Making the Monitoring Framework of the Kunming-Montreal Global Biodiversity Framework fit for purpose.

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Abstract

The Kunming-Montreal Global Biodiversity Framework (GBF) is the most ambitious agreement on biodiversity conservation and sustainable use to date. It calls for a whole-of-society approach aimed at halting and reversing the loss of biodiversity worldwide. To support its implementation, the Monitoring Framework of the GBF lays out how Parties to the Convention on Biological Diversity are expected to report their progress. Given the need for capacity-building and investment to operationalize the Monitoring Framework, Parties established an expert group to provide guidance on its implementation, including a gap analysis to identify the strengths and limitations of the Monitoring Framework. We present the results of the gap analysis, highlight where more work on the Monitoring Framework is needed and provide recommendations on implementing and improving it to allow effective and comprehensive tracking of progress across all elements of the GBF's Goals and Targets. We find that using required indicators (headline and binary), the Monitoring Framework fully covers 20% of the Goals' and Targets' elements and partially covers an additional 42%. Including optional (component and complementary) indicators improves full coverage to 24% and an additional 49% partial coverage. For 13% of elements, no indicators are available. While the Monitoring Framework will enable progress towards meeting the Goals and Targets of the GBF, substantial investment is still required to collect the necessary data to compute indicators, infer change, and effectively monitor progress. We highlight both immediate and long-term solutions and offer guidance on important next steps that will progressively improve the efficacy of the Monitoring Framework.

1. Introduction

Since the Convention on Biological Diversity (CBD) was opened for signature at the United Nations Conference on Environment and Development (also known as the 'Earth Summit') in 1992[1], three sequential decadal plans have been adopted to address the alarming rate of biodiversity loss worldwide[2]. The targets for 2010 and 2020 were largely unmet[3–5]. The latest plan, the Kunming-Montreal Global Biodiversity Framework (GBF), adopted in 2022, is the most ambitious to date[6]. The 196 Parties to the CBD agreed to a vision of living in harmony with nature, to be realized through commitments to reach four Goals by 2050 and 23 action-oriented Targets by 2030[6]. The GBF is built around a theory of change that aims to tackle the drivers of biodiversity loss, recognising that urgent, transformative, and widespread action is required across all sectors of society to halt and reverse biodiversity loss.

The GBF includes a Monitoring Framework (Box 1), an important innovation guiding countries on how to report their progress towards the Goals and Targets. The Monitoring Framework sets out how Parties are expected to record their efforts and progress using a set of consistent indicators compiled at the national level[7], while allowing some flexibility due to differing capacity and data availability across Parties[8]. The Monitoring Framework was established to improve transparency and accountability among Parties[9], recognising that failure to reach targets has been linked to low levels of implementation by Parties[10] and difficulties in tracking progress[11]. There is an opportunity for the scientific community to support countries with the design and development of their domestic monitoring frameworks, including how monitoring programs can gather the data needed for indicator updates[12].

The effectiveness of the Monitoring Framework depends on two key aspects: 1) how well its indicators cover the focal elements of the Goals and Targets, and 2) the ease with which Parties can collect the data and information needed to compute indicators. Despite extensive research and use of scientific data and evidence in monitoring biodiversity and ecosystem processes[13–16], significant gaps remain, including in geographic and taxonomic coverage for some indicators[17–22], and a lack of relevant indicators for areas such as biodiversity-relevant measures of human wellbeing[23].

The CBD's Subsidiary Body on Scientific Technical and Technological Advice (SBSTTA) requested a monitoring framework be developed at its 23rd meeting[24]. The early processes of designing the Monitoring Framework occurred alongside the negotiation of the GBF text and focused on selecting indicators from available lists, such as the Sustainable Development Goals indicators[25] and those generated by members of the Biodiversity Indicators Partnership. This resulted in a list of indicators that was then categorized and matched with relevant Goals and Targets. This *post hoc* process resulted in some Targets and Goals lacking indicators. Additionally, the scientific guidance for operationalising the Monitoring Framework followed the political process of selecting indicators (Affinito *et al.*, In review). As a result, the final list of indicators did not fully reflect the needs for monitoring the GBF.

The next national reports, based on the Monitoring Framework, are due in February 2026, ahead of the 17th meeting of the Conference of the Parties (COP17). To meet this ambitious

timetable, Parties established an Ad Hoc Technical Expert Group (AHTEG) on indicators, to assess the gaps and needs of the Monitoring Framework before the COP16 meeting in October 2024. This expert group comprised 45 experts nominated by Parties and observer organisations[26] and was tasked with reviewing all the indicators, producing methodological guidance for implementing the Monitoring Framework, and assessing how well it covers the ambition of the GBF[27]. The AHTEG included experts from diverse scientific, technical, and policy fields as well as Indigenous People and Local Communities (IPLCs) and Youth.

The AHTEG's work began with an assessment of the headline indicators (quantitative indicators to be reported by all Parties, Box 1). The AHTEG worked with indicator developers and custodians to ensure that each headline indicator had a robust methodology, while considering the real capacity constraints, limited data availability, and other challenges faced by many Parties. The AHTEG also developed the methodology to report on binary indicators (qualitative indicators to be reported by all Parties, Box 1). The AHTEG reviewed all component and complementary indicators (optional quantitative indicators, Box 1) for availability of their methodology. Finally, the AHTEG conducted a gap analysis to assess the degree to which the current indicators (headline indicators, their recommended disaggregations, and binary, component, and complementary indicators) cover all substantive elements of the Goals and Targets. While the ease of use of the indicators is improving over time (Figure 1) the existing gaps and limitations have led Parties to keep the Monitoring Framework under review[7], providing an opportunity to critically evaluate its capacity to fulfil its role and identify opportunities to improve its effectiveness and coverage.

To review the Monitoring Framework's coverage, the text of each Goal and Target was split into elements (190 total) that reflect distinct, independently measurable objectives that each need to be achieved for full implementation of the GBF (Methods). For each element, indicators (Box 1) were evaluated and their coverage assessed (Box 2). The AHTEG identified key gaps to fill and made recommendations on improving the Framework[28]. Here we – members of the AHTEG and collaborators in the process – (i) present the results of the gap analysis and review of the cross-cutting issues of the Monitoring Framework and (ii) provide recommendations and (iii) suggest important next steps for effectively monitoring the implementation of the GBF.

2. Results: Improving the Monitoring Framework

2.1 Gap analysis results

2.1.1 Overall coverage

The current Monitoring Framework, including all four indicator types, covers the four Goals and 23 Targets of the Framework reasonably well, with 24% of elements (46/190) fully covered and an additional 49% of elements (94/190) partially covered (Figure 2). The four indicator types combined could offer a good picture of progress made at the global level, leaving far fewer gaps (24/190, 13%) than the headline and binary indicators alone (43/190, 23%). Including these optional indicators reduces the number of gaps by 44%, highlighting the value of component and complementary indicators in broadening the ability of the Monitoring Framework to track progress.

Nevertheless, an important finding is that many of the elements are not covered by the indicators in the Monitoring Framework: that is 10-14/28 (36-50%) for Goals and 40-59/162 (25-36%) for Targets (ranges show values with and without inclusion of component and complementary indicators). The Goals focused on conservation (A) and sustainable use (B) are considerably better covered (90-100% and 67-83% of elements at least partially covered, respectively) than those on benefit sharing (C, 0%) and resourcing (D, 20-60%; Figure 3). Additionally, there are gaps in the coverage of the Monitoring Framework for all three sections of the Targets in the Framework: reducing threats to biodiversity (Targets 1 to 8: 35-47/54, 65-87% at least partially covered); meeting people's needs through sustainable use and benefit sharing (Targets 9 to 13: 15-20/39, 39-51% at least partially covered); and tools and solutions for implementation and mainstreaming (Targets 14 to 23: 53-55/69, 77-80% at least partially covered; Figure 4).

2.1.2 Headline indicators

It is apparent that headline indicators, including their recommended disaggregations, will only allow partial tracking of progress, completely covering 25/190 and partially covering 60/190 elements, and relating to only 16/23 targets (Figures 1, 2 and 3). Excluding their recommended disaggregations (which some Parties, in their review of the AHTEG's report, have argued should be considered optional) reduces the utility of the headline indicators further, limiting their coverage to 15/190 elements completely and 57/190 elements partially. This narrow focus can be mitigated in some cases. For example, expanding geographic or taxonomic coverage through data acquisition and methodological development would help to improve the coverage of some headline indicators (e.g. A.1, A.3 and A.4).

Several headline indicators (e.g. B.1, 2.1, 3.1 and 6.1) have the potential to cover more elements of their specific Goal or Target if additional disaggregations can be developed (e.g. by ecosystem type or gender). In some cases, the current lack of disaggregations results from a methodological challenge, while in others, it is due to data availability. Improving and/or broadening data collection for these indicators would improve the coverage of the Monitoring Framework without the need to develop completely new indicators.

