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Comment on "Opinion paper: Forest management and biodiversity": the role of protected areas is greater than the sum of its number of species

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1 Introduction

In a recent opinion paper, Schulze et al. (2014) compared animal and plant richness of protected areas with intensively and extensively managed forests in Germany and in Romania. Schulze et al. hypothesised that "differences in management practice have contributed to the observed differences in diversity of central versus southeastern Europe". The study concludes with a hypothesis that "clear-felling followed by natural succession may even be superior to the protection of old-growth forests, regarding biodiversity". We wish to continue the dialog on this important topic, and express our somewhat different perspective on the conclusions and implications of this particular paper (Schulze et al., 2014). We agree in principal that emulating natural disturbance regimes and creating openings via clear-fellings can be one of several management tools to introduce heterogeneity in otherwise homogenous mid-seral stands that have resulted from past management (Franklin and Johnson, 2012). However, we believe it is misleading to compare clear-fellings to protected areas dominated by old-growth or primary forests using a simplistic measure of biodiversity and without a landscape perspective on the role of different habitat types (successional stages) to sustain biodiversity over time and space. We identify some critical limitations of the original opinion paper and offer an alternative perspective to the authors' conclusions regarding protected forests.

We highlight three major issues of the opinion paper of Schulze et al. (2014): limited scope, an incomplete conceptual framework, and conjectural interpretations unsupported by solid data.

2 Limited scope

The suggestion that clear-felling followed by natural succession ("cut and leave") is superior to old-growth protection for biodiversity is far too elementary and unnecessarily simplifies the concept of biodiversity. Commercial forest management (including extensive and intensive types) often results in even-aged stands that lack many critical structural habitat elements (e.g. snags, coarse woody debris, vertically complex canopies), while most species in European forests are adapted to past natural disturbance regimes characterized by a mosaic of different successional stages and structural complexity across varying spatial scales (Nilsson and Ericson, 1997). Through ecological succession, species composition of an area may change over time. Different species depend on different successional stages, including old growth (structurally complex forests dominated by large old trees) as well as structurally complex early seral stands (those following severe canopy-opening disturbances) (e.g. Halme et al., 2013; Lehnert et al., 2013; Sippola, 2001; Swanson et al., 2014). This landscape-scale gamma diversity, and the continuity of habitats over broad scales, is equally relevant as the stand-scale differences in alpha diversity that Schulze et al. (2014) reported. Dead wood and other habitat features are often found in old-growth conditions (e.g. Bobiec, 1998; Standovár et al., 2006), and their presence across space and time is a precondition for many species (Müller et al., 2007). These types of stands, often found only in protected or inaccessible areas, constitute a tiny fraction of the contemporary landscape in central and southeastern Europe (Parviainen et al., 2000; Wesołowski, 2005; Schulze et al., 2009). Consequently, they play a critical conservation role for many species, ecosystem services, and carbon storage (Knohl et al., 2009; Luyssaert et al., 2008). The opinion paper did not assess the role of protected or wilderness areas beyond a select group of species found. Nor did it consider protected area value in the landscape context of the recent management practices discussed, past forest protection differences, and overall forest and land use. Schulze et al. (2009) did not account for possible extinction debt (see e.g. Berglund and Jonsson, 2005) associated with different forest use history. In Germany, the forests have been managed more intensively for centuries compared to Romania, and the missing species are likely the result of the slow erosion of biodiversity due to the high level of habitat alteration through intensive management. De-emphasizing the well-established role of protected areas is likely to have adverse effects on primary forest remnants and some taxa (e.g. Nordén et al., 2013; Penttilä et al., 2004; Stokland and Larsson, 2011; Lesica et al., 1991; Niemelä et al., 1993).

3 Incomplete conceptual framework

Focusing only on species richness of selected groups, such as trees and herbaceous plants, is not a comprehensive or robust measure to compare different forest management strategies with respect to biodiversity (e.g. Müller et al., 2007; Cadotte et al., 2010; Mouillot et al., 2013). Although there may be a greater number of early seral species in clear cuts in the region, they are not truly at risk in the majority of contemporary landscapes dominated by early successional habitats associated with recent forest management (Knorn et al., 2012a, b). From a conservation standpoint, a taxa that is abundant in clear-felling settings (e.g. *Calamagrostis* spp.) is clearly not equivalent to a rare species (e.g. *Linnaea borealis* L.) found almost exclusively in protected areas of old forests. Moreover, while such basic measures of species richness can have value, they should virtually always be complemented by measures of evenness and abundance to paint a more complete picture of community response (e.g. Donato et al., 2009).

