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Selection and application of spatial indicators for nature conservation at different institutional levels

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Summary

As European integration increasingly affects pan-European nature conservation, indicators for the assessment of habitats are urgently needed to support ecosystem integrity monitoring as well as the target of halting biodiversity loss by 2010. The Natura 2000 network of protected sites with a strong focus on the protection of habitat types and strict monitoring obligations is now legally binding for all Member States. From a set of indicators that have been proposed for habitat monitoring by the SPIN project (Spatial Indicators for European Nature Conservation) we describe measures of landscape structure and soil function and their potential for the monitoring and management of protected areas and the surrounding landscape. In a case study from Austria, we show that structure-related indicators hold potential for the documentation of local-scale changes on a degraded raised bog Natura 2000 site. In a regional scale case study in northern Germany, we show how landscape metrics relate agricultural statistics, e.g. farm size and livestock density to landscape structure. In a third case study from Slovenia, we show how coarse-scale soil data can be disaggregated to finer scale by integrating topographic information and additional parameters for modelling, and production of soil-related habitat suitability maps. From these case studies we provide an overview of some of the critical issues affecting the selection and application of spatial indicators for nature conservation monitoring tasks. End users of spatial indicators work at different scales and in different biogeographical regions. The indicator selection and application demonstrated in our three case studies reveals the capability to contribute to a more quantitative evidence base for monitoring and management of biodiversity in Europe.

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Introduction

Biodiversity conservation was established firmly on the political agenda with the Convention on Biological Diversity (CBD), the main outcome of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. In Europe, the implementation of the CBD is based on the EC Biodiversity Strategy and its four sectoral Biodiversity Action Plans (Commission of the European Communities, 1998, 2001), as well as the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) (1993). A more recent driver of the political biodiversity agenda is the '2010 target' agreed at the meeting of the European Council in Gothenborg in June 2001 (Delbaere, 2004) which sets the ambitious target of halting biodiversity decline within the EU by 2010.

A number of indicator schemes are currently being established to provide an evidence base for national and EU level biodiversity conservation. These are the European Environment Agency (EEA) core set of biodiversity indicators, the EU biodiversity headline indicators, as well as indicators for the implementation and evaluation of effectiveness of the EC Biodiversity Strategy and Action Plans 'BioIMPs' (Delbaere, 2004). A report summarising the latest status of development and use of biodiversity indicators to monitor progress in, and to support the achievement of the 2010 target in Europe can be found in ETC (2004).

With regard to the practical issue of protecting the EU's rich biodiversity heritage, the Natura 2000 network of protected sites is one of the most important legally binding mechanisms in Europe. The Natura 2000 network combines Special Protection Areas (SPAs), established under the Birds Directive and Special Areas of Conservation (SACs) under the Habitats Directive (Commission of the European Communities, 1992). The Natura 2000 concept was characterised as potentially the most significant initiative for nature conservation at European scale (Krott et al., 2000; Weber & Christophersen, 2002). More critical reviews concern the perceived inflexible top-down approach as well as the focus on the concept of protected areas (Hiedanpää, 2002; Ledoux, Crooks, Jordan, & Turner, 2000).

Apart from the indicator requirements for the EU or national level (headline indicators), there is an increasing need to supply locally and regionally relevant and spatially explicit indicators to comply with the strong monitoring component of Natura 2000. Most indicators described in the literature relate to statistical or administrative units but do not reflect the information needs at lower levels, which require spatially explicit information (Blaschke, 2001; OECD, 2001; Weiers, Bock, Wissen, & Rossner, 2004). Spatially explicit indicators provide quantitative information on habitats that can be used to form part of a conservation status assessment.

Within the EU-funded SPIN project (Spatial Indicators for European Nature Conservation) it became clear that the user requirements differed greatly depending on the spatial scale (from local to national level) of the user's involvement in EU nature conservation. This was confirmed throughout the project by feedback from questionnaires sent out to end users as well as from personal interviews with decision makers at the EU level.

The SPIN project followed a multiple indicator strategy with a combined set of indicators to characterise the status of the test sites. Several groups of indicators were developed, applied and tested within the project: biodiversity indicators (Mitchley & Xofis, 2005), change indicators (Kleinod, Wissen, & Bock, 2005), pressure indicators as well as structural and functional indicators. These indicator categories are not mutually exclusive, often need to be applied together and sometimes the most appropriate level depends on the application context. In this paper, we focus on the last two categories of indicators, structural and functional, and their application to different nature conservation tasks in three different case study areas. Structural and functional indicators can form the basis of new indicator categories. For instance, changes in structural indicators over time could be used to develop a change indicator or could contribute to the development of pressure indicators or biodiversity indicators.

Furthermore, the combined application of the indicators can be a meaningful asset for investigations of drivers of landscape change. There is growing recognition of the need to combine the protection of valuable habitats and species with a more holistic approach that includes biodiversity protection outside protected areas (Hossell, Ellis, Harley, & Hepburn, 2003). We widen our scope from the monitoring objectives of the local Natura 2000 site to include, e.g. agricultural land surrounding protected areas.

The first case study from Austria is a local level nature conservation area that forms part of the Natura 2000 Network and evaluates the potential of quantifying landscape structure for monitoring the conservation status of a raised bog. The second case study from Germany describes a larger, regional scale case study area, in which several Natura 2000 sites are embedded and investigates monitoring and evaluation of the impacts of