



The mixed severity disturbance regime of primary beech-dominated forests and its trends of 200 years development

Pavel Janda¹, Marek Svitok^{2,3}, Ondřej Vostárek¹, Martin Mikoláš¹, Radek Bače¹, Vojtěch Čada¹, Jakob Pavlin¹, Thomas Nagel^{1,4}, Krešimir Begović¹, Ecaterina Fodor⁵, Karol Ujházy⁶, Michal Frankovič¹, Michal Synek¹, Martin Dušátko¹, Tomáš Kníř¹, Daniel Kozák¹, Ondřej Kameniar¹, Arne Buechling¹, and Miroslav Svoboda¹

¹Department of Forest Ecology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences, Prague, Kamýčka 129, 165 21 Prague, Czech Republic (jandap@fd.czu.cz)

²Department of Biology and General Ecology, Faculty of Ecology and Environmental Sciences, Technical, University in Zvolen, Masaryka 24, 96001 Zvolen, Slovakia

³Department of Ecosystem Biology, Faculty of Science, University of South Bohemia, Branišovská 1760, 370, 05 Ceske Budejovice, Czech Republic

⁴Department of Forestry and Renewable Forest Resources, Biotechnical Faculty, University of Ljubljana, Večna pot 83, 1000 Ljubljana, Slovenia

⁵Forestry and Forest Engineering Department, University of Oradea, Oradea, Romania

⁶Department of Phytology, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, Masaryka 24, 96053 Zvolen, Slovakia

Primary beech-dominated forests are rare in Central Europe, while the knowledge of natural processes of these ecosystems is crucial for understanding the forest dynamics providing complex of ecosystem services. In order to understand these ecosystems better, which were one of the most widespread in this region, we decided to study their disturbance regimes and their long-term and recent trends driven mostly by natural disturbances.

The study was conducted within the region of Carpathian Mountains including 14 stands and 210 permanent study plots. All living and dead trees were inventoried on these plots, while selected trees were cored. Disturbances were reconstructed by examining individual tree growth patterns: (1) rapid juvenile growth rate (open canopy recruitment), and (2) abrupt, sustained increases in radial growth (release). From these disturbance patterns we reconstructed other disturbance parameters as disturbance severities, patch sizes and plot proportions of disturbed plots on the stand scale characterizing disturbance regime. Further, generalized linear mixed effect models were used to assess long-term and recent trends in these disturbance parameters.

Studied ecosystems were driven by mixed severity disturbance regime. The disturbance events revealed continuous gradient from low-severity, small-scale events to higher-severity, larger-scale events, and this gradient was progressively increasing with the rotation period. The low severity class was the most frequent, but it had similar canopy area disturbed (23.9 %) as moderate and high severity class (34.4 %, 27.1 %), respectively. The very high severity class had the longest rotation period and it affected only 14.7 % of overall canopy area disturbed. Long-term and recent

trends in disturbance severities and patch areas were not detected. Plot proportions of disturbed plots on the stand scale had slightly declining trend in time over last two centuries, but the recent trend was not detected.

Analysis of the recent trends in disturbance characteristics have not shown increasing trend, as it was reversely observed in Europe proving the value and stability of these ecosystems under pressure of climate changes. Based on our findings we highly recommend to localize and protect primary and old-growth forests for their high conservation values, high and stable carbon stock, and provision of other ecosystem services. For enhancement of the managed forests' stability we could recommend to support natural species composition and nature-based forest management mimicking natural disturbance regimes as retention silvicultural system combining irregular shelterwood and selection systems with occasional clear cuts.

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