



Land ownership affects diversity and abundance of tree microhabitats in deciduous temperate forests



Franz Johann^{a,*}, Harald Schaich^{a,b}

^aChair for Landscape Management, Institute of Earth and Environmental Sciences, Faculty of Environment and Natural Resources, University of Freiburg, Tennenbacher Str. 4, 79106 Freiburg, Germany

^bDepartment of Environmental Planning, Landscape Ecology and Nature Conservation, Environmental Protection Agency, City of Freiburg, Talstr. 4, 79102 Freiburg, Germany

ARTICLE INFO

Article history:

Received 19 June 2016

Received in revised form 19 August 2016

Accepted 21 August 2016

Available online 29 August 2016

Keywords:

Tree microhabitats

Microstructures

Biodiversity conservation

Land tenure

Dead wood

Forest management

Stand structure

ABSTRACT

Tree microhabitats – e.g. cavities, bark pockets or crown dead wood – have been described as key habitat elements, which are particularly important for birds, bats and xylobiont insects. They are therefore vital for promoting biodiversity in forest ecosystems. The occurrence of such tree microhabitats in forest stands is closely related to forest management. In Central European cultural landscapes, forest areas are subdivided into a mosaic of stands under different ownership types and owners vary in their forest management strategies and practices. However, little is known about the influence of forest ownership on the density and diversity of tree microhabitats in forest stands. In this study, we investigate tree microhabitats – categorised into 31 different tree microhabitat types – within forest stands in clusters of different ownership types. We compare small-scale private forests, municipal forests and state-owned forests in deciduous temperate forest ecosystems in south-western Germany. Our results reveal that the density of tree microhabitats per hectare is more than twice as high in small-scale private forests than in municipal or state-owned forests. Similarly, the diversity of tree microhabitats related to area is highest in small-scale private forests. Moreover, we found differences in tree microhabitat occurrences under the three ownership types at the single tree level. Besides ownership type, relevant indicators for tree microhabitats are basal area of forest stands as well as tree vitality and diameter. Within the study region, the share of tree microhabitats provided by small-scale private forests plays a substantive role for overall forest biodiversity. Management of publicly owned forests should promote a higher density and diversity of tree microhabitats to comply with goals of close-to-nature forest management approaches. In conclusion, we regard the type of forest ownership as a relevant driver of tree microhabitat occurrence. Ownership should therefore be considered in the design of policy frameworks and instruments which address the promotion of forest biodiversity.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Forest management drives forest biodiversity (Putz et al., 2000). Negative consequences of forestry affect many species (e.g. Brunet et al., 2010; Lonsdale et al., 2008). This may in turn reduce quality of life because human well-being and biodiversity are closely related (Cardinale et al., 2012). On the other side, wood is needed as a regrowing resource for a wide range of human purposes. Against the backdrop of this conflict of interests, extended knowledge of the factors which influence forest biodiversity is required. One crucial link between forest management and forest biodiversity are tree microhabitats

(TMHs). They are forest features which are strongly regulated by forest management and at the same time are a determining factor for forest biodiversity (Regnery et al., 2013a; Winter et al., 2005).

TMHs are referred to in the relevant literature as ‘special tree structures’ (Winter et al., 2005), ‘tree microhabitat structures’ (Michel and Winter, 2009), or ‘tree microhabitats’ (Larrieu and Cabanettes, 2012; Larrieu et al., 2012; Regnery et al., 2013a; Vuidot et al., 2011; Winter and Möller, 2008). TMHs such as tree holes, are determining factors of forest biodiversity (Michel and Winter, 2009). In France, 41% of forest-related birds are tree hole dwellers (Blondel, 2005). More than half of Germany’s bat species use tree roosts (Dietz, 2013). Decay holes create TMHs for rare epiphytic lichens and mosses (Fritz and Heilmann-Clausen, 2010). Many xylophilous insects depend on TMHs because of their specialization on dead wood, lignicolous fungi, mould or sap-runs.

* Corresponding author at: August-Becker Str. 7, D-76846 Hauenstein, Germany.
E-mail addresses: franz.johann@mars.uni-freiburg.de (F. Johann), harald.schaich@stadt.freiburg.de (H. Schaich).

For other insect species, the tree nests of birds, bats or social insects are essential habitats (Köhler, 2000).

Diversity and density of TMHs are key attributes of biodiversity and are particularly present in old-growth forests. A higher number of species occur where TMHs are more abundant (Winter et al., 2005; Regnery et al., 2013a). TMHs have therefore been proposed as indicators for measuring forest ecosystem biodiversity (Michel and Winter, 2009). In Germany, forests are the second most widespread land cover type after agriculture (Bolte and Polley, 2006) and cover 31% of the land area (BMELV, 2005). Prior to human logging activities, 85–95% of the land surface had been covered by forest ecosystems (Korneck et al., 1998). Hence, forest structures and tree characteristics such as TMHs are of crucial significance for the conservation of large-scale biodiversity. National policy agendas have taken biodiversity requirements for forest management into account (e.g. BMUB, 2015).

The impact of land ownership on biodiversity has been revealed in previous studies, e.g. by Lovett-Doust et al. (2003), who revealed significantly greater rare-species richness on publicly owned land in comparison to private land in Canada. Schmithüsen and Hirsch (2010) summarised forest ownership data from 23 European countries and calculated that publicly owned forest lands represent 50.1% of all forests. Roughly 20% of German forests are state owned, 33% are owned by municipalities or other public bodies like churches and trusts and 47% are privately owned. Fifty-seven percent of the private forests in Germany are smaller than 20 ha (Depenheuer and Möhring, 2010). Private forest owners of large and medium-scale forests frequently have strong economic interests (Pickenpack, 2004). In contrast, small-scale forest owners vary more in their management objectives and are increasingly driven by recreation and nature conservation motives (Härdter, 2004). Small-scale private forests are frequently managed very extensively for firewood cutting or remain unexploited (Bieling, 2004).