Some headline indicators have been specifically designed following the adoption of the Monitoring Framework (e.g. B.1, C.1, C.2 and 21.1) and have the potential to cover the respective Goals and Targets comprehensively but are not yet fully in place. Committing the resources needed to finalise, test and implement their methodologies would enable the monitoring of targets that currently cannot be monitored (Figures 2 and 3).

Some headline indicators are so narrowly focused that they provide very limited coverage of their target, and component and complementary indicators are needed to track progress effectively. Specifically, Targets 5 and 12 are only sparsely covered due to the narrow focus of headline indicators 5.1 and 12.1 (Figure 4 and Box 2); both are SDG indicators and cannot be extended easily.

Some Targets are likely to require significant effort to fill the gaps identified. Specifically, the headline indicators proposed for Targets 1 and 9 remain hypothetical (Figure 1) and are a high priority for methodological development. In doing so, it may be helpful to identify synergies in data requirements that may simplify indicator compilation. For example, synergies between indicators are possible for Targets 5 and 9 (addressing trade in wild species and benefits derived from the use of wild species, respectively).

2.1.3 Binary indicators

The 14 binary indicators cover 13 Targets, 8 of which have no headline indicator, and will provide a valuable source of information that can be used to rapidly and reasonably assess progress made on taking measures to deliver on Goals and Targets. However, by their very nature, they cannot inform on the realised implementation (e.g. what kind of measures, their breadth or relevance) or outcomes of these measures. As such, they can only track those elements in Goals or Targets that specifically call for actions (e.g. Target 15) and not the elements relating to the results of such actions. Therefore, for all Targets calling for results, and for which only binary indicators are available (Targets 8, 14, 16, 20, 22 and 23), only partial coverage of the elements can be achieved with the current Monitoring Framework (Figure 4). Efforts are needed to design fit-for-purpose quantitative indicators that can support the binary indicators to cover the outcome elements of those targets. Collaboration may help lower the burden of designing new indicators. For example, the UN Women's Caucus and the Global Youth Biodiversity Network are working on indicators that may be suited to report on targets relevant to women and girls (Target 23) and to children and youth (Target 22), respectively.

2.1.4 Complete gaps

For 24-45 elements (13-23%, Figure 2), no indicators are available to track progress. There are three Goals (B, C and D) and 11 Targets (1, 2, 3, 4, 10, 11, 12, 13, 17, 18 and 19) containing elements that cannot currently be monitored under the Monitoring Framework (Figures 3 and 4). For some of these (e.g. D and 12), the gaps are sufficiently significant that new indicators may need to be added to the monitoring framework. For others (e.g. 3 and 13) it might be possible to extend the methods or identify disaggregation options for existing headline indicators to cover the gaps. Other Targets (e.g. 2 and 4) may require specific indicators to complement the existing headline indicators. These additional indicators could come in the form of component indicators specifically addressing the gaps identified (e.g. Target 2: "enhancing ecological integrity and connectivity") or additional straightforward binary indicators may suffice (e.g. Goal D: "adequate capacity-building is secured"). Additional component and complementary indicators could be developed by custodian organisations currently focused on those specific aspects of the Goals and Targets (for example human-wildlife conflict[29]) whereas additional binary indicators could be proposed by Parties and follow the methodology designed by the AHTEG. Alternatively, Parties may choose to include national indicators addressing these gaps within their national context.

3. Recommendations

3.1 Data needs

Many gaps or issues of partial or potential coverage are linked to the availability of data. There are historical reasons behind the incomplete coverage of biodiversity data globally[21,30] which have resulted in poor coverage of many species around the world, especially in tropical regions[31]. As such, improving sampling efforts of biodiversity data is a key priority for monitoring of the GBF. Data collection, archiving, and reporting efforts should follow the FAIR[32] and CARE[33] principles and take advantage of new technology and guidance on designing effective biodiversity monitoring systems to strategically fill gaps and compute indicators[34–37]. They should build on and make use of existing data infrastructures, tools, and community-developed standards that provide well-functioning and evolving mechanisms for sharing and integrating biodiversity data from diverse sources of evidence[38].

Ideally, biodiversity monitoring systems should be designed to integrate *in situ* observations gathered by conventional research programmes, such as long term ecological research networks[16,39,40], or community-based monitoring and information and citizen science efforts[41] with remote sensing data[42] and expert judgement, to take advantage of big data[43] and potential advances in artificial intelligence[44]. To monitor the Goals and Targets of the GBF and link biodiversity outcomes to drivers of change, these data will need to be linked to national census surveys and other relevant physical, economic and social measures. However, gaps exist in these datasets as well and national census surveys specifically may need to be updated to reflect the needs of the GBF. For example, questions on mainstreaming (Target 14) may help address a data-poor section of the Monitoring Framework. One important reason for this poor, and declining[45] biodiversity data coverage is the lack of investment and institutional support for biodiversity monitoring efforts[46]. However, many of the headline indicators are actively developed and supported by international organisations. If resourced, the same organisations can guide data collection, provide capacity-building, and offer support to Parties required to implement these indicators. Additionally, civil society and volunteer efforts to collect biodiversity data provide significant value to states in administrative cost savings[47] and should be promoted and integrated with government-led biodiversity monitoring systems.

Collecting additional relevant data could further allow disaggregation of indicators, which would improve the coverage of the Monitoring Framework. However, it should be noted that there is a difference between asking Parties for more disaggregated data (which would increase the burden of reporting) and overlay of data provided by Parties with information from other sources (which implies more effort in analysis of collated data). Ultimately, the issue of data collection, whether done by Parties or in collaboration with non-governmental organisations, is one of capacity[48]. Resourcing additional data collection efforts will be a significant challenge for many Parties and will require North-South and South-South collaboration as well as financial resources to be made available.

3.2 Methodological needs

The issue of data is linked to the tools and methods currently available to detect trends in biodiversity and benefits derived[49]. Adapting the way biodiversity change is understood to better reflect the data available today is necessary to avoid difficulties in measuring change[50]. Furthermore, the scientific community has not yet come to a consensus on how to understand

and monitor different facets of biodiversity and people's needs[23,51]. Indeed, the needs of the GBF go beyond what might have historically been considered biodiversity data and require that information on drivers of biodiversity change and societal outcomes be monitored. In some cases, this results in the need for entirely novel data collection and analytical methods, such as for financial flows[52] and access and benefit sharing (ABS) indicators[53]. Specifically for ABS indicators, legal frameworks (e.g. the Nagoya Protocol[54]) did not foresee the need to measure societal outcomes but rather national compliance metrics. Thus, the Monitoring Framework now requires new types of biodiversity-related data and analytical methods to enable policymakers to evaluate whether and to what extent the third objective of the CBD is being met.

Integrating across data sources and between social and ecological data is a significant challenge that requires well-designed pipelines and data products that can standardise information and make it usable for indicator calculation (Figure 5). For example, essential variables for biodiversity[55,56] and ecosystem services[57] can standardise multiple data types, enabling the use of analytical pipelines to compile indicators and support further development efforts. Additionally, approaches to integrate Indigenous and local knowledge into scientific processes are improving[58,59] but more remains to be done for these to be systematically applied and fully inclusive[60].

One of the strengths of the Monitoring Framework is that it will enable consistent reporting of indicators by countries, supporting comparisons between countries and aggregation for regional and global synthesis. For example, the AHTEG recommended a consistent approach to compiling and reporting indicators related to ecosystems, their protection, restoration, sustainable use, and status. This would allow the impacts of the actions (e.g. restoration) to be tracked on outcomes, such as extent of natural ecosystems (indicator A.2) and their risk status (indicators A.1 Red List of Ecosystems). The AHTEG recommended using the IUCN Global Ecosystem Typology (IUCN GET)[61], to better address section C of the GBF on the need to adopt an ecosystem approach. The IUCN GET, adopted in March 2022 as an international statistical standard by the UNSC, can serve as the basis for disaggregating ecosystem-related indicators by ecosystem functional group (level 3 in the typology). This would allow a full picture of given ecosystem groups (e.g., coral reefs, or tropical lowland rainforests) within a country, and globally across the indicators.

An important focus area for rapid and systematic indicator calculation is interoperability[62,63]. Designing analytical pipelines that are capable of fully integrating and interpreting data types and meaning[64,65] and of producing indicator calculations will significantly reduce the capacity needs of Parties. Prioritising these efforts for the compilation of headline indicators and sharing code openly to all Parties could significantly reduce the equity and capacity barriers to monitoring the GBF and free up resources for Parties to include additional optional indicators relevant to their needs. Some of the infrastructure to enable this process is already in place[66–68] but additional efforts are required to fully operationalise it.

