Ecological Indicators 10 (2010) 753–761

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

The Austrian Forest Biodiversity Index: All in one

Th. Geburek [a,*], N. Milasowszky [a], G. Frank [b], H. Konrad [a], K. Schadauer [b]

[a] Department of Genetics, Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Hauptstraße 7, A-1140 Vienna, Austria
[b] Department of Forest Inventory, Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Seckendorff-Gudent Weg 8, A-1131 Vienna, Austria

ARTICLE INFO

Article history:
Received 14 November 2008
Received in revised form 2 October 2009
Accepted 4 October 2009

Keywords:
Monitoring
State indicators
Response indicators
Conservation
Sustainable forestry

ABSTRACT

Forest biodiversity cannot be measured and monitored directly. Indicators are needed to tackle this task and must be based on scientifically valid relationships concerning different levels of biodiversity. In addition, indicators must provide tangible goals for forest policy and other relevant stakeholders. Here, we propose a single aggregated measure – the Austrian Forest Biodiversity Index (AFBI) – which is composed of different indicator values being weighed depending on their significance for the maintenance of forest species richness and genetic diversity. The AFBI consists of nine state and four response indicators. Selection of state indicators was based on the general hypothesis that forests which mimic natural conditions or are characterised by structural elements of old-growth forests maintain a high number of forest dependent species and a high genetic richness therein. Among the response indicators we considered the establishment of natural forest reserves, genetic reserve forests, seed stands and seed orchards as most relevant. Proposed operational tools, especially for state indicators, are mainly based on the Austrian forest inventory. The sum of all weighted indicator measures is rescaled as a total score that may vary from 0 to 100, so that the AFBI is simple to communicate and straightforward to apply. The AFBI gives certain weight to genetic parameters which are often neglected in previous approaches.

1. Introduction

Conservation of biodiversity is an important issue of the environmental policy in Europe. Presently, the most urgent task is the "2010 biodiversity target" (Balmford et al., 2005), which aims at halting the loss of biodiversity at all levels by the year 2010. Assessment of the status of biodiversity requires both suitable indicators and suitable monitoring. Evidently, such an assessment is a great challenge both for science and policy (Mace and Baillie, 2007). Many national and international governmental and non-governmental organisations promote biodiversity indicators in the context of global as well as pan-European processes and initiatives. Sound basic data on the status of forest biodiversity can be derived from national monitoring programs (Puumalainen et al., 2003).

Austria signed the Convention on Biological Diversity (CBD) in 1992 and ratified it in 1994. Consequently, in 2004 a conceptual project, called "MOBI-e" (Monitoring, Biodiversität, Entwicklung) was initiated by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (Bogner and Holzner, 2006). MOBI-e is expected to provide a set of indicators for assessing the state and trends of biodiversity in Austria and to fulfill the reporting requirements/obligations to the EU, particularly with reference to the "2010 target". The MOBI-e project team consisted of five expert groups participating in eight workshops. Additionally an advisory board consisting of 43 persons from the Federal Ministry of Agriculture, Forestry, Environment and Water Management, Federal State Governments, governmental and non-governmental agencies, universities and research organisations was implemented to review the outcomes of these workshops. Experts of the Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) were assigned to develop and propose indicators – on condition to consider the ongoing international indicator finding processes – to be used in the forestry sector.

The present paper reports on indicators of biodiversity in Austrian forests in the fields of management, game impact, fragmentation, conservation and genetics for use by policy makers and other relevant stakeholders including strategic planners. We propose an Austrian Forest Biodiversity Index by making the resulting data as useful as possible to both science and policy. Since the decline of genetic diversity is recognized as a major threat to long term conservation of all forms of organisms (Geburek and Konrad, 2008) we give – as an innovative element in biodiversity monitoring – certain weight to genetic parameters. We are well aware that our proposed index has not been used in practice since not all necessary data have been made available yet. Therefore, this

* Corresponding author.
E-mail address: thomas.geburek@bfw.gv.at (T. Geburek).

1470-160X/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ecolind.2009.10.003

paper is primarily intended to define baselines and targets that may help to convince policy makers implementing this index and to stimulate international discussion in this field. However, this proposal is neither intended to evaluate sustainability of multi-functional forestry nor to comprehensively survey the existing literature and review the current state of existing indicator processes because that task would go far beyond the scope of this paper.

2. Background

Many indicators have been proposed to assess sustainable forest management including its influence on biodiversity at different levels (Noss, 1999; Lindenmayer et al., 2000; Gough et al., 2008). While for political reasons a harmonized approach seems to be needed at the European level (Delbaere, 2004), political belief systems, government structures, available inventory systems among many other reasons ask for country specific solutions in order to create an adequate domestic monitoring programme (cf. Hagan and Whitman, 2006; Geburek and Konrad, 2008). Such monitoring is a great challenge and requires a large amount of coordinated efforts at different levels with broad stakeholder involvement in the development of objectives and implementation. From a conservation perspective, the key issue regarding forest management is not primarily what has caused the decline in biodiversity, but to find the most effective remedy for it (Nichols and Williams, 2006). A targeted monitoring approach designed and based on scientifically sound *a priori* hypotheses should meet both the objectives of forest policy makers and conservation practitioners (Lindenmayer et al., 2006).

