Chapter 8
Applying GLOBIO at Different Geographical Levels

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ABSTRACT

Biodiversity is decreasing at high rates due to a number of human impacts. The GLOBIO3 model has been developed to assess human-induced changes in terrestrial biodiversity at national, regional, and global levels. Recently, GLOBIO-aquatic has been developed for inland aquatic ecosystems. These models are built on simple cause–effect relationships between environmental drivers and biodiversity, based on meta-analyses of literature data. The mean abundance of original species relative to their abundance in undisturbed ecosystems (MSA) is used as the indicator for biodiversity. Changes in drivers are derived from the IMAGE 2.4 model. Drivers considered are land-cover change, land-use intensity, fragmentation, climate change, atmospheric nitrogen deposition, excess of nutrients, infrastructure development, and river flow deviation. GLOBIO addresses (1) the impacts of environmental drivers on MSA and their relative importance; (2) expected trends under various future scenarios; and (3) the likely effects of various policy-response options. The changes in biodiversity can be assessed by the GLOBIO model at different geographical levels. The application depends largely on the availability of future projections of drivers. From the different analyses at the different geographical levels, it can be seen that biodiversity loss, in terms of MSA, will continue, and current policies may only reduce the rate of loss.

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1. INTRODUCTION

Biodiversity is decreasing at high rates due to a number of human impacts. The changes in biodiversity include the shifts of entire biomes due to climate change, the appearance of new 'alien' species, that may become invasive and the decrease in abundance of species, eventually leading to local and global extinction of some of them. The recorded losses of species and habitats urged policy makers to take actions at national regional and global levels. The Convention on Biological Diversity (CBD) was formed in 1992 and in 2002 the 2010 target of significantly reducing the rate of biodiversity loss was formulated. A series of indicators was proposed in order to measure the changes of biodiversity and to be able to evaluate the biodiversity targets. The 198 parties to the Convention adopted the target. The EU decided to sharpen the target to halt the loss by 2010. By the year 2010, proclaimed as the International Year of Biodiversity by the UN, the COP – CBD admitted that the target was not met (sCBD, 2010). Several reports concluded that biodiversity loss continues and will continue in the coming decades, if major actions fail to materialize (Leadley *et al*., 2010; Pereira *et al.*, 2010).

In 2010 the CBD and other bodies are formulating new and achievable targets on biodiversity protection. An initiative to prepare appropriate indicators was launched in 2007 (BIP; www.twentyten.net), an initiative was started for designing and coupling global monitoring systems (GEO BON; www.earthobservations.org/geobon) and an Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem services (IPBES) was launched.

Models describing impacts of human induced environmental changes (drivers) on biodiversity are essential tools for analyzing the relative importance of drivers, to describe expected trends under future scenarios and to evaluate the likely effects of various responses or policy options. Models can thus be used to predict whether biodiversity targets can be met or not if necessary policy actions are taken.

For this purpose an international consortium, made up by UNEP World conservation and monitoring centre (WCMC), UNEP GRID – Arendal and the PBL-Netherlands Environmental assessment Agency, developed the GLOBIO3 model (Alkemade *et al*., 2009). GLOBIO3 is a simple method linking multiple drivers to a metric of biodiversity: the remaining mean species abundance (MSA) of original species, relative to their abundance in pristine or primary ecosystems. (see Table 1). MSA is comparable to the Biodiversity Integrity Index (Majer & Beeston, 1996) and the Biodiversity Intactness Index (Scholes & Biggs, 2005) and can be considered as a proxy for the CBD indicator on trends in species abundance (UNEP, 2004). The main difference between MSA and BII is that every hectare is given equal weight in MSA, whereas BII gives more weight to species rich areas. MSA also bears some analogy to the Living Planet Index (LPI; Loh, *et al.*, 2005), which relates changes in selected populations to a 1970 baseline, rather than to the pristine situation. MSA represents the average response of the total set of native species belonging to an ecosystem. It should be emphasized that MSA does not completely cover the complex biodiversity concept, and a combination of complementary indicators should be used in biodiversity assessments (Faith *et al.,* 2008).

The intensity of drivers is linked to changes of the abundance and occurrence of species, calculated as MSA, in simple cause-effect relationships. Observational data and data derived from experiments were used to generate these relationships. A major advantage of this approach is its generality. The relationships can be applied in combination with spatial maps, tabulated summaries and environmental model outcomes. It can also be applied at different geographical levels, ranging from sub-national to global level. It can be used in different types of studies from global

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