Collaboration for Environmental Evidence

Systematic Review No. 84

WORKING TITLE:

The relation between biodiversity and land use in the tropics: a meta-analysis.

Draft Review Protocol

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Title	**The relation between biodiversity and land use in the tropics: a meta-analysis.**
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1. Background

The current loss of biodiversity at rates significantly exceeding those in the fossil record is a source of concern to many people, conservation organizations and governments (UNEP, 2002a). Recent assessments on global biodiversity show that biodiversity at levels of ecosystems, species and genes decreases rapidly due to several driving forces, including climate change, habitat fragmentation and land use change (MEA, 2005;CBD, 2006). At the species level the process of biodiversity loss is generally characterised by a decrease in the abundance of many species, resulting in an increase in the number of threatened species and in the extinction of others (Pullin, 2002).

Land use and land cover change results in considerable areas of natural habitats being converted into cropland, pasture, urban areas, or are otherwise impacted by human uses such as forestry and hunting. This causes biodiversity loss at a local, regional and global level (Hannah et al., 1994;Chapin et al., 2000;Sala et al., 2000;Sanderson et al., 2002;UNEP, 2002b). Even though it is clear that changes in land use and land cover will cause changes in species composition, the loss of biodiversity due to land use change is not well quantified. In some studies it is either explicitly or implicitly assumed that habitat loss due to conversion of land cover implies extirpation of all species from that habitat (e.g. MEA, 2005). This assumption does not hold for every land use change as shown by Majer and Beeston (1996) and Scholes and Biggs (2005). These studies show that the degree of biodiversity loss depends on the completeness of the conversion and on the intensity of land use after conversion.

Tropical forests that are relatively undisturbed harbor many floral and faunal species (Singh and Sharma, 2009 and references therein). Due to the conversion or degradation of this primary forest to other types of land use however, many species decline in numbers or disappear from the area (Castelletta et al., 2000;Barthlott et al., 2001;Raman, 2001;Robertson and van Schaik, 2001) which largely influences global biodiversity. In the proposed review we intend to assess the effect on biodiversity of different taxa when relatively undisturbed tropical forest is converted or degraded to other types of land use.

The data collected during the review will be used to feed the Global Biodiversity Model (GLOBIO3) developed by the Netherlands Environmental Assessment Agency (PBL). The GLOBIO3 model has been developed to assess human-induced changes in biodiversity, in the past, present, and future at regional and global scales. The model is built on simple cause–effect relationships between environmental drivers and biodiversity impacts, based on state-of-the-art knowledge (Alkemade et al., 2009).

> The proposed review will be executed on behalf of the Netherlands Environmental Assessment Agency (PBL). PBL is the national institute for strategic policy analysis in the field of environment, nature and spatial planning. Among others, it performs assessments on biodiversity to evaluate policy and to explore policy options. For these assessments PBL develops indicators and models to determine the past, current and future state of biodiversity and its causes. The proposed systematic review deals with a topic relevant for an important component of one of PBL's models and will support PBL's efforts to develop policy scenario models of biodiversity responses to human interference.

2. Objective of the Review

2.1 Primary question

What is the effect on biodiversity when relatively undisturbed tropical forest is converted or degraded to other types of land use?

2.2 Secondary questions

Do different taxonomic groups show different responses when relatively undisturbed tropical forest is converted or degraded to other types of land use?

How does biodiversity differ between different types of land use?

3. Methods

3.1 Search strategy

The search aims to capture a representative sample of the literature published in peer-reviewed journals as well as other sources (grey literature), relevant to the research questions. Different sources of information will be searched in order to maximise coverage, among which will be ISI Web of Knowledge (Web of Science), Scopus and Google Scholar. Search terms such as species, tropics, primary forest, conversion, degradation, land use, habitat type, agro-forestry, secondary forest, plantation, cropland, urban area, diversity, richness and abundance will be used. Variation in spelling of search terms will be checked.

The World Agroforestry Centre (ICRAF), and in particular Meine van Noordwijk (Global Science Advisor), as well as Douglas Sheil (Center for International Forestry Research) and Francis Putz (University of Florida) will be contacted for advice and provision of any unpublished data that might be relevant to our review study.

