



Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Effects of natural disturbances and salvage logging on biodiversity – Lessons from the Bohemian Forest

Simon Thorn^{a,*}, Claus Bässler^{a,b}, Miroslav Svoboda^c, Jörg Müller^{a,b}

^a Field Station Fabrikschleichach, Department of Animal Ecology and Tropical Biology, Biocenter University of Würzburg, Glashüttenstraße 5, 96181 Rauenebrach, Germany

^b Bavarian Forest National Park, Freyunger Str. 2, 94481 Grafenau, Germany

^c Czech University of Life Sciences, Faculty of Forestry and Wood Sciences, Prague, Czech Republic

ARTICLE INFO

Article history:

Received 31 May 2016

Received in revised form 1 June 2016

Accepted 2 June 2016

Available online xxxx

Keywords:

Bark beetle

Ips typographus

Windstorm

Biodiversity

Forest management

ABSTRACT

Severe natural disturbances are common in many forest ecosystems, particularly in the Northern Hemisphere. Attempts to minimize their effects through forest management include salvage logging. In the Bohemian Forest, one of Central Europe's largest continuous forests, windstorms and bark beetle outbreaks have affected stands of Norway Spruce for centuries. Over the past decades, these natural disturbances and their management in the Bavarian Forest National Park and the adjacent Šumava National Park in the central part of the Bohemian Forest have been scientifically studied. Owing to a benign-neglect strategy, both windstorms and bark beetle outbreaks have increased stand structural heterogeneity, the amount of dead wood and light availability, which contribute to increased populations of nearly-extinct forest specialists. However, the response of a particular taxonomic group or species strongly depends on its relationship to specific legacies that persist after disturbances. Stand climate but not dead wood appears to greatly influence the diversity of epigeal bryophytes, whereas both factors determine the diversity of epixylic bryophytes. Both the amount and heterogeneity of dead wood seems to be more important than stand climate in determining assemblages of wood-inhabiting fungi and lichens. To reduce the population density of bark beetles in the management zones of both national parks, storm-felled spruces are salvage logged, which alters a variety of these legacies and natural successional pathways. Consequently, the numbers of species of wood-inhabiting fungi, saproxylic beetles and epixylic lichens are reduced. Natural levels of biodiversity in salvage-logged areas can be preserved by (1) preserving root plates of storm-felled trees with partly retained trunks; (2) avoiding soil disturbance by using cable yarding instead of harvesters; (3) retaining sun-exposed dry branches of storm-felled trees and snags of beetle-killed spruces; (4) avoiding logging damage of natural regeneration and of large trees that survive disturbances; and (5) bark scratching instead of debarking to avoid bark beetle outbreaks while maintaining biodiversity. Windstorms and bark beetle outbreaks could be utilized to restore intensely managed forests of Central Europe to their natural composition and structure. Furthermore, experimentally mimicked natural disturbances might help in gaining a mechanistic understanding of how natural disturbances affect biodiversity.

© 2016 Elsevier B.V. All rights reserved.

Contents

1. Introduction	00
2. Natural disturbances in the Bohemian Forest	00
3. The role of disturbance-created dead wood	00
4. Increasing insolation by disturbance	00
5. Conservation-oriented management of natural disturbances	00
6. Conclusions	00

* Corresponding author.

E-mail addresses: simon@thornonline.de (S. Thorn), Claus.Baessler@npv-bw.bayern.de (C. Bässler), svobodam@fld.czu.cz (M. Svoboda), Joerg.Mueller@npv-bw.bayern.de (J. Müller).

<http://dx.doi.org/10.1016/j.foreco.2016.06.006>

0378-1127/© 2016 Elsevier B.V. All rights reserved.

Acknowledgments	00
References	00

1. Introduction

Severe natural disturbances, such as wildfires, bark beetle outbreaks and windstorms, occur regularly in forest ecosystems worldwide and can be “stand-replacing” events that remove all or most of the forest canopy (Swanson et al., 2011; Kulakowski et al., submitted for publication). Particularly conifer-dominated forests are prone to natural disturbances (Kurz et al., 2008; Moen et al., 2014).

Disturbance regimes leave distinct types of biological and/or structural legacies in their wake (Franklin et al., 2000). For instance, burned areas or stands killed by bark beetles contain large numbers of snags, and severe windstorms create uprooted trees lying on the forest floor (Swanson et al., 2011). Thus, post-disturbance forest stands are generally characterized by large amounts of dead wood, increased exposure to sunlight, higher ground wind velocities and more extreme temperatures (Fontaine et al., 2010; Waldron et al., 2013). Such structural legacies and altered abiotic conditions are key attributes of post-disturbed forests, and they enhance stand structural complexity and provide habitat for species-rich assemblages (Bouget and Duelli, 2004; Seidl et al., 2014a; Shorohova et al., 2009). However, natural disturbances typically cause multiple changes in biotic and abiotic conditions, e.g. bark beetle outbreaks and windstorms decrease canopy cover and simultaneously increase the amount of dead wood (Lehnert et al., 2013; Müller et al., 2010; Seidl et al., 2015). Thus, the biodiversity response to natural disturbances represents the net response to these multiple changes.