Finally, accounting for, handling of, and reporting on uncertainty in biodiversity estimates and indicators will be essential to effectively guide decision-making and implementation of the GBF. Uncertainty in trend detection capabilities have shed doubt on understanding of global biodiversity change[69] and on the ability to detect improvement or further decline in biodiversity with a high level of confidence[50]. Using modelling techniques that can learn from each other, such as Bayesian inference, to reduce uncertainty is part of the solution. Another is a robust and rigorous framework for dealing with and reporting on uncertainty in the context in which indicators are to be used[70]. Communicating uncertainty in indicator calculations to decision and policy makers is crucial for the Monitoring Framework to go beyond progress tracking and effectively support implementation.

3.3 A Global Biodiversity Observing System to support the Monitoring Framework

Long-term monitoring to fill data gaps, streamlining indicator compilation, capacity-building and integrating knowledge systems is a global challenge. The GBF is a common endeavour, one that, although Party led, requires nations, and stakeholders within them, to work together[71]. Recognition of this need by COP prompted a fast-track assessment by IPBES on monitoring biodiversity and nature's contributions to people to assess current capacity, identify needs and suggest solutions[72]. One solution is to support international cooperation by establishing a Global Biodiversity Observing System (GBiOS). A GBiOS would support the implementation national biodiversity monitoring networks[34,37,73,74] while assembling an international system similar to that used to monitor the oceans (i.e. the Global Ocean Observing System) or trends in climate and weather (WMO Integrated Global Observing System) that benefit all countries[75]. Following this model, GBiOS would therefore exist as a federated international network of existing and new national monitoring systems[63,74]. Over time, GBiOS would allow multilevel assessments of trends in different facets of biodiversity (genetic, species and ecosystem) that could contribute to calculating indicators and the use of robust models needed to assess policy scenarios. Making GBiOS a reality requires (i) a sustainable and inclusive governance model, (ii) a funding mechanism to support Parties looking to invest in their national biodiversity observation networks, and (iii) the human capacity and technical infrastructure required for GBiOS to operate worldwide[28]. When brought together with other knowledge types, including Indigenous and traditional knowledge, scientific expert judgement, socio-economic data, and information on governance and regulation, a GBiOS could generate the information needed to guide investments in policy actions to meet the Goals and Targets of the GBF.

3.4 Capacity needs

Capacity is a major barrier to the ambition and implementation of the Monitoring Framework. No Parties are currently able to compute all of the required indicators in the Monitoring Framework. Two essential enabling conditions to deliver on the objectives of the Convention are to provide appropriate funding for its implementation and to promote collaboration and technology transfer[76]. Failure to do so appears to be a major barrier to monitoring the GBF[77] and the additional burden that the Monitoring Framework places on Parties is a significant barrier to its ambition. There is a risk that the gaps in the Monitoring Framework will remain and worsen if Parties do not implement it fully due to lack of capacity.

Issues of equity are particularly relevant in this context as areas with the most biodiversity are often those with the least capacity to monitor its status[78] yet the Convention also recognises the right of nations to develop[76]. As such, there is a need to enhance collaboration via North-South, South-South, and triangular cooperation and via international programmes that take into account the differences in capacity needs and responsibilities of Parties[79]. Additionally, the implementation of benefit sharing agreements under the CBD and its Nagoya Protocol may help build capacity from more developed countries towards those Parties where the genetic resources are being sourced[80]. However, some experts have argued the opposite may occur if ABS legislation is overly burdensome or bureaucratic[81].

3.5 Cross-cutting considerations

Section C of the GBF outlines the cross-cutting topics to be considered in its implementation. It asks that the implementation of the GBF be consistent, inter alia, with the rights and contributions of IPLCs, different value systems, human rights, gender, intergenerational equity, and human health[7]. The considerations in Section C are partly, but not wholly, addressed by the existing Monitoring Framework and its headline and binary indicators. No indicators were specifically designed nor included to measure progress towards Section C. However, the current headline and binary indicators can be used as informative proxies. Indeed, some indicators are particularly relevant (e.g. 9.1, 14.b, 22.b and 23.b) or require that additional data be collected to allow relevant disaggregation (e.g. for IPLCs/women/youth for A.1, B.1, C.1 and C.2). In many cases, the necessary disaggregation of headline indicators is not yet possible to show how the cross-cutting aspects of the GBF are being delivered. Specifically for IPLCs, the four traditional knowledge indicators[82] could be used to complement the headline and binary indicators. Within the Monitoring Framework, the traditional knowledge indicators are component or complementary indicators for certain targets and can provide a basis for disaggregation of existing headline indicators (e.g. for indicator 3.1 by disaggregating spatial headline indicators by Indigenous and traditional territories).

A human rights-based approach to monitoring has well-established guidance, methodology, and indicators[83,84]. This approach is applied to monitoring of the traditional knowledge indicators and could be extended to the whole Monitoring Framework. Additionally, to meet existing commitments, particular attention is needed to address disaggregation by gender, age, disability, IPLCs, education, and socio-economic status. Although data availability may limit the use of disaggregated data in the next national reports, the gaps, priorities, and opportunities for data disaggregation and participatory approaches should be identified and advanced to improve future monitoring and resulting management action.

The broad nature of the GBF requires a correspondingly broad range of information sources, and diverse sources also help bridge the capacity gap for more comprehensive monitoring. The Monitoring Framework invites Parties and relevant organisations to support community-based monitoring and information systems (CBMIS). The contribution of CBMIS to monitoring progress and achieving biodiversity targets is now well documented[85]. Some community-based monitoring tools implementing a human rights-based approach, such as the Indigenous Navigator[86], are already operational. CBMIS provide cross-cutting data and knowledge useful

for monitoring multiple Targets and Section C[87]. Specifically, CBMIS collect data in remote areas where gaps are common even for well-developed indicators. Additionally, CBMIS often provide traditional knowledge that can be invaluable in promoting conservation outcomes and the implementation of the GBF[59,88]. Furthermore, CBMIS are typically community focused and reflect the needs and priorities of their members as well as different value systems[89]. Typically, CBMIS also collect additional information on health and human rights outcomes. As such, these monitoring systems should be an integral part of data collection efforts wherever they exist. Finally, community-based monitoring efforts in collaboration with scientists have proven to be a cost-effective way of furthering understanding and management of biodiversity[90,91] and therefore should be supported by all Parties.

Nevertheless, there is a need for more work to be done across all the cross-cutting elements of Section C as gaps remain in our understanding of how these topics interact with biodiversity. This was not assessed in detail in the gap analysis and remains an open area for research.

4. Going forward

4.1 Reviewing and updating the Monitoring Framework

The work of the AHTEG, in collaboration with many organisations and individuals, has significantly improved the readiness level of existing indicators and the ability of Parties to use the Monitoring Framework to track progress towards the ambitions of the GBF (Affinito *et al.*, In review). Work on improving those indicators currently in the Monitoring Framework should be encouraged and appropriate organisations resourced. Following the next round of reporting, there will be an opportunity at COP17 to review how the Monitoring Framework was operationalised at the national level, by reviewing what was reported by Parties, and considering whether it needs further development. This engagement is key to the success of the Monitoring Framework.

The Monitoring Framework is expected to be kept under review, providing an opportunity for updates and improvements. A formal process of update and review for the Monitoring Framework, akin to the annual refinement and quinquennial comprehensive review of the Sustainable Development Goals indicators[25], but focusing on updating the list of indicators as well as their methodology, could be established to fill gaps and improve the Monitoring Framework. Such a process could learn from the AHTEG and include experts and stakeholders representative of the GBF with a clear mandate and resources to update the Monitoring Framework.

4.2 Resourcing and capacity-building priorities

The most likely barrier to a successful implementation of the Monitoring Framework is one of human and financial capacity. Without the resources to implement the required indicators in the Monitoring Framework, many Parties will not be able to report on them and the gaps will remain unfilled — thus, uncertainties about progress under the GBF will persist. Through COP decisions, Parties have committed to prioritising biodiversity planning and monitoring nationally. Financial resources are now needed to establish and strengthen national and regional monitoring frameworks. These resources should be used to build nationally relevant

biodiversity observation systems with the people, technologies, and knowledge systems needed to implement the Monitoring Framework.

The challenge in funding monitoring will be particularly acute for those Parties with the least resources, for which multilateral and innovative sources of funding may be required. Private and public cooperation, through blended finance for example[92], can potentially help mobilise some of these funds. While governments will need to invest more into monitoring, private sector actors also have a role to play in enhancing funding levels and deploying innovative solutions. Around half of the world's GDP is moderately to highly dependent on biodiversity[93], meaning that private companies and financial institutions have a considerable stake in this issue. Direct engagement of the private sector in supporting biodiversity monitoring efforts[94] must respect the rights of all communities involved and ensure that all data are collected fairly and equitably.

Finally, beyond national efforts, global cooperation is required to resource the organisations acting as custodians for indicators. This is essential for the full development of indicators and their disaggregation, and for increasing the coverage of fit-for-purpose indicators that support the effective implementation of the Monitoring Framework over the long-term.