In Germany and other European countries, public forests have been legally declared a public welfare good, which must be managed in a way that supports a multitude of goals, for example, maintaining recreation functions or serving as a model for biodiversity conservation (Schaich, 2013). However, public forest management has developed on the basis of a centuries-old tradition of timber production orientated management (Pistorius et al., 2012), which continues to shape forestry in the present (Schaich and Plieninger, 2013).

The influence of forest management on TMH density or diversity has rarely been studied (e.g. Larrieu et al., 2012; Vuidot et al., 2011; Winter et al., 2005). At the stand level, the time span since the last cutting has been suggested as a predictor of TMH density. 90 years old stands had almost 13 times higher TMH density than up to 30 years old stands (Regnery et al., 2013b). The relationship between forest ownership and TMH has, to our knowledge, not yet been studied. Information on the relationship between ownership, management and TMH provisioning is needed for the design of effective policies which aim to halt the loss of biodiversity or to promote more sustainable use of forest resources; especially if such policy frameworks are to be applicable to landscapes with different land ownership types.

We investigated the occurrence of tree microhabitats in adjacent broadleaf forest stands under three different forest ownership types – small-scale private forest, municipal forest and state forest – in the Swabian Alb Biosphere Reserve located in south-western Germany. Our main objective was to quantify to which extent forests under these distinct ownership types vary in terms of the density and composition of TMHs. Schaich and Plieninger (2013) found in the same region differing basal areas and differing diameter distribution when comparing forests of the three ownership types. Based on those findings we hypothesised: (1) The occurrence of TMHs on trees is influenced by the management approaches

applied under different forms of forest ownership; (2) small-scale private forests in the Swabian Alb provide more TMHs than the publicly managed forests in the region; and (3) the diversity of TMHs is higher in small-scale private forests.

2. Material and methods

2.1. The study region Swabian Alb Biosphere Reserve

We collected data in the Swabian Alb Biosphere Reserve which is located in south-western Germany about 50 km south-east of Stuttgart (9°45'43–9°07'07 easting, 48°37'49–48°12'30 northing). It covers an area of about 85,300 ha and encompasses the lands of 29 municipalities which are subsumed within three administrative districts (Ministerium für Entwicklung und Ländlichen Raum, 2008). The region is predominantly rural and in 2005 the Biosphere Reserve had about 151,000 inhabitants (Ministerium für Entwicklung und Ländlichen Raum, 2012).

The elevation of the low mountain range Swabian Alb extends from 329 m to 872 m a.s.l. The vegetation is shaped by a sub-continental, cool-temperate climate and predominantly west-wind weather conditions which result in annual precipitation between 750 mm and 1050 mm and annual mean temperatures between –1.5 °C in January and 15.9 °C in July (Fischer et al., 2010).

The topography is varied and frequently described as three distinct natural regions: (1) The *Albtrauf*, an escarpment area with steep slopes, rock faces, gorges and its foreland in the north of the Biosphere Reserve, followed southward by (2) the *Kuppenalb*, a plateau with highly variable relief at the small scale, and the southernmost area called (3) *Flächenalb* with a gently undulating topography, intersected by the Lauter and Schmied rivers which flow into the nearby Donau. Soils are rich in clay and predominantly developed on Jurassic shell limestone (Fischer et al., 2010).

2.2. Forest vegetation

On a large scale, the potential natural vegetation type within the study area is beech (*Fagus sylvatica* L.) forests (Bohn et al., 2000). In many places, forest vegetation has been replaced by agriculture or settlements. Presently, forests cover about 37% of the Swabian Alb Biosphere Reserve (Regierungspräsidium Tübingen, 2007). Central Europe, as the centre of the beech (*Fagus sylvatica* L.) distribution, bears particular responsibility for beech forests.

The beech forests of the Swabian Alb Biosphere Reserve are frequently *Hordelymo-* or *Galio-odorati-Fagetum*. Moreover, many rare and protected forest types also occur there. Associations with *Acer pseudoplatanus* L., *Fraxinus excelsior* L. and *Ulmus glabra* Huds. thrive at particular locations with high humidity such as lower slopes and gorges, and associations with *Acer platanoides* L. and *Tilia cordata* Mill. or *Tilia platyphyllos* Scop. dominate on steep rocky scree with south-west aspect. Dry forest associations of *Carici-fagetum* or with *Quercus petraea* Liebl. and *Carpinus betulus* L. are locally distributed at hilltops, especially within the northern escarpment region (Reidel and Döler, 2006).

2.3. Definition of tree microhabitats

We defined 31 TMHs which are related to structural properties of trees or are associated species such as epiphytic plants, lichens and fungi (Table 1). They are structural features that perform particular functions for animal or plant species. A commonly occurring function is that of providing shelter against predators or weather (Gibbons and Lindenmayer, 2002). Another relevant function is the provision of access to food resources e.g. for xylobiont beetles (Köhler, 2000).

Download English Version:

<https://daneshyari.com/en/article/4759662>

Download Persian Version:

<https://daneshyari.com/article/4759662>

[Daneshyari.com](https://daneshyari.com)