to headline status, and this could be accomplished in 2024 at COP16 when the monitoring framework is finalized. Understanding the dynamics of consumption is required to reduce impacts (see [Hughes et al., 2023a](#)), including the role of global supply chains in unsustainable and inequitable consumption ([Liverpool-Tassie](#)

et al., 2020). But Parties at COP15 were not able to capture these and other components of this critical target, leaving it bereft of key elements.

Biosafety and biotechnology distribution and benefits are the focus of Target 17. However, this target is not quantified or targeted in any way (failing to meet the SMART criteria that were meant to be used), and no headline indicators are associated with it. As written in both the GBF and the monitoring framework, and with the contingency of other elements of the CBD (articles 8g and 19 of the CBD), it is hard to see how this target can be successfully implemented.

Reducing perverse, biodiversity-harming subsidies is the main focus of Target 18. Harmful subsidies are currently calculated to be worth at least \$1.9 trillion annually which is equivalent to 2% of global GDP (Koplow and Steenblik, 2022). Target 18 aims to fairly and equitably reduce harmful subsidies by at least \$500 billion a year, starting with “the most harmful” subsidies (CBD, 2022a). But this target does not identify what a ‘harmful’ subsidy is, nor does it specify how Parties may prevent the establishment of new harmful subsidies not included within the scope of the target. Furthermore, with better phrasing this could also link in with biodiversity finance by realigning incentives to fill the major gap in finance needed for biodiversity.

The two headline indicators associated with Target 18 do not go very far to measure success. The indicator “positive incentives in place to promote biodiversity conservation” (CBD 2022c) appears to be mismatched with the overall aims of the target. The second indicator, tallying the economic value of all subsidies that have been eliminated by 2030, does not account for the *value of specific impacts on biodiversity* of these reductions. Finally, Target 18 discounts the profound challenges of removing untold tens of thousands of negative subsidies within some 200 countries, monies that, despite their costs to nature, confer tremendous (short-term) benefits at multiple scales including governments, corporations and households.

Related to Target 15s focus on re-purposing funds away from negative incentives toward positive ones, the goal of Target 19 is to increase overall funding for biodiversity to USD \$200 billion by 2030. Target 19 has seven sub-targets, but most of these lack any mechanism to enable implementation or enforcement. For example, in the context of increasing international financial flows from wealthy to less wealthy countries, asking rich countries to “voluntarily assume obligations of developed country Parties” (CBD 2022c), amounts to wishful thinking (Dempsey et al., 2020). All seven components of this target are important and several could greatly facilitate data mobilisation leading to greater conservation finance. Yet definitions, standards, and implementation guidance are lacking. Furthermore, targets on green bonds have no standards, definitions, or monitoring, therefore providing possible loopholes for greenwashing, yet standards have recently been developed for some aspects (i.e., environmental accounting: SEEA, 2023), and explicit standards are needed to ensure targets can be effective. Conversely, “*impact funds*” (particularly if associated with application of funds for environmental impact assessments) could greatly facilitate data mobilisation and conservation, yet guidance that relates to environmental impact assessment and preventative measures is lacking. None of the three headline indicators for Target

19 are quantitative, though at least the sub-targets for international, and domestic public funding have methodologies. The sub-target for tracking increases in private finance for biodiversity will be very challenging to monitor since these monies are not often publicly disclosed. Furthermore, the sub-target for synergising climate and biodiversity finance targets, which is crucial for both (see Zhu et al., 2021), lacks adequate ecological guidance to prevent offsetting.

Given these gaps in Target 19, it will be interesting to observe how the USD \$200 million goal is tallied up at the end of the decade. It will also be important to think about what mechanisms and enabling conditions may improve the effectiveness of this target. Furthermore, it should be noted that 1); many if not most less wealthy countries are never going to be able to adequately fund their own capacity building and GBF implementation in the short-term out to 2030 and 2); until the Global North decides to act equitably toward the Global South and pay a fair share, these conditions will persist (Obura, 2023). What this means is that the Global North must significantly increase funding for biodiversity to a much greater degree than is in the current targets in the GBF, or face the consequences of an ongoing and deepening biodiversity crises.