5. Conclusion

The Monitoring Framework has been improved greatly since it was first reviewed[95]. Its implementation through the national reports expected in 2026 will provide a first opportunity to gauge its ability to track progress towards the GBF. A technically perfect Monitoring Framework, without gaps, is not currently achievable because all Parties face practical constraints: technical, financial and social, to what can realistically be monitored. Scientists have a role to play in developing missing indicators and providing data-informed workflows required to lower the barriers to the implementation of the Monitoring Framework. The Monitoring Framework is a good tool for tracking progress and guiding action towards the objectives of the CBD. Its effectiveness will, however, depend on the funding committed to its implementation and improvement.

The onus of implementation now sits with Parties, which must weigh multiple priorities. Mainstreaming biodiversity knowledge and monitoring across sectors and policies is likely to be the most effective way to promote the outcomes of the GBF[71,96]. One such opportunity is to promote synergies between the CBD and the global climate agenda[97]. Climate monitoring systems are more advanced than those of biodiversity yet both crises are closely linked[98,99]. For example, nature-based solutions are an important component of climate policy[100]. There are many synergies between monitoring both climate and biodiversity; connecting them would improve understanding of biodiversity change and support efficient data collection efforts[74]. Taking advantage of the capacity and knowledge already built in the climate space may also further the implementation of national and global biodiversity observing systems. Other sectors, such as those carrying out environmental impact assessments, also produce important knowledge and could contribute to monitoring of outcomes under the GBF[101]. Multiple avenues therefore exist to boost capacity or lower the barrier to implementation for Parties.

The Monitoring Framework will be essential to delivering on the ambition of the GBF by 2050. It should be considered a global learning mechanism, allowing enough flexibility for Parties to meet their objectives while sharing progress and experiences globally to improve outcomes for the whole of society. The achievement of the GBF Targets for 2030 and the Vision and Goals for 2050 depends not only on the comprehensive and effective implementation of policies and actions but also on effective implementation of the Monitoring Framework and use of the trends detected to adapt interventions.

6. Methods

6.1 The work of the AHTEG

6.1.1 Headline indicators

Methodologies for compiling headline indicators were reviewed, revised, or, in some cases, developed *de novo* by the AHTEG, in consultation with relevant organisations and experts. Metadata covering the rationale, methods, available data, and possible disaggregations for compiling each indicator are available for all headline and binary indicators agreed at COP15 except for two (Figure 1)[102].

The work of the AHTEG started with the evaluation of the metadata for each indicator by sub-teams of experts on each topic. The existing metadata for each indicator was assessed for completeness and whether it clearly reflected the latest guidance and methodology for indicator calculation. This also involved assessing whether the data required to calculate the indicator were freely available for all countries. Shortfalls in methodology, data, and the description of the indicator were considered and documented for each indicator.

6.1.2 Binary indicators

The selection of questions and evaluation of potential answers involves careful consideration if binary indicators are to provide meaningful metrics of progress towards the Goals and Targets. The AHTEG reviewed the proposed text of binary indicator questions and answers to produce Goal and Target specific guidance on interpreting questions and answers. This guidance is outlined in the metadata of each binary indicator[102]. Additionally, the AHTEG developed a methodology to aggregate responses across questions using mutually exclusive answer combinations to produce an overall score for each Party that can be used to track global progress towards implementing the measures required to deliver on the GBF.

6.1.3 Qualitative cross-cutting considerations

Section C of the GBF outlines a set of "cross-cutting" topics to address in the implementation of the GBF and which are relevant to the Monitoring Framework. Some of these cross-cutting considerations (namely human rights, gender, IPLCs, and the ecosystem approach) were reviewed by the AHTEG within the context of the Monitoring Framework and its indicators. Specific guidance was provided for considering human-rights and ecosystem approaches and how these could be implemented within the Monitoring Framework. Current limitations in the ability of the Monitoring Framework to track progress towards the cross-cutting considerations were also assessed.

6.2 Gap analysis of the Monitoring Framework

6.2.1 Mapping out the ambition

The goals and targets of the GBF reflect its considerable ambition. The text of each Goal and Target is often long and complex, containing multiple clauses that are all important to deliver on the ambition of the GBF. To enable a comprehensive and holistic analysis of the Monitoring Framework's ability to track progress towards the whole GBF, the text of each goal and target was divided into a set of distinct elements. Elements were defined as those components of the Goal or Target that would need to be measured and reported independently to evaluate whether the Goal or Target had been fully achieved. The rationale for this approach built on the methodology used to assess progress made towards the Aichi Biodiversity Targets, which concluded that none of the targets had been fully met, but some had been partially met based on achievement of one or more elements within those targets[5]. The elements were defined exclusively by the text of the Goal or Target, without the relevant considerations from Section C of the GBF.

This exercise was done in two steps: a first proposal of the elements by one member of the AHTEG was reviewed by all AHTEG members, who made suggestions for further splitting Goals and Targets into additional elements, based on the broad knowledge of different aspects of the GBF from among the experts in the group. A consolidated list of elements was agreed in this manner (Supplementary Table 1). This process was run for one month, after which other stakeholders were invited to comment on the elements of goals and targets relevant to them: specifically, the Liaison Group on the Cartagena Protocol for Target 17, the Informal Advisory Group on Technical and Scientific Cooperation for Target 20 and the Technical Expert Group on Financial Reporting for Goal D and Targets 18 and 19. Due to the complexity of the language of some Goals and Targets, incorporating multiple commitments including both actions and outcomes, the number of elements for each varied considerably. For example, Target 12 contains 8 such elements (Box 2; see Supplementary Table 1 for the complete list of elements for all Goals and Targets). The number of elements ranged from 4 for Target 23 to 14 for Target 22, with a median of 6 and a total of 190 elements across all Goals and Targets (Supplementary Table 2).

6.2.2 Assessing coverage

The indicators in the Monitoring Framework were then mapped to the elements of each Goal and Target to identify how comprehensively the GBF could be monitored, which elements were not covered by the headline or binary indicators, and which were also not covered by any component or complementary indicators (Box 2). The results and detailed explanations for the coverage status of each element were made available to Parties ahead of SBSTTA26[28].

This process was conducted in two steps: first, a survey shared with all AHTEG members prior to the AHTEG's 6th meeting in Cambridge (March 2024) and second, a working session at that meeting.

The focus of the survey was broadly to identify where the headline and binary indicators aligned with the elements of the goals and targets and where component and complementary

indicators might support monitoring of the elements. Respondents were asked to select which elements could be monitored using each headline and binary indicator in turn, then given the option to repeat this for any complementary or component indicator of their choice. At this stage, respondents did not have access to the updated metadata and list of component and complementary indicators. As such, respondents were specifying whether the intent and concepts behind the indicators could map on to each element rather than realised indicators with methodology. Therefore, the survey results were not used to report on the gaps in the Monitoring Framework but rather to guide the in-person session in Cambridge.

In Cambridge, AHTEG members were asked to split up into self-directed groups of expertise, focusing on specific goals and targets. Within each group, AHTEG members were asked to review all the goal or target elements individually. For each element, groups were asked to specify if a headline or binary indicator is available to monitor the element. When a headline or binary indicator was assigned to an element, groups were asked to specify whether the indicator:

- Covered the element, i.e. it can inform progress on the element.
- Partially covered the element, i.e. it can inform progress on some of the element.
- Potentially covered the element, i.e. it may be able to inform progress on the element, but the indicator is still in development and/or has not been tested.

The current data coverage of the headline indicators was not evaluated, but rather their design based on the metadata. For each of these categorisations, participants were asked to provide an explanation (justification and caveats) about their choice and specify whether a specific disaggregation of the indicator is required to inform progress on the element. For elements where no headline nor binary indicator could inform progress, participants were asked to suggest component or complementary indicators that may be appropriate to inform on progress towards these elements.

This process was repeated after the meeting in Cambridge for specific indicators that had not received sufficient attention during the meeting. These subsequent exercises were conducted with AHTEG members for targets 14 and 16, with the Technical Expert Group on financial indicators for goal D and targets 18 and 19 and with relevant members of the Secretariat for targets 17 and 20. Following the SBSTTA's 26th meeting in Nairobi (May 2024), the results of the gap analysis were updated to reflect the new language of the binary indicators[103].

6.2.3 Limitations

It is important to acknowledge that although the gap analysis was conducted by experts, many of whom were actively involved in the design of the methodology for indicators and the overall Monitoring Framework, the results reflect their opinions at the time the exercises were carried out. A repeat of this process with different individuals having access to the same information may have yielded somewhat different results. However, few, if any, people were more well-versed in the Monitoring Framework than the AHTEG when this work was conducted, and their opinion was recognised and used as the basis for decision-making and recommendations

to COP16 by SBSTTA 26[104]. As such, this is the best information available about where the Monitoring Framework stands and what is needed going forward.

