

GEF BENEFITS INDEX FOR BIODIVERSITY (GBI_{BIO})

Background and Context

1. The GEF Benefits Index for Biodiversity (GBI_{BIO}) provides a relative ranking of countries for meeting the biodiversity objectives of the GEF under the Resource Allocation Framework. As the financial mechanism for the Convention on Biological Diversity (CBD), the GEF's biological diversity objectives derive from the guidance of the Convention on Biological Diversity (CBD).

2. Biological diversity is defined by the CBD in terms of the variability in genes, species, and ecosystems. The CBD's objectives are conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Additionally, the CBD has set out specific targets to be met by 2010 towards achieving these objectives.

3. Consistent with the guidance of the CBD, the GEF has defined strategic priorities for catalyzing sustainability of protected areas, mainstreaming biodiversity conservation in production systems, capacity building for the Cartagena Protocol on Biosafety, and the generation and dissemination of best practices. Recognizing the biological diversity across ecosystems, these priorities are operationalized separately through operational programs for arid and semiarid ecosystems, coastal, freshwater, and marine ecosystems, forest ecosystems, mountain ecosystems and biodiversity important for agriculture.

4. Biodiversity is not equally distributed throughout the world. Rates of biodiversity loss vary across ecosystems, and ecosystems vary in their level of species richness. Neither the economic nor the ecosystemic value of biodiversity resources is well understood. In particular, there is insufficient knowledge of the interdependence of species within ecosystems and the impact of the extinction of one species on others. However, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize the threats of significant reduction or loss of biological diversity.

5. Conserving biological diversity requires achieving a balance between ensuring that resources are allocated primarily to areas of high biodiversity using the best available information, and maintaining large-scale ecological processes and life-support systems at local, regional, and global scales (i.e., ecosystem services), thus recognizing that all biodiversity is important. Sustainable achievement of global biodiversity objectives will greatly depend on the extent to which GEF activities are country-driven; respond to programs of national priority that fulfill the obligations of the Convention; and are related to appropriate national policy frameworks and plans for sectoral, economic, and social development.

GEF Benefits Index for Biodiversity

6. The GEF Benefits Index for Biodiversity is intended to be responsive to its mandate, conceptually simple, scientifically based, and comprehensive in its coverage of GEF-eligible countries. Drawing on work by the scientific community and data compiled by various organizations, including the World Wildlife Fund, Conservation International, The World

Conservation Union (IUCN), Birdlife International and FishBase, the Secretariat has constructed the GEF Benefits Index for Biodiversity with the support of the World Bank's Development Research Group. The GEF Benefits Index, described below, makes maximum possible use of the available, scientifically-reliable information for a cross-country assessment of terrestrial and marine biodiversity. The index has benefited from extensive technical consultations with conservation scientists in NGOs. It will be further refined and updated as additional reliable data and indicators become available.¹

7. The GEF Benefits Index reflects the complex, highly uneven distribution of species and threats to them across the ecosystems of the world, both within and across countries. It recognizes the richness of available data in some areas of biodiversity (e.g., species within certain taxonomic groups) and the sparseness of available data in others (e.g., genetic diversity and ecosystem services). It also acknowledges the gaps in the available data -- for example, information on genetic diversity and ecosystem services at the country level -- through the inclusion of broad indicators that capture the uniqueness of ecoregions within each country. It is aligned with the 2010 targets of the CBD through the incorporation of the following elements:

- (a) Magnitude of taxonomic variability at the species and higher levels, by recognizing species richness with special emphasis on threatened species. As speciation is correlated with genetic diversity, it also recognizes variability at the genetic level;
- (b) Large and unique eco-regions that provide opportunities for expansion in the global network of protected areas, both by area and species representation;
- (c) Explicit inclusion of marine and terrestrial biodiversity, recognizing their distinct contributions to ecosystems in these spheres; and
- (d) Recognition that all biodiversity is important and provision of opportunities for sustainable use and the maintenance of ecosystem services at various scales, by ensuring a minimum level of resources to all countries.

8. Wherever feasible, the GEF Benefits Index for Biodiversity (GBI_{BIO}) is developed from sub-national data that are based on biological science and not on political boundaries. The bottom-up approach can also provide detailed local information on globally-important biodiversity resources, to help countries formulate their own biodiversity programs.

