A HALF-MILLENNIUM RECORD OF DISTURBANCE HISTORY IN THE BOHEMIAN FOREST

ivana.vasickova@vukoz.cz
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Ivana Vašíčková[1], Vojtěch Čada[2], Marco Heurich[3,4], Pavel Janda[2], Jakub Kašpar[1], Tomáš Koutecký[5], Miroslav Svoboda[2], Pavel Šamonil[1]

1 Department of Forest Ecology, The Silva Tarouca Research Institute, Lidická 25/27, 602 00 Brno, Czech Republic
2 Department of Forest Ecology, Czech University of Life Siences, Kamýcká 129, 165 00 Prague, Czech Republic
3 Nationalpark Bayerischer Wald, Freyunger Str. 2, 944 81 Grafenau, Germany
4 Institute for Forest and Wildlife Management, Inland Norway University of Applied Sciences, Anne Evenstads vei 80, 2480 Koppang, Norway
5 Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemědělská 3, 613 00 Brno, Czech Republic

1 Introduction

In the context of the expected increasing frequency and severity of disturbance events under accelerating global change, detailed knowledge about past disturbance dynamics forms a crucial foundation for the conservation management of natural forests. The Bohemian Forest Ecosystem stands as one of the largest natural wilderness area with limited past human impact in the Central Europe, harbouring two national parks in the **Czech Republic** and **Germany**. Based on robust dendrochronological dataset our trans-boundary research aims to describe the impact and spatiotemporal pattern of natural disturbances (i.e. **windthrows** and **insect outbreaks**) in the history of the Bohemian Forest in relation to region and within-stand heterogeneity. This knowledge anticipates the future impacts of climate change by planning the most suitable forest management strategies considering forest habitat.

2 Data and methods

We used unprecedentaly large dataset of **1.400 plots** including increment cores of more than **7.000 trees**. Based on tree-ring widths and unified approach we counted growth release and gap recruitment episodes as a evidence of past canopy removal, indicating disturbance events. Standard dendroecological methods for disturbance detection were applied, e.g. boundary line (Black and Abrams 2003), gap origin (Lorimer et al. 1988). Decadal summary reconstruction of disturbance events was performed spanning the latest 500-year period since the ancient pre-indistrial era.

3 Study sites

Mountain study area lies on the Czech (Šumava Mts.) and German (Bavarian Forest National Park) border in the elevation from 600 to 1.400 m a.s.l. During the last 30 years, large windthrow events resulted in stand-replacing bark beetle outbreaks, creating widespread disturbed areas. While some locations are considered to be primary forests with no direct human impact in the past, we still cannot exclude historical human interventions at certain locations (in the sense of logging or grazing).

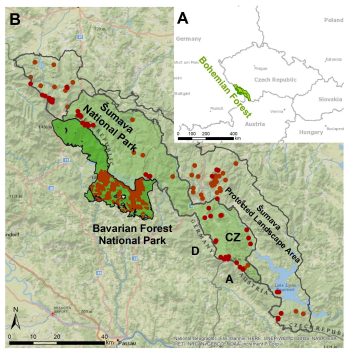

Fig. 1. Location of the study area (A) within the Central Europe and (B) within the Bohemian Forest Ecosystem (brown circles).

4 Results

Our results indicate that periodic natural disturbances, associated with wind and biotic (bark beetle) events are an important components of the disturbance regime in the Bohemian Forest Ecosystem, shaping the current structure of mountain forests. These events triggered large-scale canopy removal, facilitating the germination and growth of forest regeneration, leading to the initiation of most stands. Despite the same region and similar tree-species composition, historical forest trajectories mostly differ between the Czech-German border (Fig. 2 A,B) from the point of view severity as well as temporal variability for most of the centuries. Severe stand-replacing disturbances dominate on primarily northern-exposed slopes on the Czech side contrasting with the southern-exposed Bavarian Forest, reflecting more local events. Over the last five centuries, the most severe disturbances peaked in the 19th century, resulting in relatively stable early 20th century. Additionally, strong winds did not hit the region randomly, instead the results revealed significant temporal differences in relation to types of forest ecosystem (Fig. 2 C-F). While spruce mountain forests were heavily affected by the windstorm in 1820s, watterlogged and peat forests were mainly disturbed during 1870s. Mixed ravine forests, on the other hand, experienced the greatest wind disturbance during 1840s and 1850s. They were distributed throughout the whole region, affecteding large areas with varying levels of severity (Fig. 4).

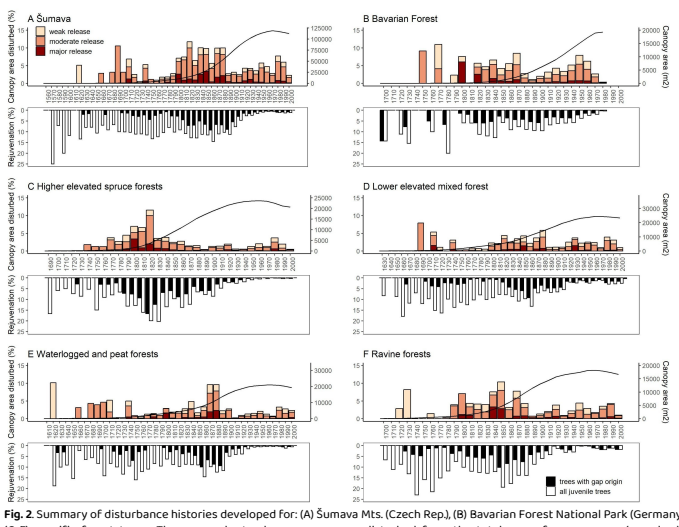

Fig. 2. Summary of disturbance histories developed for: (A) Šumava Mts. (Czech Rep.), (B) Bavarian Forest National Park (Germany) and (C-F) specific forest types. The upper charts show canopy area disturbed from the total sum of canopy area (sample depth) for particular decades, categorized according to release intensity. The bottom charts represent the proportion of trees rejuvenating in gaps after disturbance (black colour).

Fig. 3. Extreme strong windthrow Herwart (2017) left several hectare-sized blowdowns in the Boubin Primeval Forest

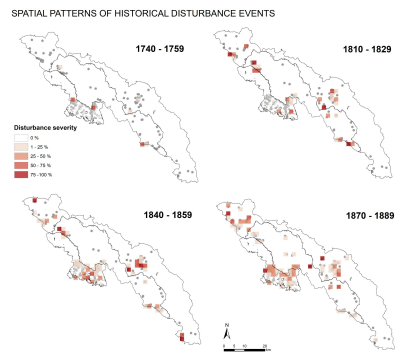

Fig. 4. Maps of spatiotemporal distribution of the strongest disturbance events in the Bohemian Forest Ecosystem, categorized by disturbance severity.

5 Conclusion

Dendroecology provide a useful tool to obtain reliable information on historical disturbance dynamics. Exceptional wind and bark beetle disturbance-rich episode during the 1990s and 2000s in the Bohemian Forest Ecosystem is analogous to severe windstorm events of the 18th and 19th century, accelerated by biotic outbreaks. Temporal variations in detected disturbances among forest types as well as different sides of the mountain range offer a starting point for further analysis, suggesting past forest management and geographic and climatic factors as a crucial drivers.

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