7. References

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Figures & Tables list

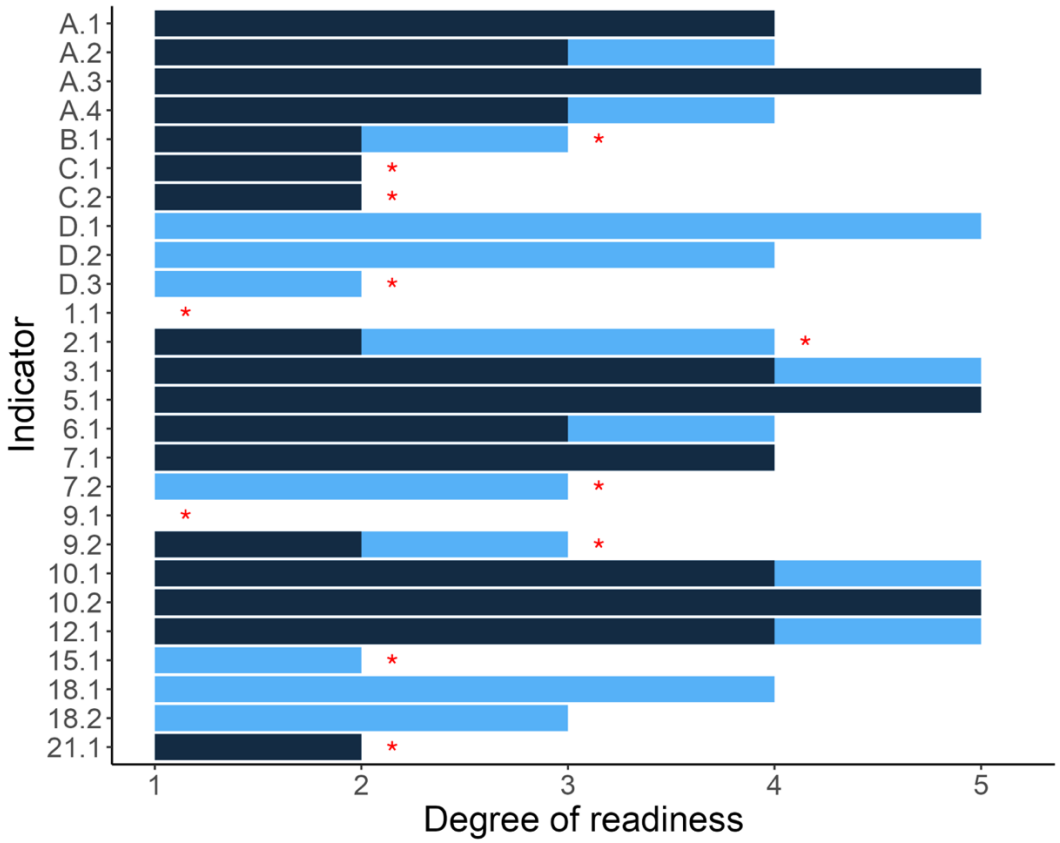


Figure 1. Degree of readiness of the headline indicators for the Global Biodiversity Framework. Dark blue bars show the readiness level at the time of COP15 (December 2022), and light blue bars show the level in June 2024 (i.e. reflecting progress since COP15). Asterisks identify indicators that lacked an agreed methodology when they were adopted at COP15[7]. Readiness was scored as: 1. Methods not yet developed, and a process needs to be established to develop them. 2. Methods not yet developed but a process is underway, led by one or more organisations, to develop them. 3. Methods developed (or partially developed) and tested/piloted, but data not yet widely available (and/or collection not yet underway). 4. Methods established, data being compiled and indicator operational in at least some countries, but further investment in methods ongoing and/or further data collection required. 5. Methods established, data being compiled and accessible, and indicator operational for most/all countries.

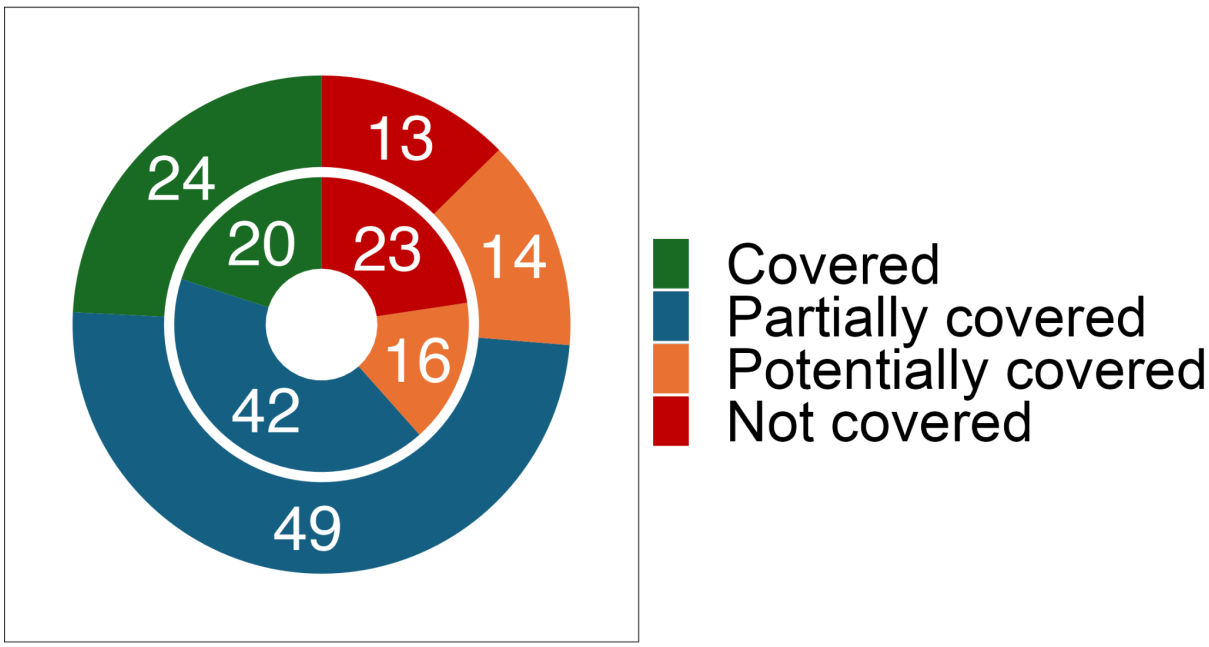


Figure 2. Overall coverage of elements of the goals and targets of the GBF by indicators in the Monitoring Framework. The inner circle shows coverage by the required headline and binary indicators (including the recommended disaggregations of the former), while the outer circle shows coverage by these indicators as well as the optional component and complementary indicators. Numbers represent the percentage of elements with each score for coverage. 'Partially covered' applies to elements for which the indicator(s) reflect some aspects of the element, but not all. 'Potentially covered' applies to elements that could be covered by indicators that are still in development, so there is uncertainty as to whether the final metric(s) produced will adequately cover the element. 'Not covered' means that no indicators (headline, binary, component, nor complementary) are available to monitor the elements.