The remaining Targets 20–23 focus on capacity building, data sharing and accessibility, inclusive participation for Indigenous Peoples and local communities, and gender responsiveness and equitable participation, especially for females. These primarily social targets are less data-driven, more values-based, and therefore more challenging to measure and monitor. But they are indeed critical to improving equity and the social processes that ultimately surround the CBD and implementation of all targets. Given tremendous variation between countries in how Targets 20–23 are defined, understood, and assigned primary or other importance, it will be challenging to create standards for measuring and monitoring “success”, especially as the GBF text notes this will be done “*in accordance with national legislation*”. The text does not help with this; only one of these four targets has a headline indicator. Implementation will also depend on funds that are not yet available. Despite such issues, these targets are essential for GBF success; they are also indicative of how biodiversity conservation may be finally ready to meet the social-ecological challenges of the 21st century (Gupta et al., 2022). Building capacity is crucial to implementation of any elements of this target, and while this is elaborated on in supportive annexes on capacity building, resource mobilisation and funding, these mechanisms lack necessary details. Finally it is important to note that as well as the headline indicator that “binary indicators” have been agreed for some targets, but as these lack qualitative elements they are unlikely to provide a meaningful index of effective actions or progress towards targets without great care.

Moving forward to improve the GBF framework

As is abundantly clear, most of the GBF targets contain flaws which will likely limit successful implementation by 2030. Based on scoring indicators against SMART criteria (Table 1), and goodness of fit to target, targets 1-3 are ranked some of the highest, followed by target 19 on Finance. Business and biodiversity (T15) and sustainable consumption (t16) scored moderately poorly as did

target 6 on Invasive species, and other targets performed less well. Whilst scores for some target indicators (e.g., T21 on data) were also low, less controversial targets, and those requiring action of NGOs or IGOs rather than governments may also make greater progress, as agreement on how to take forward such targets require fewer actors with lead coordinating roles in biodiversity data aggregation (such as GEOBON and GBIF) and thus may achieve progress despite insufficient detail within the current monitoring framework. In general, a major barrier to implementation is the vague language of the text and lack of definitions of key concepts, thus a glossary providing definitions of key terms would greatly facilitate implementation (Supplementary Table S1). These flaws mean that many of the targets are open to multiple interpretations and misunderstandings that could lead to lack of transparency in implementation and a higher risk of greenwashing. A related issue is lack of baseline data for many basic aspects of biodiversity conservation, and the need to better structure mobilisation of temporally explicit data (such as their inclusion in National Biodiversity Strategy and Action Plans). This is not reconciled in the headline indicators; lack of data impedes the construction of a workable monitoring system, especially on the timescale needed for the GBF. Consequently, no monitoring system can be deployed without national-level biodiversity monitoring systems in place, though many Parties lack this capacity (Perino et al., 2022). Having relatively weak (or no) headline monitoring indicators, or indicators that do not provide the necessary detail to track biodiversity trends increases confusion, adding to implementation difficulties. The current GBF indicators were selected in part because they appeared to be comprehensible and, in many cases, were thought to require less capacity to implement (Hughes, 2023). Furthermore, these indicators were often already known to parties, and many were already available to use, or in use. In fact, the component and complementary indicators often offer better metrics for monitoring; however, the trade-off is that they require more capacity to use, or are less well known and have been insufficiently communicated. However, because these indicators are clearly labelled 'optional' in the GBF, they will likely not be widely employed by many Parties.

Despite these concerns, scientists and conservation experts still have three main avenues to influence implementation of the GBF: First, though the GBF targets are now set in stone after COP 15, the monitoring framework remains provisional (but notes the inclusion of GEOBON essential biodiversity variables (EBVs) as an addition to the main sets of indicators). Thus, development of the EBVs may provide an easier way to update indicators as it is already noted within the framework and provides more flexibility than the core sets of indicators, given that the EBVs can still be developed whilst the rest of the framework is largely finalised. The monitoring framework will not be finalized until COP16 in 2024 (CBD 2022c), and so the unfinished monitoring framework provides the best remaining leverage for scientists to help to strengthen GBF implementation. Strengthening monitoring to enable navigation forward is essential (Gonzalez and Londono, 2022), and it is clear that further discussions on appropriate species-level monitoring standards (and all metrics across all GBF targets) are needed to assess movement toward meeting targets, particularly those falling under Goal A. In fact, if adequate time and resources are not expended now on these issues to the extent

possible, we will be doomed to replay this scenario in 2030. The CBD Secretariat is already forming several groups of experts to provide: 1) input on the monitoring framework and development of indicators prior to COP 16 under the auspices of the Subsidiary Body on Scientific, Technical and Technological Advice (CBD 2022c), primarily through the development of the AHTEG (Ad-Hoc Technical Expert Group) on Indicators by the CBD and, 2) input on strengthening implementation capacity (especially in the Global South) through the Subsidiary Body on Implementation (CBD 2022c). Both of these processes allow for input from experts.