Prior to the review proposed in this protocol, the Netherlands Environmental Assessment Agency (PBL) collected data for a global study on biodiversity related to land use. Those data are recorded in a database and part of it will be used here. Data from the tropics will be selected and supplemented with data from 2007 until 2009 under the scope of the review proposed here.

3.2 Study inclusion criteria

- **Relevant subject(s):** floral and faunal species assemblages
- **Types of intervention:** conversion or degradation of relatively undisturbed tropical forest* to other types of land use
- **Types of comparator:** relatively undisturbed tropical forest
- **Types of outcome:** change in species richness, species abundance and species diversity

- **Types of study:** all primary studies that report on the effect on species presence and abundance when undisturbed tropical forest is converted or degraded

*'Relatively undisturbed forest' in our study is defined as primary forest which is either undisturbed for as long as it is known or which was subject to mild disturbance in the past. Mild disturbance could include small scale selective logging or subsistence hunting. Such disturbance should be clearly described in the study. Old growth secondary forests do not count as 'relatively undisturbed forest' unless they are more than 100 years old. The study needs to describe the 'primary', 'intact', 'mature' or 'old growth' forest which is studied, otherwise the study will not be included in the review.

3.3 Potential effect modifiers and reasons for heterogeneity:

Variability in data will undoubtedly occur. Reasons for this variability include the type and extension of forest conversion, the temporal and spatial scale of studies, variety in the biodiversity of the reference forest, location of the study and sampling schemes and techniques. Species or taxonomic groups respond differently to conversion.

Numerous factors other than land use change affect the abundance and spatial distribution of plants and animals, including climate change, background colonisation and extinction patterns, etc.

3.4 Study collection

A first reviewer will filter the outcome of the searches by selecting those studies with a relevant title and keywords. The abstracts of these articles will be read to further determine the suitability of the study. The studies remaining hereafter, will be read in full to determine which ones are suitable for data extraction. A second reviewer will check the studies of which the suitability is unclear to the first reviewer.

At the start of the literature selection phase, both reviewers will assess suitability of several studies together to assure consistent use of inclusion criteria.

3.5 Study quality assessment

Ideally a study includes a undisturbed primary tropical forest as a reference, to which species abundance in other types of land use is compared. A table with individuals counts per species in the undisturbed reference and in other types of land use within the same area would be most suitable to calculate mean species abundance and relative species richness (of original species) (see below for a description of these biodiversity indicators). If such tables are absent, graphs and other figures will be studied to determine if they can provide information to calculate at least one of the biodiversity indicators.

Studies may differ in the number of species, or taxonomic groups studied and in the spatial and temporal scales that are covered. Sampling design and techniques may also

seriously affect the quality of the studies. We will however incorporate all studies if they fulfil the inclusion criteria.

3.6 Data extraction strategy

Only quantitative data will be extracted from the articles. Two reviewers will assess the suitability of the data in order to proceed with calculations. The data that will be extracted are stored in a database that already exists (it contains data relevant to the topic of the review up to and including 2006). If present in the article or report, tables presenting individuals or species counts in different land use types will be copied to the excel database for further calculations.

3.7 Data synthesis and presentation

The extracted data will be used to calculate three indicators of biodiversity for each land use type covered in the study. Each study will have to include a reference biodiversity calculated for the undisturbed forest (the comparator). We will apply meta-analytical techniques to combine the results of independent studies in a quantitative way (Arnqvist and Wooster, 1995).

The first biodiversity indicator is relative species richness (RSR) which is defined as the species richness found in a particular land use type, relative to that of the undisturbed forest. The second is the relative species richness of original species (RSR_{os}) which is the proportion of species in a particular land use type that were also recorded in the undisturbed forest. The third is the mean species abundance (MSA) and is a refinement of RSR_{os} as it not only accounts for the presence or absence of species but also the change in abundance of each species.

Biodiversity indicators will be presented per land use type and for each taxonomic group separately. The land use types that will be distinguished are: undisturbed forest, lightly used forest, secondary forest, agro-forestry, wood plantation, perennial crops, low-input crops, high-input crops and urban areas.

4. Potential Conflicts of Interest and Sources of Support

Tropenbos International supports this review.
There are no known conflicts of interests.

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