Indicators are tools to assess key factors of forest biodiversity. We define an indicator as a quantitative or qualitative parameter which can be assessed in relation to the criterion maintaining of a certain biodiversity level which should be monitored periodically (Hagan and Whitman, 2006). Here, we distinguish between state and response indicators (e.g., EEA, 1999). For state indicators, we concentrate on scientifically well elaborated and undisputed relationships between forest inhabiting species and underlying environmental factors. For response indicators, we focus on countermeasures that have been proven in the past to preserve forest biodiversity elements through active involvement of policy makers, landowners and stakeholders.

3. The Austrian Forest Biodiversity Index (AFBI)

The proposed AFBI is an aggregated index. First single indicator values are calculated ranging from 0 to 100; then each indicator is weighed depending on its relevance for the maintenance of forest biodiversity. Selection and weighing of indicators has been done in accordance with the advisory board of MOBI-e (see above). The weight factor is scaled from 1 to 5 (1 being minor and 5 major). Finally, the sum of all weighted indicator measures is rescaled as a score theoretically varying from 0 to 100, so that the AFBI is straightforward to apply (Fig. 1).

The maximum value of the AFBI is obtained when the following conditions are fulfilled: biologically sustainable managed forests consist exclusively of trees species typically found in the potential natural vegetation; they have more than 10% deadwood volume in relation to the total standing volume; they harbour veteran trees; they have a sufficient natural regeneration layer, if the forests are in the regenerative phase, they have been established with genetically appropriate forest reproductive material, if artificial regeneration is unavoidable; regeneration is not negatively affected by game stock. Furthermore, forest types are sufficiently represented in natural forest reserves, and the gene pool of indigenous forest tree species is sufficiently conserved by genetic reserve forests; all forest tree species are safeguarded through an adequate number of seed stands; all rare and/or endangered forest tree species are conserved in seed orchards and the use of their seed is promoted.

We propose to collect adequate field data for a representative assessment of forest biodiversity within the framework of the Austrian forest inventory (AFI) (see also Newton and Kapos, 2002). This sampling scheme is characterised by quadratic tracts systematically distributed across Austria in a regular grid system of 3.89 km × 3.89 km. Sampling units relevant for biodiversity assessment are four sample plots each of 300 m^2 located at the four vertices. In total, 11,000 sample plots can be considered (Gabler and Schadauer, 2008). For most indicators that are not based on the AFI, raw data can be provided by existing BFW databases.

Indicators that are not exclusively used in forests, such as the Austrian soil inventory (http://bfw.ac.at/rz/bfwcms.web?dok=2966) or monitoring by laypersons for birds (http://www.birdlife.at/), will not be mentioned here, because they are considered to be implemented independently (see Bogner and Holzner, 2006).

In the following, each AFBI indicator is described in detail.

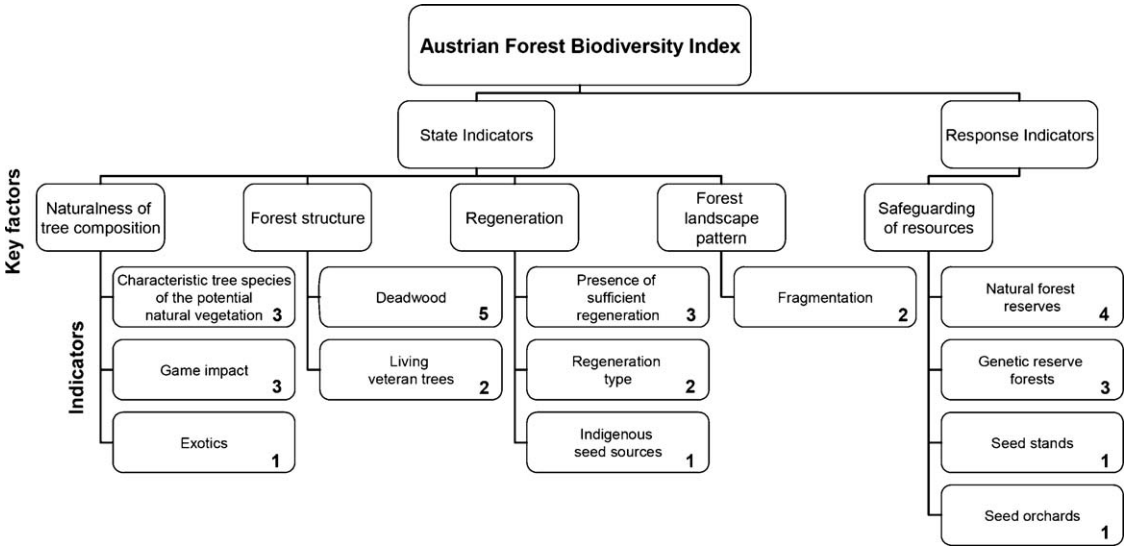

Fig. 1. Components of the Austrian Forest Biodiversity Index (AFBI); 13 indicators are linked to their key factors; indicator weights are given as numbers (minimum 1, maximum 5). Maximum AFBI = 13 indicators × 100 value points × 31 weighing points = 40,300 points (=100%).