9. The GBI_{BIO} for a country is a weighted average of the country's scores for marine biodiversity and terrestrial biodiversity, as detailed in the next two sections. The terrestrial score is weighed 80 percent and the marine score is weighed 20 percent. The GBI_{BIO} scores are not evenly distributed across countries. **Figure 1.1** show the share of the total GBI_{BIO} accounted for by each country eligible for receiving GEF funding for biodiversity projects.² Countries with the

¹ For instance, additional indicators for agrobiodiversity are currently under review for inclusion in GBI.

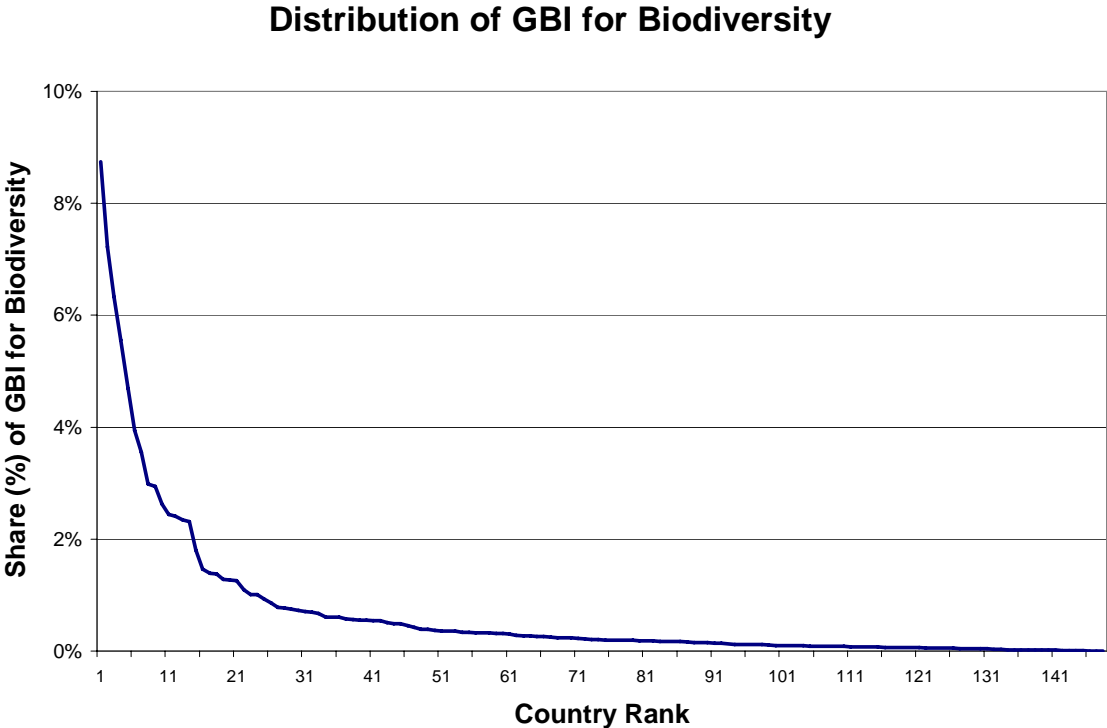
² The shares reported here are the shares of the total GEF Benefits Index for Biodiversity (GBI_{BIO}) only; they are not the allocation shares in the Country and Group Allocation Phase of the Resource Allocation Framework. The latter are computed after the benefits index shown here are combined with the GEF Performance Index using the equation described in the first technical note in this series.

highest scores are shown in the left while those with the lowest scores are shown in the right. 30 countries account for about 76% of the global biodiversity benefits, while the remaining 118 countries account for 24% of the global biodiversity benefits.

$$\text{GEF Benefits Index for Biodiversity} = W_T \times \text{Terrestrial Score} + W_M \times \text{Marine Score}$$

With $W_T=0.8$ and $W_M=0.2$

Figure 1.1: Distribution of GEF Benefits Index Biodiversity (GBI_{BIO})



Terrestrial Score for each country

10. The terrestrial score for each country is built up from highly-detailed subnational data available for specific taxonomic groups, but recognizes the paucity of data for other groups and for ecosystems. The score is constructed in four steps, which are described more fully in the following section.

