

Indicators for Elevating Mountains in the Convention on Biological Diversity's Post-2020 Global Biodiversity Framework

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Effective indicators of mountain biodiversity and ecosystems status and trends are crucial for supporting the goals and targets of the Convention on Biological Diversity's (CBD) Post-2020 Global Biodiversity Framework (GBF). Given the uniqueness of biodiversity in mountains, and the relevance of the ecosystems services they deliver for the well-being of people worldwide, the need to elevate mountains in the GBF was addressed by previous policy briefs presented at the first¹ and second² meetings of the Open-Ended Working Group (OEWG). This document complements earlier contributions and supports decision-makers in ongoing Post-2020 GBF discussions by:

- identifying indicators in CBD/SBSTTA/24/3Add.1³ considered effective for safeguarding mountain biodiversity and ecosystem integrity
- providing the rationale for the use of such indicators at multiple levels
- suggesting indicators for further consideration and development.

Integration of indicators that promote the value of mountain biodiversity conservation will contribute to realizing the CBD's vision of "Living in Harmony with Nature" by 2050, and strengthen the coherence among international frameworks and science- and evidence-based policy-making.

Indicators suggested in CBD/SBSTTA/24/3Add.1 fall into three groups: headline, component, and complementary. A minimum set of high-level headline indicators tracks national, regional, and global progress on GBF goals and targets. Component indicators measure progress toward the goals' and targets' components more specifically. Complementary indicators support an in-depth analysis of goals and targets on national, regional, and global levels. They are highly specific and therefore may not be applicable or relevant for the majority of countries.

¹ [Elevating Mountains in the Post-2020: Global Biodiversity Framework, Nairobi, Kenya, 2019](#)

² [Elevating Mountains in the Post-2020: Global Biodiversity Framework 2.0, Rome, Italy, 2020](#)

³ <https://www.cbd.int/doc/c/ddf4/06ce/f004afa32d48740b6c21ab98/sbstta-24-03-add1-en.pdf>

Linking policy brief recommendations with CBD/SBSTTA/24/3Add.1 indicators

	Code	Indicators	Policy brief recommendations							
			1	2	3	4	5	6	7	8
Headline	A.0.1	Extent of selected natural ecosystems*	✓	✓	✓	✓		✓		
	A.0.4	Species Habitat Index	✓	✓		✓	✓			
	2.0.1	Protected areas coverage of important biodiversity areas	✓	✓	✓	✓	✓			✓
	2.0.2	Species Protection Index	✓	✓		✓	✓			
	10.0.2	Ecosystems providing reduced coastal erosion, flood protection and other services	✓	✓	✓	✓		✓		✓
Component	A.1.1.	Extent of natural ecosystem (A.0.1) by type	✓	✓	✓				✓	
	2.1.1	Protected area coverage by type**	✓	✓	✓	✓	✓			✓
	2.1.2	Protected area coverage of important biodiversity areas by type**	✓	✓	✓	✓	✓			✓
	19.1.4	Growth in Species Occurrence Records Accessible Through GBIF		✓						

* forest, savannahs and grasslands, wetlands, mangroves, saltmarshes, coral reef, seagrass, macroalgae and intertidal habitats

** marine, freshwater, mountain and terrestrial

Acknowledge the importance of mountain biodiversity & ecosystem services (SDG 15.4) **1**

Collect sound data for science & policy **2**

Acknowledge ecosystem-specific risks & needs in mountains **3**

Reduce pressures & facilitate biodiversity conservation **4**

Support protected area coverage & effective area based conservation measures for important sites for mountain biodiversity **5**

Address the effects of global change & support the adoption of ecosystem-based approaches to conservation **6**

Recognize mountains as reservoirs of genetic resources & local breeds of comestible species & wild relatives **7**

Strengthen regional networks & coordination mechanisms **8**

Figure 1: linking policy brief recommendations with CBD/SBSTTA/24/3Add.1 indicators

Examples of published delineations of global mountain extents that can be applied for disaggregating indicators to mountains at multiple scales include:

- Global Mountain Biodiversity Assessment mountain inventory V1.2, useful for applications ranging from comparative research in mountain biodiversity to the spatial placement of biodiversity inventories and conservation planning. https://www.gmba.unibe.ch/services/tools/mountain_inventory.
- U.S. Geological Survey Global Mountain Explorer, a web-based visualization and query tool for exploring the three major delineations of global mountain extent. Provided layers can support disaggregation of data to mountain-relevant scales. <https://rmgsc.cr.usgs.gov/gme/>.