Second, given the number of problems in the GBF outlined in this review, we suggest that scientists focus on the following issues. If most global reports stating population declines in wild species lack consistent long-term data on populations, better and more overarching approaches are needed to monitor species and ecosystem health, along with development of standardised long-term monitoring programs. Similarly, a glossary is urgently needed to clarify definitions of key terms in the GBF and close the many interpretive loopholes that currently exist (see supplements). One partial solution is the suggestion of a global biodiversity observation monitoring system (Gonzalez et al., 2023). By coordinating data collection, developing standards and capacity, such a system could provide the higher spatial and temporal resolutions needed to genuinely measure biodiversity trends; which is crucial for Goals A and B. It should be noted that many current headline indicators do not provide the data needed for monitoring, thus measuring trends (from population to landscape, and for both native and non-native species) such a system would help provide baselines and monitoring data, though obviously other data (such as trade monitoring) would be needed in addition for some indicators to gauge the sustainability of any use of biodiversity.

In revising the monitoring framework there must be a focus on both the actual indicators, and the precision of language, with glossaries and agreed-on definitions to prevent misuse. The importance of clear standards and terminology has been illustrated in many previous UN-related programs, as vague language and a lack of definitions can create loopholes which exacerbate current issues. Previous examples include REDD, where the use "nature-based solution" failed to have sufficient ecological provisions and actually drove deforestation. Yet, similar issues exist in many elements of the GBF; for example, the concepts of "nature positive" and "nature-based solutions" could create loopholes if stronger standards are not applied, as, for example, a monoculture of a non-native species could be proposed as a "nature-based solution" despite the lack of benefits to biodiversity (Hughes, 2023). Furthermore, while Intergovernmental organisations such as IUCN have developed clear guidelines on what nature-based solutions should entail (to ensure that they are virtually synonymous with ecosystem-based solutions (IUCN, 2020)), this is not explicitly referenced within the GBF, meaning that the framework itself remains vulnerable to abuse.

In addition to the need for a glossary to ensure targets and indicators are used as intended, we consider inclusion of the following specific headline indicators to be critical for implementation success.

- For Target 1, (protection of high diversity areas), clearer definitions or mechanisms for identifying high diversity

areas are crucial. The same is true for the indicators used with the Redlist of ecosystems which still only exists for a subset of ecosystems in a subset of countries, with not all following standard guidelines (and the majority of assessments not available). Developing standards and making all data available will be crucial.

- For Target 2 (ecosystem restoration), restoration terms must be clarified and an operable indicator must be selected by COP 16. The Secretariat can reach out to global partners already engaged in large-scale restoration (Van der Esch, et al., 2021) for input and project coordination.
- For Target 3 (implementation of 30 × 30), headline indicators for representativeness, connectivity and management effectiveness on lands and waters must be added to the monitoring framework. It is also critical that the Secretariat address specific definitions and implementation guidelines for OECM lands; this is especially important to accommodate Indigenous Peoples' land and waters (Mitchell et al., 2018; Gurney et al., 2021).
- For Target 4 the IUCN Red List does not meet the criteria needed to monitor implementation; efforts are needed to create standardised approaches for the monitoring of populations, and standard reporting to detect changes in abundances or ranges.
- For Target 5 and 9, monitoring of what species are traded is needed, and this means better national reporting of imports and exports of wildlife, and assessments of populations for species coming from the wild to ensure that such trade is genuinely sustainable. Sustainability requires measures of what is in trade and wild populations, and data is needed for all wildlife in trade for these targets to be met. Here complementarities are possible, for example, the A.5 indicator (populations of over 500 individuals) the selection of species could aim to both be representative, and to focus on species in trade, to provide the baseline monitoring needed to assess vulnerability of species to over-exploitation.
- For Target 7 (pollution), a nitrogen headline indicator should be included.
- For Target 8 (climate change), an adequate headline indicator is needed; it should support strategic planning with other UN bodies specific to future climate impacts on conservation lands and waters as well as food systems out to 2050 and beyond (Brodie and Watson, 2023).
- For Target 16 (sustainable consumption), it is imperative to reinstate dietary change and nutrition guidelines as headline indicators.