- (a) Identify all components of distinct terrestrial ecoregions within a country (these Country-Ecoregion Components are abbreviated as CECs);
- (b) Score each CEC using four characteristics – represented species, threatened species, ecoregion representation, and threatened ecoregions;
- (c) Determine the composite score for each terrestrial CEC using a weighted average of the four characteristics scores; and
- (d) Compute the score for each country as the sum of scores for all of the CECs in the country.

Identify Terrestrial Country-Ecoregion Components

11. An ecoregion is a relatively large unit of land containing a distinct assemblage of natural communities and species, with boundaries that approximate the original extent of natural communities prior to major land use changes. The World Wildlife Fund (WWF) has recently developed a map of the world that identifies and characterizes 867 terrestrial ecoregions.³ The map's resolution is high enough to make it suitable for designing networks of conservation areas.⁴

12. Terrestrial ecoregions are defined with respect to original extent of biodiversity, while the focus of the GEF framework is on countries. Terrestrial ecoregion boundaries often overlap national boundaries, which are in most instances unrelated to the geographic distribution of biodiversity. Country Ecoregion Components (CECs) are identified by overlaying the biologically-determined ecoregion map of the world on a politically-determined map of country boundaries. Given the focus on current actions and projects, only areas that remain currently uncleared for agriculture or urban settlement are considered.⁵ Within countries, CECs reflect the distributions of local fauna and flora.

13. A CEC is defined as the part of a terrestrial ecoregion within a country's boundaries that currently remains uncleared for agriculture or urban settlement. For instance, an ecoregion that runs across four different countries is divided into four CECs, each containing the part of the ecoregion that currently remains uncleared within the respective country's borders. Making this

³ WWF has also partially characterized the freshwater and marine ecoregions of the world. These regions can also be incorporated into the GEF Benefits Index in the future when the characterization is globally complete. See www.nationalgeographic.com/wildworld/terrestrial.html for additional details.

⁴ The average size of an ecoregion in the WWF delineation is about 150,000 km².

⁵ High-resolution GIS maps supplied by the International Food Policy Research Institute (IFPRI) are used to identify parts of the original ecoregion that have been cleared.

distinction divides the 867 terrestrial ecoregions into approximately 1,700 CECs. Of these, 1,326 CECs are in GEF-recipient countries and are the focus of analysis for the GEF Resource Allocation Framework.

Score Terrestrial Country Ecoregion Components

14. The second step in computing the terrestrial score of each country is characterizing each CEC with four indicators – represented species, threatened species, represented ecoregions, and threatened ecoregions -- each of which is discussed below.

Represented Species

15. The represented species score is obtained by averaging scores for all the available taxonomic groups. The current score is based on data for mammals, birds, amphibians, reptiles, freshwater fish, and vascular plants. Additional taxonomic groups will be added as data become available.

16. This indicator is aggregated from separate analyses of the remaining habitat for each species. Only species that have been evaluated in a manner that is comprehensive and meaningful for cross-country comparisons are included.⁶ Each species receives a total credit of 1 globally, which is distributed across CECs in proportion to the remaining habitat for the species. For instance, if 60 percent of the habitat for a species lies in a particular CEC and the remaining 40 percent is distributed evenly across two other CECs, the three CECs receive credits of 0.6, 0.2, and 0.2 for that species. All other CECs do not receive any credits for the species. For each CEC, species credits are totaled for each of the taxonomic groups (or taxa) and normalized using the total number of species in the taxa worldwide. The CEC score for represented species is computed as the average of the normalized credits for the six taxonomic groups for which data are currently available. This approach gives equal representation to the taxa at the world scale.⁷

Threatened Species

17. Computation of the threatened species score is identical to computation of the represented species score, after one initial adjustment. In this adjustment, species receive credits based on their threat class, rather than uniform credits of 1. The current score is based on threat-class information for mammals, birds and amphibians. Additional taxonomic groups will be added as data become available.

18. The threatened species score recognizes the greater urgency of protecting species that face significant risks of extinction. After evaluating global threats to each existing species,

⁶ IUCN has provided comprehensive range data for mammals, birds and amphibians. More aggregative data on reptiles and plants have been provided by the World Conservation Monitoring Center, while data on marine and freshwater fish have been provided by FishBase.

⁷ Aggregating credits at the species level would result in domination of indicators by taxonomic groups with large numbers of species, such as flowering plants. Group averaging more fully recognizes the breadth of biodiversity across taxonomic groups.

