How to use the conservation decision support tool

The conservation decision support tool is meant to facilitate global or realm wise comparisons of sites based on macroecological datasets. The spatial scale of the included datasets enables the user to compare a vast number of sites globally based on the six different conservation objectives. Nevertheless, two important points need to be kept in mind when using the decision support tool and interpreting the evaluation results.

Large-scale comparison, not local assessment

Firstly, due to the coarse resolution of most globally available datasets the decision support tool facilitates a first evaluation of the included sites but ***should not be used for local assessments***. This means that for the selection of specific areas for conservation and the practical implementation of nature conservation on the ground requires further evaluation steps that a tool like this cannot cover. These further steps should involve an on-site assessment based on additional parameters at a higher resolution (e.g. more detailed biological data acquired through surveys and observations). For a final decision, it is also crucial to consider non-biological characteristics, ranging from available infrastructure, NGO presence, political situation, access to the site and potential funding possibilities to socio-economic factors.

Underlying data uncertainty varies among objectives

Secondly, the different indicator datasets included within the six conservation objectives come with different levels of uncertainty and error margins, which affects the resulting ranking. These varying error margins should be kept in mind when interpreting the results. For example, a ranking of sites based exclusively on the biodiversity objective is less prone to errors, because the global patterns of species richness and diversity are well-known and unlikely to change substantially in the near future at the used spatial scale. In contrast, the climatic stability objective is based on modelling of future biodiversity responses to climate change, which are sensitive to human societal and political decisions and need to be regularly updated with ongoing developments and new knowledge; therefore, the ranking of sites based exclusively on the climatic stability objective is more prone to errors and could change in the future. ***We have therefore colour-coded the sliders for the individual objectives in the panel on the left based on the expected error margin, ranging from green (high certainty) via yellow (intermediate certainty) to red (uncertain). An objective can be left out entirely of the site evaluation by leaving its slider at 0.*** Below we briefly describe the underlying main sources of uncertainty that should be considered with each conservation objective.

Biodiversity objective: **Low error margin**

This objective consists of three conservation indicators:

- species richness is the number of species occurring in the region the site is located in and is derived from species range polygons provided by BirdLife International (birds [1]), IUCN (mammals, amphibians [2]) or GARD (reptiles [3]).

- endemism is the range size rarity across all species occurring within the site.

- evolutionary diversity is calculated using phylogenetic endemism (PE), which is a combined measure of evolutionary history and the uniqueness of a species community. PE identifies areas with high numbers of evolutionary isolated and geographically restricted species.

The base data for these indicators are globally available species range maps for virtually all species in the four classes of terrestrial vertebrates (mammals, birds, reptiles, and amphibians) and, for evolutionary diversity, phylogenies that describe how species are related to each other. The observed indicator patterns are well-known and therefore stable at the global scale and unlikely to introduce high amounts of uncertainty into the site evaluation, although we acknowledge that the individual species range maps are only rough representations of where species actually occur and should therefore not be used for local assessments. Similarly, some uncertainty exists in the phylogenetic tree. Due to the coarse nature of the range maps, the resulting species numbers for the individual sites should be interpreted as the number of species occurring within the region where the site is located, not as the exact number of species known to occur within the site.

Ecosystem integrity objective: Intermediate error margin

The ecosystem integrity objective includes three conservation indicators with differing error margins:

- The biodiversity intactness index (BII) connects modelled land-use pressures on biodiversity with locally observed biodiversity data from the PREDICTS project. There are several sources of uncertainty associated with this modelling approach, including the quality of the underlying biodiversity data and the modelling approach itself. We therefore consider the error margin for this conservation indicator as higher compared to e.g. the indicators included in the biodiversity or size objective, but not as high as the completely modelled indicators such as climatic stability. Details on the BII can be found in Newbold et al 2016 [4].

- The human footprint (HFP) within the sites was estimated using the data of Venter et al (2016) [5]. The standardized HFP provided by the source data includes the extent of built environments, cropland, pasture land, human population density, night-time lights, railways, roads and navigable waterways. Data included in the footprint dates partially back to 2009 and might not reflect recent developments within and around the actual sites. Therefore, we consider the error margin for this indicator to be higher compared to e.g. the indicators included in the biodiversity or size objective, but not as high as the completely modelled indicators such as climatic stability.