Third, scientists should note that one key aim of the 23 action targets of the GBF is to continue making incremental progress toward the CBD's 2050 vision (CBD 2022d). Thus, while achieving GBF goals by 2030 is likely to prove difficult, the framework should nevertheless at minimum lay the groundwork for future targets in 2030 and beyond. Much time was lost in preparing the GBF text for negotiation by Parties due to COVID-19 restrictions on in-person meetings. This was followed by a series of extended meetings where progress was painfully slow. The lesson here is that whatever future constraints may arise, adequate time must be scheduled to finesse goals for better alignment with drivers of biodiversity loss, work on effective and

appropriate indicators, and to overcome the multiplicity of challenges inherent in reaching any international agreement (Hughes et al., 2022a). The 2010–2020 Aichi Targets negotiations taught us that years of discussion can generate good targets, but a lack of consideration of mechanisms means that well-crafted targets may not be implemented. What the GBF process should teach us is that in-person discussions with long timelines are essential for success, and that novel negotiating processes are needed to streamline textual compromise. Furthermore, many stronger elements of the GBF and monitoring framework were lost in the process of discussion. This calls for two key steps in preparing for successors to the current GBF. First, to work hard prior to the meeting to communicate potential key indicators to parties in a comprehensible and straightforward way so they could be understood and integrated into frameworks. Second, every UN convention uses a different approach to develop agreements, and learning from more efficient Party-led negotiations could pave the way to more efficient and effective discussions. One example of this is the IUCN motion development approach where online discussion and text refinement of parties and approved observers occurs before in person meetings, and in person discussions can then focus on more contentious issues where energy can be focused. Such an approach still fits within the voting structure of the CBD but may allow for better communication and a stronger text, and should certainly be considered if we are to learn from the recent negotiations.

Only 7 years exist until the 2030 targets are meant to be completed, and yet many indicators lack the detail to track implementation. Improving indicators in the run-up to COP16 and using what leverage exists through the EBVs, especially with capacity building, may provide an opportunity for better tracking progress for some of the Goal A targets. Additionally, one of the first milestones towards the GBF will be final revision of the GBF monitoring framework in 2024, and while it is unlikely that every revision discussed in this paper will be approved, revisions remain on the table and subject to expert input. Given the unlikelihood of inclusion of new indicators to fill the gaps in the current monitoring framework, assessing which complementary or contingent indicators may be appropriate to provide higher resolution in the short-terms means that partial monitoring data could be obtained for at least some countries. Beyond this, work must start now to address clear mismatches between indicators and targets (Table 1), so that appropriate and effective indicators have been established, and have sufficient National level support from at least some countries to allow consideration for inclusion in the successor to the KM-GBF in 2030. Beyond monitoring, the scientific community, individual experts, conservation organizations, and governments can continue to work to provide a more solid foundation for all CBD decision making, and to work nationally and internationally to enhance engagement with the CBD across all sectors. Furthermore, the choice of some indicators likely reflects a lack of understanding of more complex indicators may have hampered adoption; more active engagement of scientists to communicate with party delegates to help support the process may allow for the selection of better indicators in the process. Providing technical support and developing better processes of discussion and negotiation may yet place us in a stronger position to “halt and reverse global biodiversity loss”, thereby securing a brighter and more sustainable future for life on earth. Whilst success from the GBF is ultimately dependant on implementation, having the ability to monitor progress can guide implementation and enhance our ability to reach goals. Weak or inappropriate indicators reduce our ability to guide

progress towards targets. Thus, learning from this process as well as revisiting and refining indicators may ultimately bolster the probability of reaching the ambitious goals outlined within the GBF.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary Material](#), further inquiries can be directed to the corresponding author.

Author contributions

AH: Conceptualization, Writing–original draft, Writing–review and editing. RG: Conceptualization, Writing–review and editing.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2023.1281536/full#supplementary-material>

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