IUCN classifies it into one of six categories: extinct in the wild, critically endangered, endangered, vulnerable, near threatened and least concern. Taking scientifically-estimated extinction probabilities and conservation priorities into account, the six categories are respectively assigned weights of 10, 10, 6.7, 1, 0 and 0.⁸

19. The threatened species credits for each CEC are aggregated separately for mammals, amphibians and birds, and normalized by the total number of threatened species credits in each taxon. The threatened species score averages the normalized credits for the three taxa.

Represented Ecoregions

20. Each terrestrial CEC represents an ecoregion with unique characteristics from a global perspective. Each ecoregion receives a total credit of 1 globally, which is distributed across the CECs comprising that ecoregion in proportion to the remaining habitat (land that is uncleared for agriculture or urban settlement). This index captures the uniqueness of each CEC as well as its scale. The wide array of factors encompassed in an ecoregion ensures that non-species-related components of biodiversity are reasonably represented in the terrestrial score. This index will be replaced with more precise indicators of genetic diversity, ecosystem services and other components of biodiversity as comprehensive data become available for all GEF-eligible countries.

Threatened Ecoregions

21. The threatened ecoregion score recognizes the greater urgency of protecting ecoregions that face significant risks of habitat destruction. The World Wildlife Fund classifies all ecoregions into three groups: critical/endangered, vulnerable and stable. Taking scientific estimates of habitat-degradation rates into account, the three categories are respectively assigned threat credits of 4, 2 and 1. The threat credit for each ecoregion is distributed across its constituent CECs in proportion to the remaining habitat. This index captures the scale, uniqueness and threat level of each CEC. Like the represented ecoregion index, it will be replaced by more precise indicators of genetic diversity, ecosystem services and other components of biodiversity as comprehensive data become available for all GEF-eligible countries.

Determine Composite Terrestrial Scores for each CEC

22. The third step in determining a country's terrestrial score is to compute the composite terrestrial score for each CEC. This is defined as the weighted average of the four scaled biodiversity indicators, as shown in the following equation.⁹ The composite scores are sensitive to the weights, which are chosen to reflect the relative contribution of each indicator to the

⁸ The highest weight, 10, is applied to both critically endangered species and species that are extinct in the wild. The latter category is given critical weighting so that conservation priorities will expand the possibility for future re-introduction of the relevant species into their native habitats.

⁹ The first step in computing the composite terrestrial score is to scale all of four indicators uniformly. This ensures that one-point changes in all four indicators will have the same impact on the composite score if they are equally weighted.

GEF's objectives. After extensive consultation with biodiversity experts on current best practice, the base-case simulations give larger weights to species indicators because these are characterized with greater certainty. Further, threatened species are given additional weight through the inclusion of the threatened species indicator which accounts for the threatened status of species. Similarly, threatened ecoregions are given additional weight compared to less threatened ecoregions through the inclusion of the threatened ecoregion. The weights are defined below.

$$\text{CEC Biodiversity Score} = W_{T1} \times \text{Represented Species} + W_{T2} \times \text{Threatened Species} \\ + W_{T3} \times \text{Represented Ecoregion} + W_{T4} \times \text{Threatened Ecoregion}$$

$$\text{Where } W_{T1} + W_{T2} + W_{T3} + W_{T4} = 1$$

$$W_{T1}=0.55; W_{T2}=0.20; W_{T3}=0.15; W_{T4}=0.10$$

Compute the Terrestrial Biodiversity Score for each Country

23. The fourth step in determining the terrestrial score for a country is to sum the terrestrial scores for all CECs within it.

Marine Biodiversity Score for each Country

24. The marine score for each country is developed in a much simpler way, because of the lack of detailed subnational data. The available information registers the presence of specific fish species within a country's waters, but does not provide data on precise ranges, extinction threats, or relative uniqueness of marine ecosystems. Consequently, the marine score is based solely on represented fish species. Each evaluated species receives a total credit of 1 globally, which is distributed across countries in proportion to the estimated habitat for the species in the respective country.¹⁰ The marine score for a country is the sum of the credits from all of the marine species located in the territorial waters of the country

¹⁰ The habitat in each country is approximated by its EEZ. A country's share of habitat for each species is the share of its EEZ area in the total EEZ area for countries where the species is registered.