The indicators below were selected in consultation with partners and experts based on specific criteria.

Indicator criteria

- (Meta)data publicly available
- Methodology for data product published or peer reviewed
- Evidence for regular update of the indicator
- Mechanism for maintenance of the indicator
- Can be disaggregated for mountains

Box 1: indicator criteria

Rationale for selected headline indicators considered effective for safeguarding mountain biodiversity

While most headline indicators under consideration for the GBF are relevant to mountains in different ways, only some offer specific prospects to safeguard mountain biodiversity and ensure that the GBF relates to unique mountain environments. The indicators below were selected in consultation with partners and experts based on specific criteria. Selected component and complementary indicators associated with each headline indicator are listed in Appendix 1.

GBF Goal A: Ecosystems, species and genetic diversity

[The area, connectivity and integrity of natural ecosystems increased by at least [X%] supporting healthy and resilient populations of all species while reducing the number of species that are threatened by [X%] and maintaining genetic diversity]

A.0.1 Extent of selected natural ecosystems (forest, savannahs and grasslands, wetlands, mangroves, saltmarshes, coral reef, seagrass, macroalgae and intertidal habitats)

Different ecosystems span mountains' elevational gradients, including forests, grasslands, lakes, peatlands, ponds, rivers, and wetlands. In addition to showing temporal trends in the spatial extent of specific ecosystems, this headline indicator informs the assessment of the impact of global change drivers and the efficacy of conservation measures.

Indicator A.0.1 could be disaggregated to mountains at multiple scales and support to

- acknowledge the high intrinsic value of multiple ecosystems along elevational gradients
- enable negotiation for differentiated protection, conservation, and restoration measures that account for the ecosystem-specific impacts of global change drivers in mountains.

Note:

- *Indicator A.0.1 calls for progress in remote sensing of mountains.*
- *Remote sensing combined with models offers new avenues for globally standardized characterization and monitoring of mountain ecosystems and critical boundaries, such as the treeline.*
- *Representation of mountain ecosystems in this indicator will be critical for its effectiveness for monitoring mountain biodiversity.*

A.0.4 Species habitat index (SHI)*

This headline indicator measures the habitat and population changes of countries' species and estimates the resulting changes to ecosystems' ecological integrity. The indicator can be disaggregated to individual countries and species, as well as applied to mountain species directly. The aggregate country metric weighs individual species' trends by the relative stewardship countries hold for them. Mountain species are often highly geographically restricted (endemic). Therefore, the inclusion of countries' stewardship of endemic and rare mountain species is vital for appropriate consideration of mountain biodiversity. Countries

can maintain high SHI by limiting habitat loss, e.g., for mountain endemic species. However, it is important to also consider these endemic species in the context of other key species in mountain contexts (e.g., rare species).

Indicator A.0.4 could be disaggregated to mountains at multiple scales and support to

- acknowledge that global change drivers affecting mountains threaten the habitats and long-term survival of mountain species
- recognize the need to identify and mitigate threats to mountain habitats, particularly those endangering range-restricted species
- enable negotiation for habitat conservation and restoration measures that promote the long-term survival of mountain species and populations.

Notes:

- *SHI combines in situ biodiversity observations, remote sensing, and models to provide comprehensive and globally representative characterization of biodiversity status and trends.*
- *The performance and taxonomic scope of the indicator will improve with enhanced data collection and remote sensing of mountain species' habitats.*

GBF Target 2: Area-based conservation measures

[By 2030, protect and conserve through well connected and effective system of protected areas and other effective area-based conservation measures at least 30% of the planet with the focus on areas particularly important for biodiversity.]

