



Reply to Mikoláš's comment on “Opinion Paper: Forest management and biodiversity” by Schulze et al. (2014)

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We highly appreciate the response to our opinion paper by a group of conservation scientists as this follows our aim of starting a discussion. While the comment agrees with our main conclusion, namely that “forest protection per se does not yet ensure the maintenance of species”, the main content of the comment does not appear to be very constructive because it does not present additional data or a general conceptual framework beyond the authors’ claim that “we need more old growth forests”.

We wish to respond because our aim was to initiate a discussion and because we should correct some claims which are false.

The main objective of the opinion paper was to show that management must be included in concepts of preserving biodiversity and we note that the authors of the comment agree that “differences in management practice contributed to the observed differences in diversity of central versus southeastern Europe”. This aspect has not been included in conservation strategies of the past. We have shown that there are management practices which contribute to diversity more than others. In our opinion paper we included forests which were protected from wood extraction, and this included old-growth forests. Thus, we were never opposed to the possible conservation of old growth, but we pointed to the need to put this into a management context. We note that there seems to be agreement regarding the evaluation of landscape diversity.

The authors of the comment claim that our opinion paper was written without a landscape perspective. This is not true. Our opinion paper is based on data derived from a grid-

based inventory in Germany (about 2000 grid points across an entire landscape in Thuringia, Germany) and in Romania (national forest inventory of about 5000 grid points across all forest types in Romania). Clearly, we have to publish these large data sets in detail elsewhere (see Schulze et al., 2014 a, b). Our opinion paper is an objective description of landscapes at various grid scales ranging from 4 km × 4 km down to 100 m × 100 m. Surprisingly, the authors of the comment discard the landscape facts, and focus on a few selected observations of old growth remnants without any information about their plot numbers and observations nor about information regarding the actual and surrounding landscape.

The comment states three main areas of critique, without presenting new of additional data or concepts. The claims are as follows:

1 The opinion paper is criticized as having limited scope

As said before, we are not aware of any other study that is grid-based and includes the whole range of management options from coppice to old growth stands. We clearly included all types. Conservation is regarded as one form of “management”.

The comment does not broaden the scope, but rather narrows it to the claim that old growth forests are pillars of diversity in a landscape, without presenting any species or data. It would have been desirable if our initial Opinion Paper table would have been supplemented by an additional

section on "old-growth stands". In contrast to the statement in the comment, we would like to clarify that the opinion paper implicitly included beta and gamma diversity because we worked on a national grid.

The old growth forest has become an "icon" of conservation, the assumptions being that (i) they have more deadwood, (ii) old growth stands play a critical conservation role, (iii) they offer more ecosystem services and (iv) they store greater amounts of carbon. However, none of these claims are supported by data. We show in the opinion paper that in the Romanian management mode "cut and leave", as we call it, the deadwood stores reach levels which are comparable to those in protected forests. Based on our inventories, the data of managed and unmanaged forests are not different.

The comment paper, which is confined specifically to old growth forests, does not list any species. It neither specifies which additional ecosystem services are provided by old growth stands that are not also provided by managed forests nor does the comment critically elucidate the fraction/proportion which these remnants contribute at the landscape level. In a recent study we show (Schulze et al., 2014b) that the net carbon flux is not higher in old growth than in managed systems because respiration is higher in old growth stands. Also, the "extinction debt" is even negative for trees species in managed systems. We calculated the extinction rate for vascular plants for central Europe, and it is far below global average (Schulze et al., 2014b). If old growth stands in deciduous forests contain only one remaining species, namely *Fagus sylvatica*, the extinction rate cannot be high as far as the trees are concerned. The authors ignore the fact that old growth beech forests may show low plant diversity over hundreds of years.

We would also like to point out that the remnants of old growth forests occupy very special sites in a landscape, such as steep slopes or deep canyons. These sites are not representative of the habitats of the main landscape, and may thus contain organisms which are confined to these special ecological conditions which are independent of the conservation status. A considerable number of saproxylic beetles, woodland ground beetles and woodland molluscs that are presently labeled as beech forest species are in fact linked to an adequate frequency and habitat continuity of admixed secondary tree species (like *Quercus*, *Acer*, *Fraxinus*, *Ulmus*) within beech forest landscapes (Walentowski et al., 2010, 2014).

