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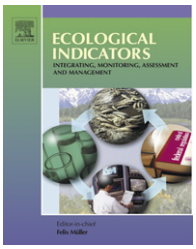

Perennial polypores as indicators of annual and red-listed polypores

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ABSTRACT

Many polypores are specialized in their requirements for substrate and environment, and they have been suggested to indicate the continuity of coarse woody debris or naturalness of a forest stand. However, the use of polypores as indicators of conservation value is restricted by the temporally limited appearance of annual fruit bodies. We studied whether the species richness of perennial polypores (perennials) can be used to predict the species richness of annual or annual red-listed polypores (annuals). Our data included 1471 separate datasets (sample plots or larger inventoried areas) in different parts of Finland and Russian Karelia, ranging from the southern to northern boreal zone. At the large scale (the whole area) the number of perennials explained about 70% of the variation in the number of annuals, and about 67% in the number of red-listed annuals. A minimum set of 40–60 perennial occurrences gave a reliable estimate on the species richness of annuals, and 60–80 occurrences on the species richness of red-listed annuals. The richness of perennials predicted the richness of annuals and, in particular, richness of red-listed annuals, better than the size of inventoried area. According to our results, perennial polypores can be used as a surrogate for overall polypore species richness in natural and seminatural boreal forests, but the predictive power is weaker in managed forests. In addition, the relationship between the perennial and annual species seems to differ in different vegetation zones, management types and forest types. Due to this variation direct application of the indicator values derived from different vegetation zones and management or forest types are not recommended. Since perennials are easier to identify than annuals, detectable throughout the year, and have much smaller year-to-year variation, their use as an indicator group seems to offer advantages regarding the timing and cost-efficiency of inventories.

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1. Introduction

Long-term conservation of biological diversity in boreal forests is a major challenge for modern forestry, which has traditionally concentrated on producing timber for industry. The emphasis in the research of forest management and forest ecology has recently shifted towards the questions of ecosystem management and protection of important habitats (Angelstam et al., 2004). Conservation activity has grown, and conservation programmes and networks of protected areas are developed to reduce further losses of biodiversity (Parviainen et al., 2000). More focus is also turned to the cost-efficiency of conservation measures (Juutinen and Mönkkönen, 2004). Well-substantiated conservation efforts require data on ecological characters and species composition of the proposed conservation areas. However, complete species inventories of most taxa are impossible or expensive even in very small areas (Kaiser, 1997; Lawton et al., 1998). Rapid and reliable assessment methods are thus needed to evaluate the composition of species assemblages, and to survey and prioritize the conservation value of different forest areas.

Considering species assemblages, the use of indicator species or species groups has been suggested to fulfill the need for rapid biodiversity assessment (e.g. Pearson, 1994; Jonsson and Jonsell, 1999; Manne and Williams, 2003; Similä et al., 2006). The results of studies in different biogeographical regions and on different species groups have been somewhat contradictory. Several studies have shown that the covariation in species richness of different taxa is often low (Prendergast and Eversham, 1997; Jonsson and Jonsell, 1999; Berglund and Jonsson, 2001; Hopkinson et al., 2001; Similä et al., 2006), while fewer studies have found useful indicator species or species groups (Kerr et al., 2000; Jonsell and Nordlander, 2002; Lawler et al., 2003). The potential ability of some taxa to serve as indicators of the overall biodiversity (Faith and Walker, 1996; Jonsson and Jonsell, 1999; Hopkinson et al., 2001), or of the ecological integrity of an area (Carignan and Villard, 2002) has also been studied, with the conclusion that a single species group rarely functions as a general indicator of conservation aspects.

It can also be questioned whether species-oriented conservation is the most efficient avenue of conservation at all, or whether efforts should be concentrated on the preservation of whole ecosystems (Franklin, 1993; Simberloff, 1998). The extant species assemblages constitute, nevertheless, the most important criteria in a more detailed evaluation of the conservation value of different areas, and thus some information on species must be gathered even though the focus is in preserving ecosystems. Several criteria have been proposed for the selection of indicators (e.g. Noss, 1990; McGeoch, 1998; Juutinen and Mönkkönen, 2004). For instance, the data for the indicator should be relatively easy to sample, the indicator should be sufficiently sensitive to environmental changes, widely applicable, and relatively insensitive to sample size. No single indicator taxon is likely to fulfill all the properties of an ideal indicator; therefore, different indicators are needed for different purposes.

It indeed seems unlikely, that any species group could serve as a general indicator of the overall biodiversity, or of other taxa with very different ecological requirements. Thus, we would argue, that the most promising avenue of using indicator species appears to be that the species richness of an ecological group is predicted with a subgroup of its own members, or with another taxonomic group sharing similar niche requirements. Ideally, an indicator group has higher detectability or some other attributes making it a more useful target for practical surveys and monitoring than the entire species group of interest.

Among stand structural features, the amount and quality of coarse woody debris (CWD) have been suggested as potential surrogates for evaluating the conservation value of forest areas (Humphrey et al., 2004; Stokland et al., 2004; Juutinen et al., 2006). Polypores have been proposed to function as good indicators of the CWD continuity and naturalness of a forest area (Bader et al., 1995; Kotiranta and Niemelä, 1996; Müller et al., 2007), and they are commonly used for those purposes in the Nordic countries (Karström, 1992; Kotiranta and Niemelä, 1996; Nitare, 2000; Stokland and Kauserud, 2004) even though some critique has also been presented (Nordén and Appelqvist, 2001). In addition, some studies indicate that polypores could work as indicators of the species diversity of other saproxylic taxa (Jonsson and Jonsell, 1999; Juutinen et al., 2006; Similä et al., 2006).

In Finland, about 25% of all polypore species form fruit bodies that live for several years (Niemelä, 1986). These species are called perennials in this paper. The rest of the species form mainly short-living fruit bodies living from few weeks or months to a maximum of 1 year. These species are called annuals in this paper. The majority of annual fruit bodies appears in boreal forests from August to November, and there are often large year-to-year fluctuation in their occurrence and abundance. In unfavourable years, some annual species may not form fruit bodies at all, and thus remain undetectable.

Polypores with perennial fruit bodies form a group of species which are easily detectable throughout the snow-free season, and have little year-to-year variation in their occurrence. In the boreal forests, there are only a few species groups which are possible to detect throughout most of the year with the same frequency and same perceptivity. These groups (including perennial polypores, woody plants, epiphytic lichens, etc.) are also the only species groups in boreal forests whose occurrence is not substantially influenced by the weather or other conditions that may vary within a year or between the years.

In this paper we studied the possibility to predict the species richness of annual polypores, and the species richness of annual red-listed polypores, based on the richness of perennial polypore species. The strength of the relationships between the occurrences of these species groups will reveal the utility of the perennials as indicators of the whole polypore diversity. Furthermore, we examined the effects of vegetation zone, dominant tree species and the management history to the correlations between the perennial and annual species diversity. We also focused on what is the size of the inventory area and sample size required for reliable conclusions based on the perennial species diversity.

To accomplish this, we compiled a comprehensive polypore species data collected by several Finnish polypore