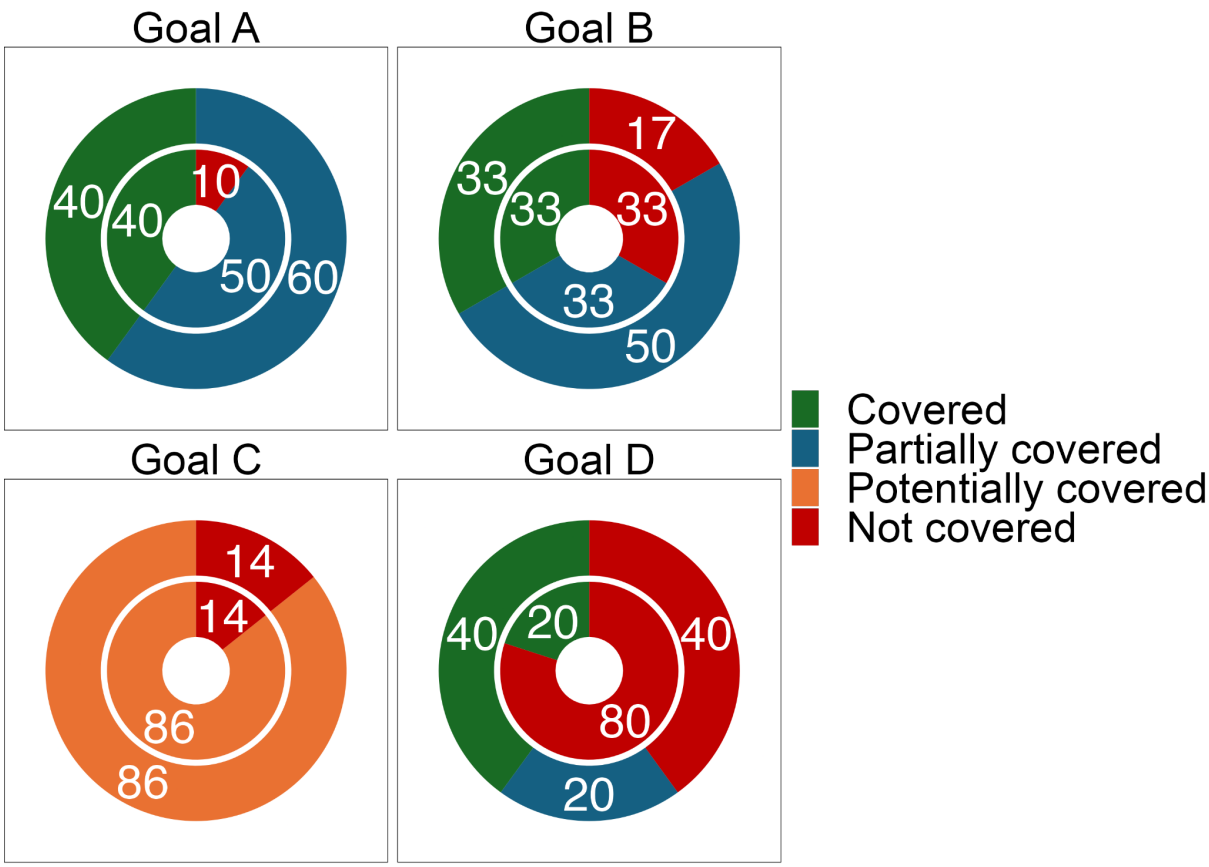


Figure 3. Coverage of elements of each of the four Goals of the GBF by the indicators in the Monitoring Framework. The inner circle shows coverage by the required headline and binary indicators (including the recommended disaggregations of the former), while the outer circle shows coverage by these indicators as well as the optional component and complementary indicators. Numbers represent the percentage of elements with each score for coverage. 'Partially covered' applies to elements for which the indicator(s) reflect some aspects of the element, but not all. 'Potentially covered' applies to elements that could be covered by indicators that are still in development, so there is uncertainty as to whether the final metric(s) produced will adequately cover the element. 'Not covered" means that no indicators (headline, binary, component, nor complementary) are available to monitor the elements.

Figure 4. Coverage of the elements of each of the 23 Targets of the GBF by the indicators in the Monitoring Framework. The inner circle shows coverage by the required headline and binary indicators (including the recommended disaggregations of the former), while the outer circle shows coverage by these indicators as well as the optional component and complementary indicators. Numbers represent the percentage of elements with each score for coverage. 'Partially covered' applies to elements for which the indicator(s) reflect some aspects of the element, but not all. 'Potentially covered' applies to elements that could be covered by indicators that are still in development, so there is uncertainty as to whether the final metric(s) produced will adequately cover the element. 'Not covered" means that no indicators (headline, binary, component, nor complementary) are available to monitor the elements.

Box 1. The structure of the Monitoring Framework

Indicators

The Monitoring Framework relies on five types of indicators designed to track progress towards the Goals and Targets of the GBF[7]. In the context of the CBD, indicators can be defined as "a measure based on verifiable data that conveys information about more than itself"[105]. These indicators include headline and binary indicators (which Parties are required, and expected, to report on), component and complementary indicators, and additional nationally relevant indicators (which are optional). Through the structure provided by its indicators, the Monitoring Framework enables much greater standardisation of the outputs expected from Parties in their national reports, compared with previous reporting rounds, marking a paradigm shift.

Headline indicators are a minimum set of high-level indicators intended to capture the overall scope of a Goal or Target. There are a total of 24 headline indicators in the framework spread across the four Goals, and 15 of the 23 Targets. Headline indicators are quantitative measures of process and/or biodiversity outcomes relevant to each Goal or Target. These indicators are calculated from data mostly collated at the national level but can be aggregated or disaggregated to provide more in-depth information - for example by taxonomic group for species-related indicators, or by sectors of society (e.g. gender and youth). In some cases, these data are obtained from third-party multilateral data aggregation tools, such as the World Database on Protected Areas. Headline indicators each have between 2 and 21 disaggregations recommended by the AHTEG and described in the metadata for each indicator.

Binary indicators are qualitative measures of the efforts made by Parties to deliver on the GBF. These indicators are compiled from a set of questions to be answered by Parties and aimed at understanding the progress made towards implementing measures, processes, and legislation to deliver on the ambition of the GBF[102]. The answers to the set of questions are used to assign an overall score (from 0 to 5, showing an increasing level of implementation) for each binary indicator, providing valuable information about the progress made by Parties in facilitating and promoting the outcomes of the Goals and Targets. These indicators are simpler in design than headline indicators and are more readily compiled.

Component and complementary indicators help monitor progress made towards the Goals and Targets, beyond the information provided by the headline and binary indicators. There are currently 55 component and 124 complementary indicators spread across all of the Goals and Targets[103]. Component indicators are intended to cover elements of the Goals and Targets that are not covered by headline or binary indicators. Complementary indicators support more in-depth thematic analysis of the Goals and Targets.

Finally, national indicators include any additional indicators that Parties have established or developed, which they may choose to compile and report on, supplementing the other indicators. These national indicators may be relevant to the specific context of a Party and provide additional information on progress.

National reports

Regular national reports presented by Parties provide information on measures taken in support of the Convention's objectives and their outcomes. Six rounds of reporting were completed between 1994 and 2020; the seventh and eighth national reports are due in 2026 and 2029 respectively (Article 26[76]). In the upcoming national reports, Parties are required to report on the headline indicators using data assembled through biodiversity and ecosystem monitoring networks and relevant agencies, and to provide responses for all binary indicators. Where indicators are generated by international bodies using local, national, regional, and/or global data, the values for each country will be pre-populated in national report templates. Parties can choose to use these values or replace them with their own where appropriate. Parties may further choose to include any additional optional indicators. Using the information submitted in national reports, through the online reporting tool[106], the CBD Secretariat will be able to compile and track progress towards the GBF at the global level, for example in the global report[107] on collective progress in the implementation of the GBF, due in 2026.

Box 2. Gaps in indicators for Target 12

Here, an example for Target 12 shows the separation of the target into its individual elements and coverage by indicators. The specific emphasis of each element to be monitored in the Monitoring Framework is highlighted in **bold**. This target contains eight (a–i) distinct elements that reflect its ambition to transform the relationship between cities and biodiversity. All other targets were similarly assessed in the gap analysis. Target 12 has a headline (12.1), binary (12.b), and component (CBI[3]) indicator. Headline 12.1 was adopted by Parties in part because it is an SDG indicator with a development team and host organisation based at UN-Habitat. This headline indicator however falls short of measuring change in most elements included in Target 12 because it only quantifies access to green spaces, which partially informs on element 12e and could provide some information on 12a. Indicator 12.b further tracks the existence of measures in place for biodiversity-inclusive urban planning, enabling monitoring of 12g. The other elements of Target 12 are not covered by its headline or binary but some (12a, b, f , and h) could be monitored for those Parties choosing to report on the component indicator. Overall, monitoring of progress on Target 12 under the Monitoring Framework is therefore only currently guaranteed for one element, partially feasible for one element, potentially feasible and dependent on Parties' good will for four elements, and not possible for two elements. In this case, the component indicator for Target 12 appears theoretically superior to its headline indicator but is not supported by any custodian organisation and requires a large amount of data which is unlikely to be available in most cities. It is worth noting that the City Biodiversity Index was not a component indicator in the originally negotiated Monitoring Framework but was recommended as such by the AHTEG.