Norway Spruce (*Picea abies*) is the most widespread and economically most important tree species in Europe (Brus et al., 2011) and is naturally vulnerable to windstorms and outbreaks of the European Spruce Bark Beetle *Ips typographus* (Overbeck and Schmidt, 2012). Windstorms and bark beetle outbreaks have thus become the dominant disturbance regimes in Europe, and it has been predicted that they will damage 60 million m³ of wood annually between 2021 and 2030 (Seidl et al., 2014b).

Increasing societal demands for timber compels forest managers to ‘salvage’ wood damaged by natural disturbances, even in locations otherwise spared from green-tree logging (Lindenmayer and Noss, 2006). However, salvage logging typically also removes or alters existing legacies, which results in altered species assemblages and contributes to greater restoration costs and fire hazards (Donato et al., 2006; Leverkus et al., 2012; Lindenmayer et al., 2008). Thus, forest managers and conservationists debate how to adequately deal with naturally disturbed forests. Here, we review the findings of scientific studies investigating natural disturbances and their subsequent management in the Bohemian Forest, an area heavily affected by natural disturbances (Čada et al., 2016; Svoboda et al., 2012). We review the effects of windstorms and bark beetle outbreaks on biodiversity, with a focus on changes in the amount of dead wood and light availability, which determine responses of species assemblages to the disturbances. Furthermore, we discuss the impacts of salvage logging after natural disturbances and provide evidence-based recommendations that aim at mitigating negative impacts of salvage logging on biodiversity.

2. Natural disturbances in the Bohemian Forest

The Bohemian Forest is located at the borders between Germany, the Czech Republic, and Austria. This low mountain

range is about 120 km long and up to 50 km wide (Fig. 1). It approximately covers the area from Cham in the northwest to Deggendorf in the west to Freistadt in the southeast to Strakonice in the east, and represents the watershed between the Danube and Elbe catchment areas. The highest peak in this region is the Großer Arber at 1456 m a.s.l. The bedrocks of the crystalline complex of the Bohemian massive consist mainly of mica schists, gneisses and granites. Soils are dominated by podzols consisting of sandy loams partly covered with rocks (Bässler et al., 2009).

Early historical reports and dendroecological reconstructions provide strong evidence that recent forests in the Bohemian Forest have been shaped by windstorms and bark beetle outbreaks that occurred in 1760 (Čada et al., 2016; Svoboda et al., 2012). The Bohemian Forest was again hit by severe windstorms and accompanied bark beetle outbreaks around 1740, 1820, 1840, 1868, and 1870, but old-growth forest still accounted for 26% of the region in 1880 (Brůna et al., 2013). Particularly remnant virgin forests at higher elevations were characterized by gaps caused by windthrow and bark beetle infestation, with huge numbers of standing and lying dead trees in the early 20th century (Hennevoel, 1905; Strobl and Haug, 1993), when modern forest management began in the central parts of the Bohemian Forest (Čada et al., 2016).

In 1970, the Bavarian Forest National Park (242 km²) was established on the German side of the central part of the Bohemian Forest, followed by the Šumava National Park (680 km²) on the Czech side in 1991. Together, these national parks represent one of the most extensive contiguous forest landscapes in Central Europe. Today, both national parks are dominated by mixed mountain forests with high proportions of Norway Spruce and admixtures of European Beech (*Fagus sylvatica*) and Silver Fir (*Abies*

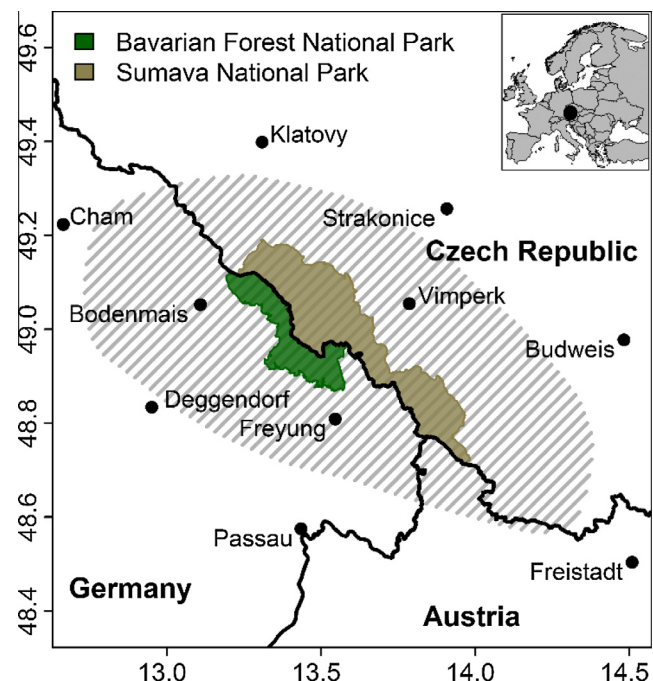


Fig. 1. The Bohemian Forest (grey hatching) in Central Europe. The Bavarian Forest National Park and the Šumava National Park are located in the central part of the Bohemian Forest. Coordinates refer to WGS 84.

Download English Version:

<https://daneshyari.com/en/article/4759537>

Download Persian Version:

<https://daneshyari.com/article/4759537>

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