UNIVERSITY OF CAMBRIDGE
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Natural Capital Impact Group

Measuring business impacts on nature: A framework to support better stewardship of biodiversity in global supply chains

Supplementary material

This document gives additional information and context on aspects of the Biodiversity Impact Metric. It draws on work undertaken by a number of experts at the University of Cambridge Institute for Sustainability Leadership (CISL), The Biodiversity Consultancy, BirdLife International and the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC).

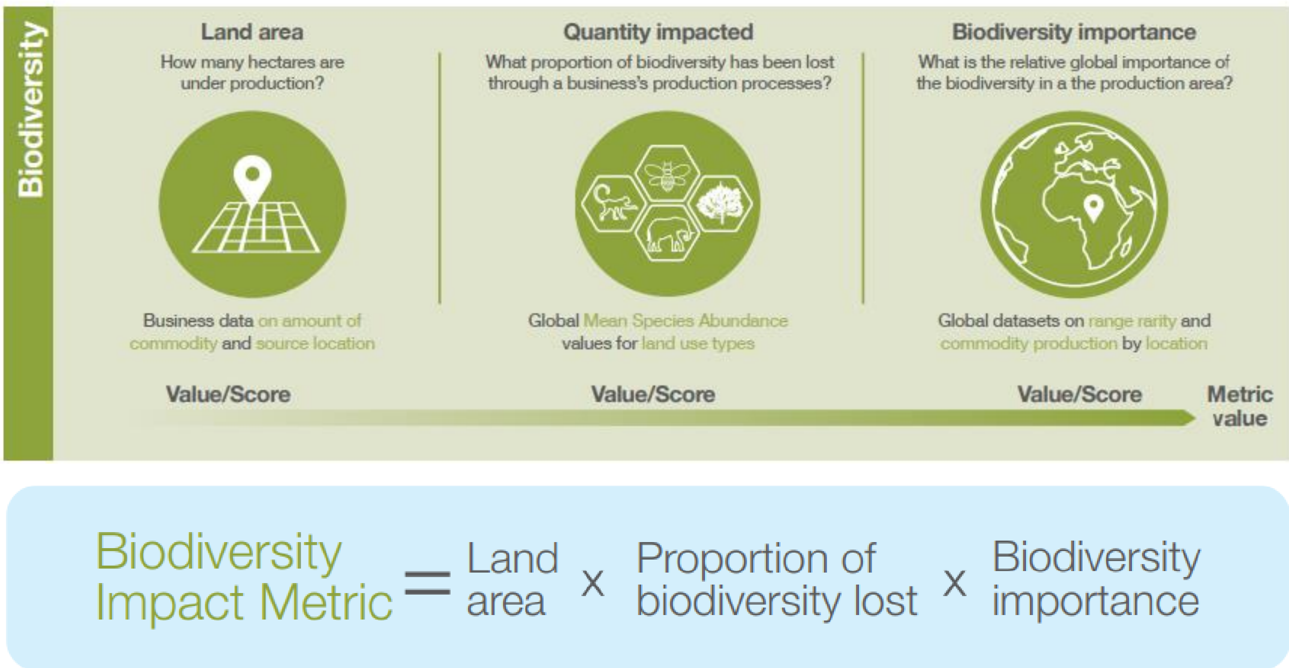

Figure 1. The Framework and equation for the Biodiversity Impact Metric

Determining the proportion of biodiversity loss for different land use types and intensities

The Biodiversity Impact Metric uses the coefficient values set out in Table 1 to estimate the proportion of biodiversity loss for different land use types and intensities. This coefficient ranges from 0 (no loss) to 1 (complete loss). The values are based primarily on Mean Species Abundance (MSA) coefficients.[1,2] MSA is an indicator of biodiversity intactness defined as the mean abundance of original species relative to their abundance in undisturbed ecosystems.[3] It is an output of the GLOBIO model,[1] a modelling framework that can calculate the impact of environmental drivers on biodiversity. However, the GLOBIO model MSA parameters do not cover the full range of land use types and intensities required for the Biodiversity Impact Metric, therefore, the coefficients were also informed by other relevant sources.

The Biodiversity Impact Metric also draws on the work of the Projecting Responses of Ecological Diversity In Changing Terrestrial Systems (PREDICTS) database.[4] The PREDICTS database is a large, reasonably representative database of comparable samples of biodiversity from multiple sites that differ in the nature or intensity of human impacts relating to land use. These data, collected from published studies, are used to develop global and regional statistical models of how local biodiversity responds to these measures.[4] The PREDICTS database was used to inform a Biodiversity Intactness Index (BII), which is the modelled response of species richness and total abundance to land use change and other pressures.[5] As more studies are added to the PREDICTS database, the accuracy of the BII coefficients is expected to improve, however, currently there is high uncertainty around some of these estimates.

Another approach has used refinements of species-area models by combining land use maps with the IUCN habitat-use classification scheme to identify which species in three vertebrate taxonomic groups can be expected to persist in modified habitats.[6] The results show 'taxon affinity' (a measure of the proportion of species remaining) around four to ten times smaller than found using the BII.[2] The results from these studies were taken into consideration when adapting the MSA values shown in Table 1. There remains considerable uncertainty about the accuracy of coefficients that estimate species loss through land use change and intensity, therefore, the coefficients in Table 1 should be updated as more accurate estimates arise in the literature.