- The biome to anthrome change over the last 20 years measures the conversion of natural ecosystems to different human-dominated land-use categories. This indicator is derived from satellite pictures, which are classified into biome and anthrome classes [6]. From these classes, the percentage change in class coverage across the image pixels falling into each site is then calculated. This indicator has a low error margin, as it is unlikely to introduce high amounts of uncertainty into the site evaluation.

Climatic stability objective: High error margin

The climatic stability objective includes two conservation indicators with high error margins:

- projected change in biodiversity until 2050 modelled under a medium emission pathway (IPCC scenario RCP 6.0 [7]) and associated level of global warming
- projected change in tree cover until 2050 modelled under a medium emission pathway (IPCC scenario RCP 6.0 [7]) and associated level of global warming

Both indicators are based on models, which come with various sources of uncertainty, including the underlying biodiversity data, the chosen model type and the climatic drivers and associated models (details on can be found here [8,9]). Projected change in biodiversity is the turnover in species community compositions between today and 2050 based on species-specific distribution models for virtually all species of the four classes of terrestrial vertebrates (mammals, birds, reptiles, and amphibians) projected onto modelled future climatic conditions. Projected change in tree cover is measured as the percentage change between today and 2050 based on a global dynamic vegetation model that was run for modelled present and future climatic conditions. These projections give an estimate where the impacts of climate change are expected to be severe and which areas might be less affected, but they come with high levels of uncertainty and models are constantly updated as they are based on human societal behaviour and political decisions. We thus expect a relatively high error margin for the climatic stability objective compared to the other objectives.

Land-use stability objective: High error margin

The land-use stability objective is based on one conservation indicator:

- percentage of projected land-use change in a buffer zone around each site (50 km buffer from site margin) until 2050 modelled under a medium emission pathway (IPCC scenario RCP 6.0 [7]) and associated level of land-use conversion [e.g. from pasture to cropland].

The underlying modelled data are matching those for the conservation indicators included in the climatic stability objective. These models come with several sources of uncertainty and additionally depend on the applied assumptions of population growth and economic development (details on the methods and potential sources of uncertainty can be found here [10,11]). The projected changes in land-use give an indication where circumstances might be beneficial for a future increase in land-use potentially adding additional pressures on sites, but these projections are highly uncertain and need to be constantly updated as they are based on human societal behaviour and political decisions. The expected error margin for the land-use stability is thus expected to be high.

Carbon storage objective:* *Low error margin

The carbon storage objective consists of three different measures of carbon storage as a conservation indicator:

- baseline carbon, i.e. the amount of carbon stored in the above and below ground as well as the soil organic carbon of an ecosystem.
- vulnerable carbon is defined as the amount of (baseline) carbon that is likely to be released through typical land conversion in an ecosystem.
- irrecoverable carbon, is defined as the amount of carbon, that if it is lost through typical land conversion actions, and that cannot be recovered over the following 30 years.

All three measures are derived from the same data source [12] and measure carbon storage because this effectively removes the greenhouse gas carbon dioxide (CO_2) from the atmosphere, thus protecting the current climate system from global warming effects. The baseline carbon estimates for the underlying dataset have been derived from various sources and combine the best estimates available. Whilst the amount of vulnerable and irrecoverable carbon strongly depend on the estimates of carbon lost through land conversion and recovery time, the overall spatial patterns of carbon storage are well-known and likely to be stable. The expected error margin for the carbon storage objective is thus expected to be comparatively low, contrary to the climatic and land-use stability objectives which depend on complex modelled datasets.

***Size objective:* *Low error margin*.**

The only conservation indicator for the size objective is the size of the sites. This is directly calculated from shapefiles provided by the World Database on Protected Areas [13] and BirdLife International [14] and has an expected low error margin. As the calculated size depends on the accuracy of the shapefiles, this accuracy might therefore slightly affect the site evaluation for some included sites, but the errors are likely to be minor.

Literature

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