2 The opinion paper presents an incomplete conceptual framework

Of course, we focus on trees and herbs based on the study by Scherber et al. (2010) that all other organisms are linked to this primary diversity. There are several studies that show that our trend is accompanied by mosses and lichens (Boch et al., 2013). The authors name *Linnaea borealis* as an example for a vascular plant species that survives only in old

growth stands. This is not a good example because *Linnaea* grows in boreal forests at all levels of management, and it disappeared from Thuringia in 1941 despite conservation (Rote Listen Thüringens, 2011). Thus, it is important to recognize that environmental forces other than management and conservation may cause species losses (e.g., the Salamander decline; Stokstad, 2014), and it remains important to differentiate between these causes and to realize that this is not the result of land management, not to claim that conservation of old growth will prevent extinctions. We have analyzed the distribution of endangered plant species and were able to show that the problems are not caused by forest management (Schulze et al., 2014b). In fact, there are only three species in Germany with particularly local distributions, under conservation, which have been identified as endangered and are strictly protected. It is not justified to relate the list of endangered species to forests and to forest management.

It would have been helpful if the comment had contributed additional organismic groups within our framework. But unfortunately this has not yet been done. The comment merely states that "rare species may be poor umbrella species". We would even question the usefulness of umbrella species because the proposed "umbrellas" are usually not based on a reliable species analysis and therefore have frequently been criticized (Roberge and Angelstam, 2004; Seddon and Leech, 2008).

3 Conceptual interpretations unsupported by solid data

We would welcome any additional relevant information, which unfortunately the comment does not present. Our data are based on systematic national inventories, with regional and landscape extents. We consider this approach as being more rigorous than a subjective claim that old growth stands are "more valuable". We agree that deadwood is an important resource for a high diversity of organisms, but we find the exaggerated focus on deadwood unjustified. After all, wood completely decomposes and does not contribute to soil carbon stores (Kahl et al., 2012). We do not agree with the claim that the value of a forest ecosystem can be assessed only by the amount of deadwood. In the "cut and leave" mode of management, 50 % of the wood produced is deposited on the forest floor. Since *Fagus* deadwood generally decays within 1 or 2 decades, this provides the maximum amount of deadwood that can be sustained in a closed forest excluding catastrophic events. Deadwood is only one of many components of an ecosystem, and since soil carbon is maintained by annual leaf fall and root turnover, all forest services could be maintained even if there were no deadwood. Thus, the exaggerated focus on deadwood provides a limited basis for evaluating ecosystem functions (except for its role in nursing young trees and providing the cultural service of biodiversity).

Obviously, we do not want to support land-use change, but harvesting is part of management, and a harvested area does not necessarily imply deforestation. Clear cuts are one kind of disturbance, and it is not the responsibility of management to create old growth forest, but to use forest resources for human needs. Thus, without including management objectives, we will not be able to reconcile the conservation and land-use controversy. There are many additional factors which determine diversity such as deer browsing in Germany, grazing in Romania, hunting and tourism, none of which are taken into account by conservation.

The remnants of old growth do hold aesthetic value for humans and as such they should be conserved. In addition, they can be important refuges and stepping stones for biodiversity conservation, but support for this is scarce (Niemela, 2001). The few habitats that remain and which are mostly appreciated by the public are, however, not representative of the wider landscape. Thus, the justification for conserving old growth may need some revision.

Canadell and Schulze (2014) have shown that the demand for wood and fiber will increase in the near future to the extent that global demand for forest land will be such that remote and previously inaccessible land will be required for human use, mainly for wood extraction. Thus, it is timely to think about ways to look for types of management that are based on rational considerations and multiple objectives, including the preservation of biodiversity (Gadow, 2013). The "cut and leave" mode of forest use has been regarded as pure exploitation in the past, but in view of species conservation, it seems to be a successful method of operation.

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