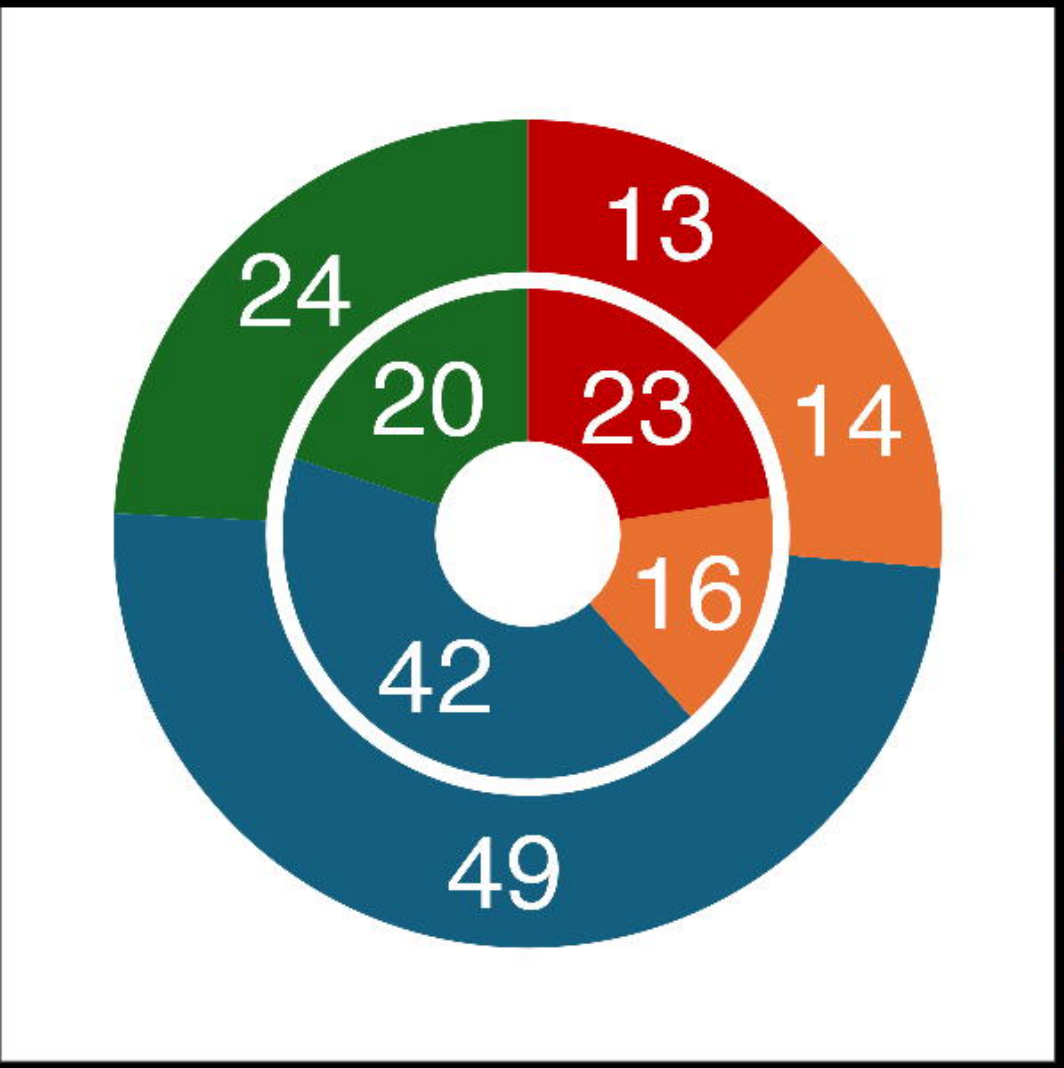
Target 12: Significantly increase the area and quality and connectivity of, access to, and benefits from green and blue spaces in urban and densely populated areas sustainably, by mainstreaming the conservation and sustainable use of biodiversity, and ensure biodiversity-inclusive urban planning, enhancing native biodiversity, ecological connectivity and integrity, and improving human health and well-being and connection to nature and contributing to inclusive and sustainable urbanisation and the provision of ecosystem functions and services.

Target 12 elements	Mandatory indicator(s)	Coverage	Optional indicator(s)
12a. Significantly increase the **area of green spaces in urban and densely populated areas**	12.1[1]	Potential	CBI[3]
12b. Significantly increase the **area of blue spaces in urban and densely populated areas**			CBI[3]
12c. Significantly increase the **quality of green and blue spaces in urban and densely populated areas**			
12e. Significantly increase the **access to and benefits from green and blue spaces in urban and densely populated areas**	12.1[1]	Partial	
12f. **Mainstream the conservation and sustainable use of biodiversity in urban and densely populated areas**			CBI[3]
12g. Ensure **biodiversity-inclusive urban planning** contributing to inclusive and sustainable urbanization and to the provision of ecosystem functions and services.	12.b[2]	Complete	
12h. **Enhance native biodiversity in urban and densely populated areas**			CBI[3]
12i. **Improve human health and well-being and connectedness to nature,** through biodiversity-inclusive urban planning			

[1] Headline indicator 12.1 is based on SDG indicator 11.7.1 which measures the share of land allocated to public spaces and the total population with access to these spaces by age, gender, and disability.

[2] Binary indicator 12.b tracks the number of countries with biodiversity-inclusive urban planning referring to green or blue urban spaces.