Determining the land use types and intensities for a business's production practices

To use these coefficients in the Biodiversity Impact Metric, information on production practices and land use type is required. A description of these different categories is also provided in Table 1; these are adapted from Newbold et al. 2016.[5] These descriptions can be used to form the basis of a questionnaire to determine the appropriate intensity coefficient. If key information is unknown, a precautionary 'intense' is assumed.

Table 1: Description of different land use types and intensities and the resulting coefficient used to determine the proportion of biodiversity lost

Land use	Intensity	Description	Coefficient
Natural forest	Minimal	Any human disturbances identified are very minor (eg a trail or path) or very limited in the scope of their effect (eg hunting of a particular species of limited ecological importance).	0.15
	Light	One or more human disturbances of moderate intensity (eg selective logging) or breadth of impact (eg bushmeat extraction), which are not severe enough to markedly change the nature of the ecosystem. Primary sites in suburban settings are at least Light use.	0.3
	Intense	One or more human disturbances that is severe enough to markedly change the nature of the ecosystem; this includes clear-felling. Primary sites in fully urban settings should be classed as Intense use.	0.5
Plantation forest	Minimal	Extensively managed or mixed timber, fruit/coffee, oil-palm or rubber plantations in which native understorey and/or other native tree species are tolerated, which are not treated with pesticide or fertiliser, and which have not been recently (< 20 years) clear-felled.	0.7
	Light	Monoculture fruit/coffee/rubber plantations with limited pesticide input, or mixed species plantations with significant inputs. Monoculture timber plantations of mixed age with no recent (< 20 years) clear-felling. Monoculture oil-palm plantations with no recent (< 20 years) clear-felling.	0.75
	Intense	Monoculture fruit/coffee/rubber plantations with significant pesticide input. Monoculture timber plantations with similarly aged trees or timber/oil-palm plantations with extensive recent (< 20 years) clear-felling.	0.8
Cropland	Minimal	Low-intensity farms, with small fields, mixed crops, crop rotation, little or no inorganic fertiliser use, little or no pesticide use, little or no ploughing, little or no irrigation, little or no mechanisation.	0.6

	Light	Medium-intensity farming, typically showing some but not many of the following: large fields, annual ploughing, inorganic fertiliser application, pesticide application, irrigation, no crop rotation, mechanisation, monoculture crop. Organic farms in developed countries often fall within this category, as may high-intensity farming in developing countries.	0.7
	Intense	High-intensity monoculture farming, typically showing many of the following features: large fields, annual ploughing, inorganic fertiliser application, pesticide application, irrigation, mechanisation, no crop rotation.	0.9
Pasture	Minimal	Pasture with minimal input of fertiliser and pesticide, and with low stock density (not high enough to cause significant disturbance or to stop regeneration of vegetation).	0.2
	Light	Pasture either with significant input of fertiliser or pesticide, or with high stock density (high enough to cause significant disturbance or to stop regeneration of vegetation).	0.4
	Intense	Pasture with significant input of fertiliser or pesticide, and with high stock density (high enough to cause significant disturbance or to stop regeneration of vegetation).	0.7

Determining the biodiversity importance of a production area

The Biodiversity Impact Metric uses range rarity to define the biodiversity importance of the production area. Range data from the IUCN Red List[1] (2017) was used to create a range rarity layer to be used as a proxy of biodiversity importance. Range rarity was determined using range maps for the four taxonomic groups that were completely assessed on the IUCN Red List of Threatened Species, ie amphibians, mammals, birds and conifers. As the IUCN Red List assessment and mapping process is ongoing, further groups could be included in future leading to a more representative index of biodiversity importance.

IUCN Red List range maps reflect the best current knowledge of range and are variably detailed for different species. Especially where knowledge is incomplete, they often approximate to Extent of Occurrence, “the area contained within the shortest continuous imaginary boundary which can be

[1] https://www.iucnredlist.org/

drawn to encompass all the known, inferred or projected sites of occurrence, excluding cases of vagrancy".[7] The species is not necessarily present at all points within its mapped range.

Range rarity was analysed for terrestrial species only. This includes some species in each taxonomic group that inhabit inland waters. However, the current range rarity analysis does not give an adequate overview of the relative importance of freshwater ecosystems and does not cover marine ecosystems.

Range rarity was calculated globally at a resolution of 1 km grid cells. For each species, the proportion of its global range was calculated for each grid cell across the world. A total score for each cell was then found by summing scores across all the species potentially occurring in it. Range rarity thus combines measures of range restriction (endemism) and species richness. The highest-scoring grid cells overlap with the range maps of many species with narrow ranges. Average scores can be calculated across the area of interest (eg eco-region).

The distribution of 'raw' range rarity scores is highly left-skewed, with a large number of very low scores, and a small number with very high scores. Therefore, for the Biodiversity Impact Metric, transformation of the range rarity values is recommended. The data were first log-transformed to produce an approximate normal distribution. The data were further scaled by dividing range rarity scores by the mean. This means that the grid cell with an average range rarity will have a score of 1. Coefficients less than 1 show areas with lower than average biodiversity importance; coefficients above 1 relate to higher than average biodiversity importance.[2]

Finally, range rarity was further standardised so that no area had a score of less than 0.05. This avoids the use of negative numbers for very small scores, and recognises the base level biodiversity significance of all ecoregions (bearing in mind that this metric is constructed from imperfect data for a very small taxonomic subset).[2]

References

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