Biodiversity conservation and planning rely on standards of species' vulnerability and irreplaceability, neither of which is conveyed in the analysis of species richness of a limited subset of taxa. The study is focused mainly on trees and herbaceous plants, and several taxonomic groups with high conservation value (e.g. fungi, lichens, saproxylic beetles) were not considered. For decision making, a more comprehensive ranking of suitable indicators (e.g. umbrella species, sensitive species, habitat association or functional guilds, species assemblages, and habitat types) is needed (Nilsson and Ericson, 1997; Müller et al., 2007); however, it should be noted that even rare species may be poor umbrella species because their distributions are too highly restricted (Fleishman et al., 2000).

4 Conjectural interpretations unsupported by solid data

The results presented in the opinion paper are based on simplistic, vague data and analysis and are without consideration of spatial relationships among sites and the implications for biodiversity. The study is based on an extensive but poorly interconnected assemblage of data, which seem to be more suitable for the comparison of the two management types (extensive versus intensive); the comparison of managed and protected types had a marginal focus. The paper provides no information regarding the number of plots in different types of forests; only Table 1 shows a review with sources of data, and it is partially reliant on personal communications with the lead author of the paper. Some of the data treatments are incomprehensible, with an apparent lack of standardization leading to illogical findings. For example, a difference between 10 and 46 bird species per unit area virtually never occurs in temperate forests, and data for the carabids apparently were not standardized (e.g. Müller 2005). The paper is not statistically rigorous and the analysis is effectively not reproducible (this indicates a problem with opinion papers in general, rather than only this paper in particular). Repro-

ducibility of the results and a higher level of transparency of the data might be possible by providing supplementary material including species and structural variables. For example, the numbers of species and volume of wood in plots of the same sizes perhaps could be used to statistically evaluate differences between the two regions. A statement such as "the coarse woody debris was not higher in protected than in managed forests in Romania" is not supported by any quantitative test, and it does not seem to be true if comparing deciduous forests in the paper's Table 1. Furthermore, it is not consistent with a well-established body of literature from similar temperate regions around the world (Burrascano et al., 2013).

The conclusions of the paper, particularly the speculation about superiority of clear-felling over the protection of old-growth stands, are not well connected to or supported by the data presented.

5 Conclusion

While we are inclined to agree with the paper's suggestion that "... forest protection per se does not yet ensure the maintenance of species", we suggest that protected forests represent a critical complement to sustainable integrative forestry practices employed on the majority of landscapes (Keeton, 2007; Bollmann and Braunisch, 2013). The Carpathian Mountains in Romania encompass the largest remaining areas of natural and old-growth forests in central Europe (Veen et al., 2010), and are recognized by UNESCO and other international organizations as globally significant due to their imperilled conservation status (Keeton et al., 2013). There has been a recent trend toward large-scale destruction of mountain forests by clear-felling, including primeval and other natural forests (Knorn et al., 2012b) across the whole Carpathian region (European biodiversity hotspots) over the past few decades (Kuemmerle et al., 2007, 2009; Griffiths et al., 2014); almost no differentiated forest management approach is applied in protected areas of Romania (Knorn et al., 2012a). Loss and degradation of habitat is a major reason why many of Europe's species are threatened or extinct, with shifting patterns of forest use impacting species populations differentially (Wallenius et al., 2010). We appreciate the efforts to encourage dialog on this subject by Schulze et al. (2014). However, unsubstantiated opinions on such critical topics may encourage or support further destruction of natural areas and their related functions; hundreds of rigorous peer-reviewed scientific papers discuss biodiversity, yet it continues to decline (Butchart et al., 2010). Opinion articles with limited scope, an incomplete conceptual framework, conjectural interpretations unsupported by solid data and analysis should not be relied upon for decision-making regarding protection of old forests in central and eastern Europe. These forests are already glaringly absent in most areas relative to the evolutionary history and ecosystems in which many species assemblages evolved, and they are essential to an overall landscape conservation strategy.

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