[3] The City Biodiversity Index is built on a score of 28 indicators measuring different aspects of a city's biodiversity and relationship to biodiversity [45].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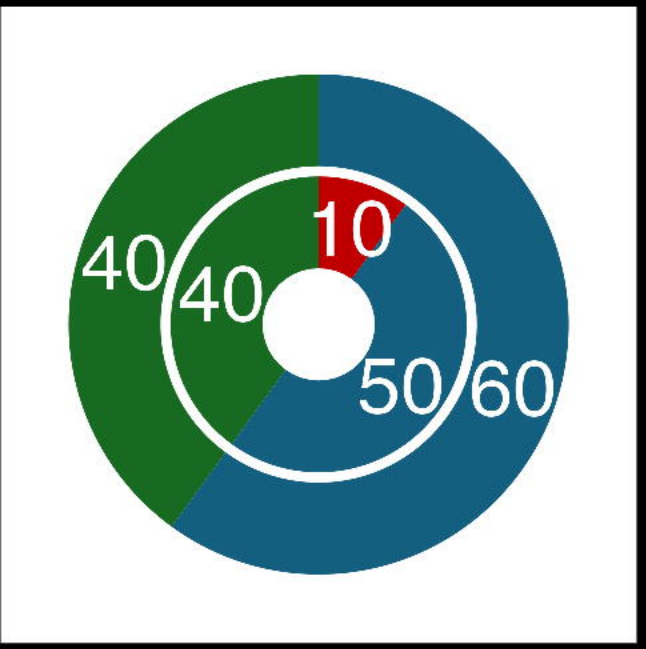
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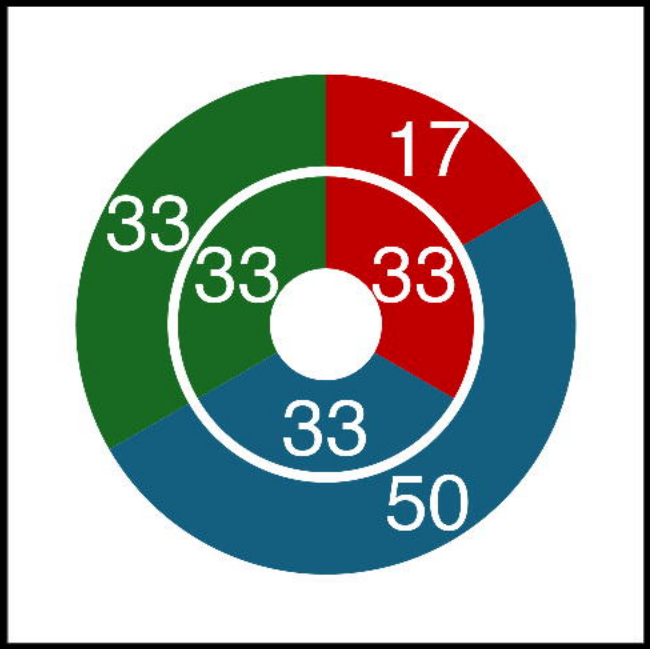
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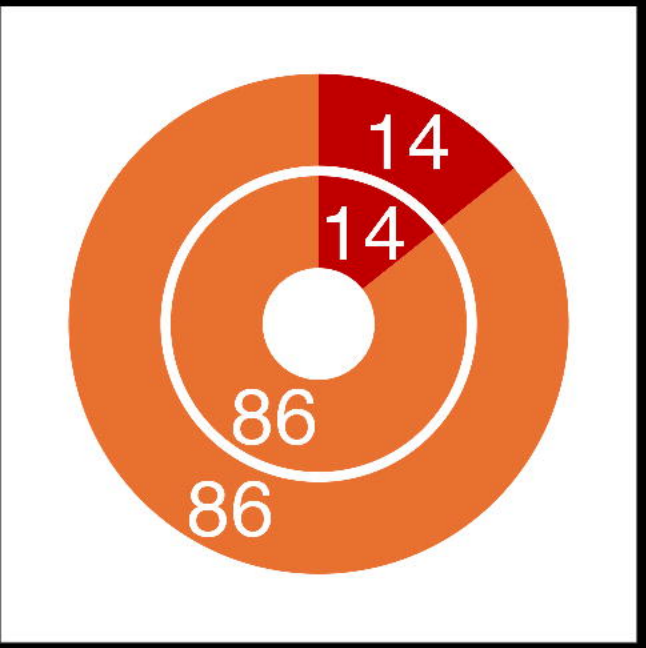
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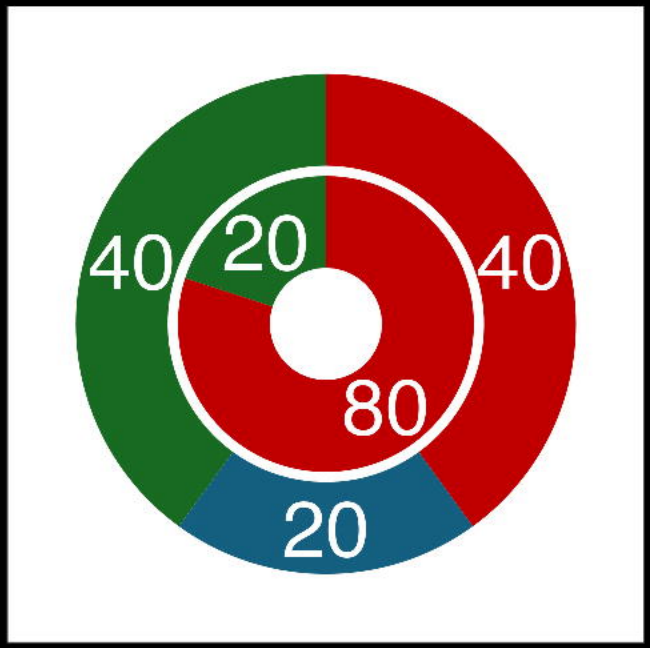
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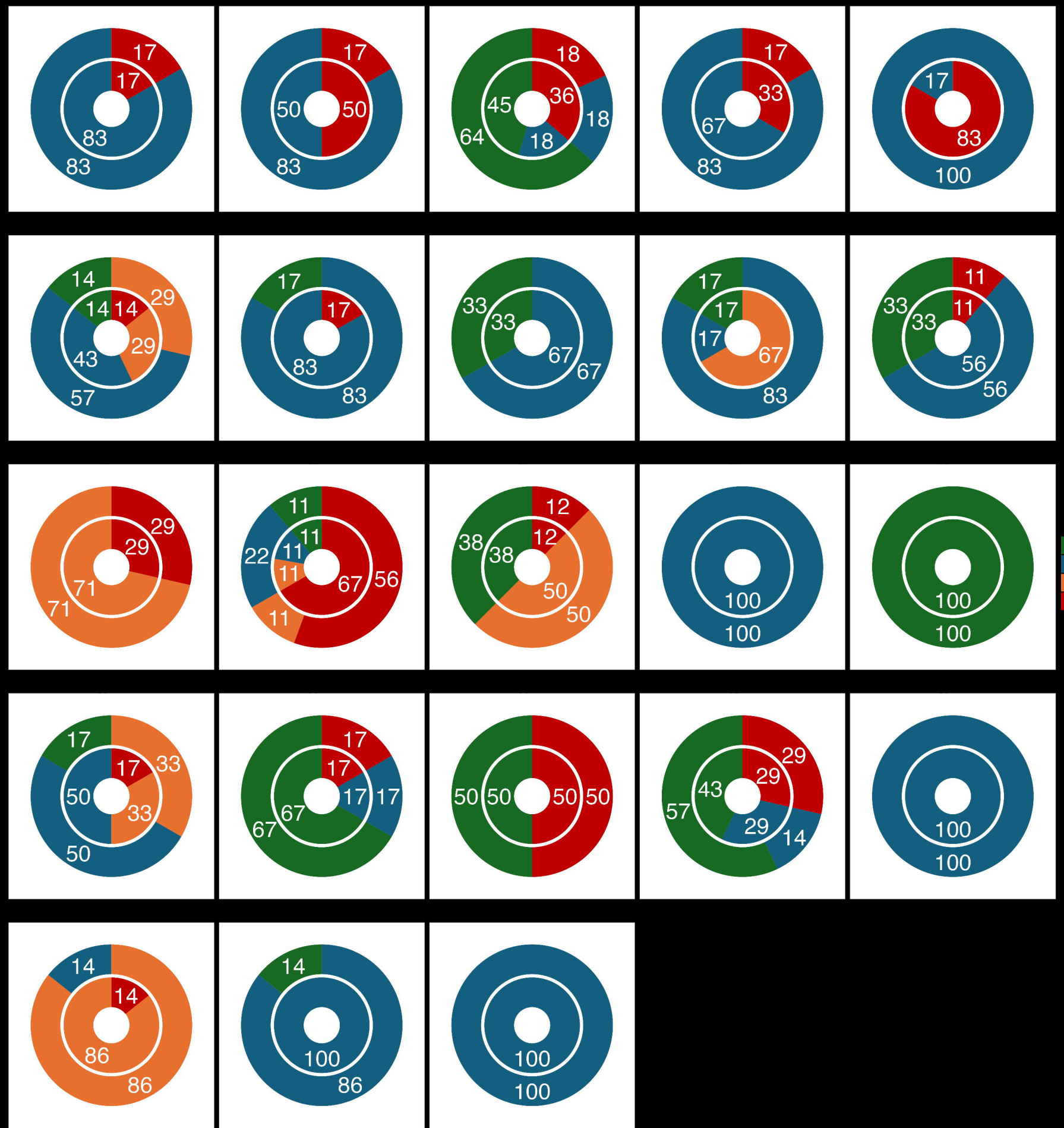
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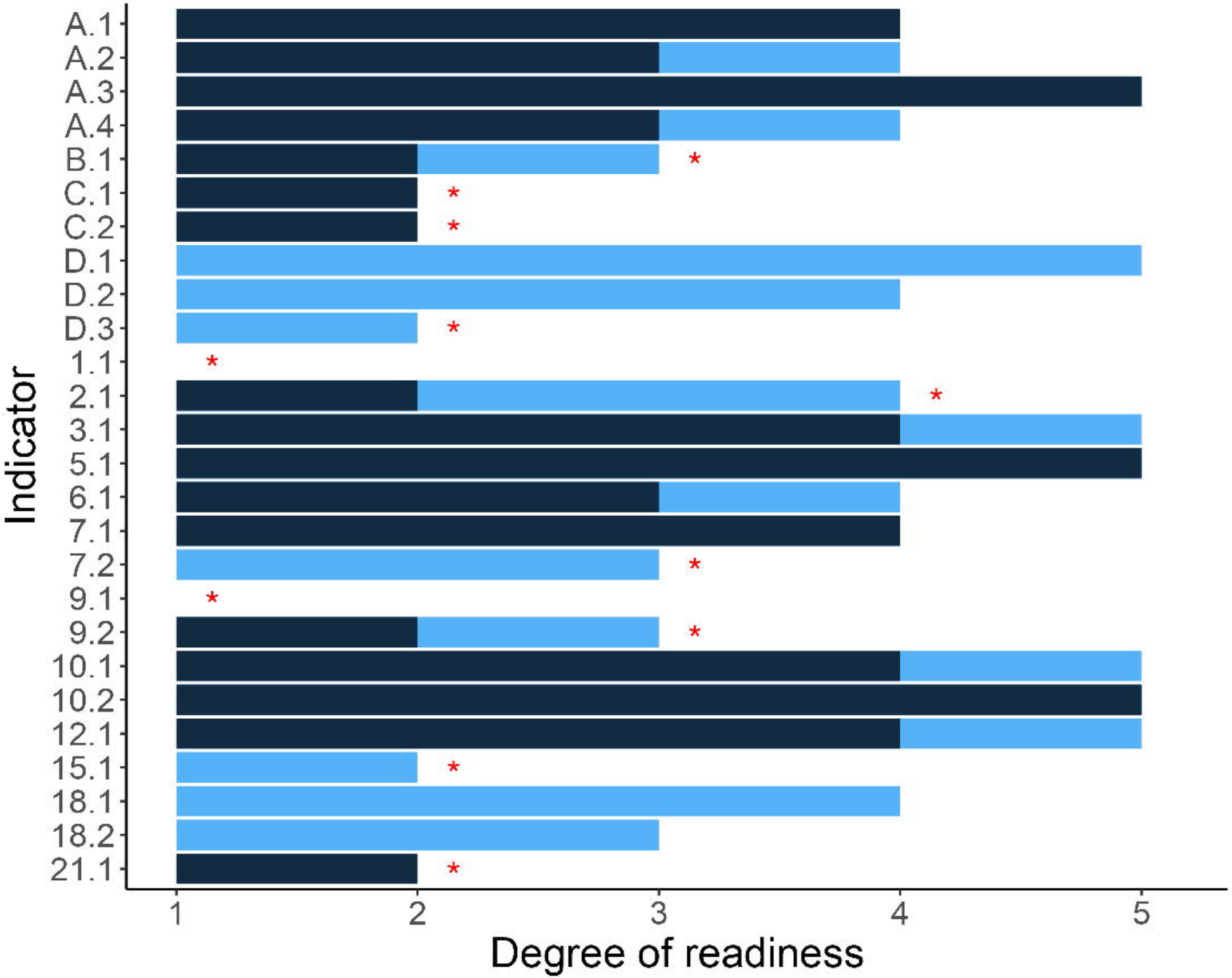
Indicator
A.1
A.2
A.3
A.4
B.1
C.1
C.2
D.1
D.2
D.3
1.1
2.1
3.1
5.1
6.1
7.1
7.2
9.1
9.2
10.1
10.2
12.1
15.1
18.1
18.2
21.1
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Degree of readiness