2.0.1 Protected area coverage of important biodiversity areas

Mountains are home to a large number of areas that are important for biodiversity, including areas of particularly rich, spatially restricted, and/or threatened biodiversity. This headline indicator informs on temporal trends in how protected areas and other effective area-based conservation measures overlap spatially with areas important for biodiversity.

Indicator 2.0.1 could be disaggregated to mountains at multiple scales and support to

- acknowledge mountains' contributions to global biodiversity maintenance and conservation
- align with ongoing monitoring for Sustainable Development Goal (SDG) 15.4.1 "Coverage by protected areas of important sites for mountain biodiversity."

Notes:

- *This indicator is still under development. Its relevance for mountains will depend on how areas important for biodiversity are defined.*
- *The definition of important biodiversity areas, as noted above, is key. The IUCN has developed a tool for prioritizing Key Biodiversity Area (KBA) sites based on whether they contain examples of un- or under- protected terrestrial ecosystems, in addition to their importance for species-level conservation.⁴*

⁴ Jacobs, P. et al. (2021). 'Identification of Global Priorities for New Mountain Protected and Conserved Areas.' Mountains Specialist Group, World Commission on Protected Areas (WCPA). International Union for Conservation of Nature (IUCN). Available at

- *Protected areas' long-term conservation potential depends on their ability to maintain the (a)biotic conditions that promote biodiversity despite changing climatic conditions. Protected area coverage does not suffice to safeguard biodiversity as it redistributes with climate (change). Protecting biodiversity along elevational gradients is essential.*⁵

2.0.2 Species protection index (SPI)*

This headline indicator measures species' representation within protected areas or other effective area-based conservation measures. SPI measures the importance of existing reserve areas for biodiversity and monitors changes in this importance. The SPI is the average percent of global reserve target met by a country for its species, with particular weight on species for which countries hold high stewardship, such as endemics⁶. SPI assesses species protection comprehensively based on high spatial resolution data. This is especially important for mountain biodiversity where multiple, often sharply delineated, mountain habitats hold value for protection and changes can occur quickly. Countries can increase their SPI by protecting mountain habitats and their rare and/or threatened, often endemic, species. In light of ongoing changes in climatic conditions and resulting redistribution of species, trends towards a decline in indicator 2.0.2 might prompt a re-evaluation of protected area coverage.

Indicator 2.0.2 could be disaggregated to mountains at multiple scales and support to

- recognize the need to protect suitable habitats for the long-term survival of rare and/or threatened, often endemic, mountain species
- enable re-evaluation and improvement of strategic protection of mountain species for which protected area targets have not been met
- align with ongoing monitoring for Sustainable Development Goal (SDG) 15.4.1 "Coverage by protected areas of important sites for mountain biodiversity."

GBF Target 10: Nature-based solutions and ecosystem services

[By 2030, ensure that, nature-based solutions and ecosystem approach contribute to regulation of air quality, hazards and extreme events and quality and quantity of water for at least [XXX million] people.]

10.0.2 Ecosystems providing reduced coastal erosion, flood protection and other services

This headline indicator supports the overall goal stipulated under Target 10. Nature-based solutions and ecosystem-based approaches to address impacts and risks in mountain areas

https://www.iucn.org/sites/dev/files/content/documents/identification_of_global_priorities_for_new_mountain_protected_and_conserved_areas_jan_2021.pdf

⁵ Elsen, P. R., Monahan, W. B., Dougherty, E. R. & Merenlender, A. M. 2020. Keeping pace with climate change in global terrestrial protected areas. *Science Advances* 6, (25), eaay0814.

<https://doi.org/10.1126/sciadv.aay0814>

° Biodiversity Indicator Partnership (BIP) indicator; basic criteria for acceptance fulfilled

°° SDG indicators

⁶ Rinnan, D. S., and W. Jetz. 2020. Terrestrial conservation opportunities and inequities revealed by global multi-scale prioritization. *bioRxiv:2020.2002.2005.936047* & Karger, D., M. Kessler, M. Lehnert, and W. Jetz. in press. Limited protection and ongoing loss of tropical cloud forest biodiversity and ecosystems worldwide. *Nature Ecology & Evolution*.

are also priorities raised within the scope of measures to address climate change (UNFCCC) and disaster risk reduction (Sendai).

Indicator 10.0.2 could be disaggregated to mountains at multiple scales and

- support the reduction of disaster-related loss and damage to mountain communities, in particular linked to risks due to climate change and other drivers
- promote integrated (spatial) planning and management based on ecosystems' health and integrity and support sustainable development
- support policy measures that safeguard mountain ecosystem services.

Selected component and complementary indicators considered effective for safeguarding mountain biodiversity

The following component and complementary indicators are specifically relevant for monitoring mountain biodiversity. They can be disaggregated to mountains and are used for reporting against the 2030 Agenda's sustainable development goals (SDGs) and the UN Disaster Risk Reduction (UNDRR) Sendai Framework and/or were endorsed by the Biodiversity Indicator Partnership.

- A.1.1 Extent of natural ecosystem (A.0.1) by type (Component)
- 2.1.1 Protected area coverage by type (marine, freshwater, mountain and terrestrial) (Component)
- 2.1.2 Protected area coverage of important biodiversity areas by type (Component)**
- 19.1.4 Growth in Species Occurrence Records Accessible Through GBIF (Component)*
- A.1.1.5 Mountain green cover index (Complementary) **
- 7.1.1.2 Number of countries that adopt and implement disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 (SDG indicator 13.1.2) (Complementary)**
- 7.1.1.4 Number of least developed countries and small island developing States with nationally determined contributions, long-term strategies, national adaptation plans, strategies as reported in adaptation communications and national communications (SDG indicator 13.b.1) (Complementary)**

Selected headline indicators for further consideration and development

The following headline indicators could be useful for monitoring aspects of mountain biodiversity and ecosystems if adopted, but require further consideration and development. Selected component and complementary indicators associated with each headline indicator can be found in Appendix 2.

A.0.3 Red List Index (RLI)*

This headline indicator shows trends in the extinction risk of sets of species and requires data from repeated assessments of species using the Red List Categories and Criteria.

Note:

- *Indicator A.0.3 calls for mountain range and/or system-level assessments of Red List status for mountain species.*
- *The disaggregation of RLI to single countries is considered problematic.*
- *Low temporal frequency of assessments causes this indicator to have limited sensitivity.*

5.0.1 Rate of invasive alien species spread

Biodiversity in mountain ecosystems is changing rapidly due to the introduction and spread of non-native (alien) species. Non-native species not only change the composition of ecosystems, but also affect multiple ecosystem processes and services. Thus, indicators on the introduction and spread of non-native (alien) species are needed and should include multiple taxa, from plants and animals to soil microorganisms. Monitoring should also consider changes in native species distribution and abundance associated with anthropogenic drivers such as land use changes (e.g. roads, habitat transformation) and climate change.

Note:

- *Indicators should include alien species as well as native species that have modified their distribution as a direct response to anthropogenic drivers ("range-expanding species"), e.g., number of alien/range-expanding species and its ratio to total species diversity by taxa.*
- *Invasive alien species' rapid spread under favourable climatic conditions, e.g., due to climate change, calls for focused monitoring in mountains.*
- *The new IUCN Environmental Impact Classification for Alien Taxa (EICAT) system offers a useful framework to assess invasion risk.*

Selected complementary and component indicators for further consideration and development

A.1.1.51 Comprehensiveness of conservation of socioeconomically as well as culturally valuable species (Complementary)^o

A.1.1.52 Number of plant and animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities (SDG 2.5.1) (Complementary)^{oo}

A.1.1.53 Proportion of local breeds classified as being at risk of extinction (Complementary)^{oo}

B 1.1.9. Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (Complementary)^{oo}

B 1.1.25 Number of mixed sites (having both natural and cultural Outstanding Universal Values), cultural landscapes (recognized as combined works of nature and people) and natural sites with cultural values including those supporting local and indigenous knowledge and practices inscribed on the UNESCO World Heritage List and UNESCO World Network of Biosphere Reserves (Complementary)

Reviewers and experts consulted

I. Alcántara-Ayala, J. Alexander, H. Bugmann, R. H. Grau, S. Haider, W. Jetz, J. Lembrechts, R. Marchant, I. Palomo, A. Pauchard, M. Price, R. Sayre, T. Seipel.

Appendix 1: Selected component and complementary indicators associated with headline indicators effective for safeguarding mountain biodiversity

2.0.1 Protected area coverage of important biodiversity areas

- 2.1.1 Protected area coverage by type (marine, freshwater, mountain and terrestrial) (Component)
- 2.1.2 Protected area coverage of important biodiversity areas by type (marine, freshwater, mountain and terrestrial) (Component)
 - 2.1.1.1 Protected area downgrading, downsizing and degazettement (PADDD) (Complementary)*
 - 2.1.1.2 Status of key biodiversity areas (Complementary)
 - 2.1.1.3 Protected area coverage of key biodiversity areas (Complementary)***
 - 2.1.1.6 Proportion of terrestrial, freshwater and marine ecological regions which are conserved by protected areas or other effective area-based conservation measures (Complementary)
 - 2.1.1.11 Protected Area Connectedness Index (PARC-Connectedness) (Complementary)*
 - 2.1.1.12 Number of hectares of UNESCO designated sites (natural and mixed World Heritage sites and Biosphere Reserves) (Complementary)

Note: the definition of "status" in 2.1.1.2 needs to be clarified, and a systematic assessment of all mountain-specific KBAs is needed.

A.0.4 Species habitat index*

- A.1.6 Species habitat index by species group (Complementary)

A.0.1 Extent of selected natural ecosystems (forest, savannahs and grasslands, wetlands, mangroves, saltmarshes, coral reef, seagrass, macroalgae and intertidal habitats)

- A.1.1 Extent of natural ecosystems (Component)
 - A.1.1.1 Forest area as a proportion of total land area (SDG indicator 15.1.1) (Complementary)***
 - A.1.1.2 Forest distribution (Complementary)
 - A.1.1.4 Grassland and savannah extent (Complementary)
 - A.1.1.6 Peatland extent and condition (Complementary)
 - A.1.1.11 Change in the extent of water-related ecosystems over time (Complementary)**
 - A.1.1.23 Change in the extent of inland water ecosystems over time (Complementary)
 - 4.1.1.36 Wetland Extent Trends Index (Complementary)*
 - 1.1.1.16 Free flowing rivers (Complementary)

Note: some of the extent-related indicators (e.g., A.1.1.6, A.1.1.11, A.1.1.23, or A.1.1.36) require guidance on how to consider consequences of changes in grassland versus forest extents in mountain areas. The dearth of mapping that captures the diversity of freshwater ecosystems in mountains (A.1.1.) will require considerable efforts to account for mountain specificities.

Appendix 2: Selected component and complementary indicators associated with headline indicators for further consideration and development

A.0.3 Red List Index*

- A.1.4 Red list index by species group (including for terrestrial, freshwater and marine species) (Component)

- A.1.1.41 Number of threatened species by species group (Complementary)
- A.1.1.42 Wild bird index (Complementary) *
- 1.1.39 Percentage of threatened species that are improving in status according to the Red List (Complementary)
- 3.1.1.4 Percentage of threatened species that are improving in status (Complementary)
- 8.1.1.4 Red List Index (species used for food and medicine) (Complementary) *
- 19.1.1.3 Proportion of known species assessed through the IUCN Red List (Complementary)

5.0.1 Rate of invasive alien species spread

- 5.1.1 Numbers of invasive alien species introduction events (Component)
- 5.1.5 Proportion of key biodiversity areas threatened by invasive alien species (Component)