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Biomechanical effects of trees in a mountain temperate forest: implications for biogeomorphology, soil science, and forest dynamics

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Biomechanical effects of trees in forest soils represent a potentially significant factor in hillslope processes, pedo-complexity, and forest dynamics. However, these processes have been only rarely studied so far. Within this study we aim (i) to elaborate a detailed and widely applicable methodology of quantification of the main biomechanical effects of trees in soil, (ii) to reveal actual (minimal) frequencies, areas and volumes related to these effects in a mountain temperate old-growth forest.

The research took place in the Boubín Primeval Forest in the Czech Republic. The fir-spruce-beech forest reserve belongs among the oldest protected areas in Europe. The reserve occupies NE slopes of an average inclination of about 14˚ on gneiss at an altitude of 930–1110 m a.s.l. We evaluated effects of all standing or lying trees of diameter at breast height (DBH) $\geq$ 10 cm in an area of 10.2 ha. In total, 4000 trees were studied from viewpoint of following features: treethrow, root mound, bioprotective function of standing as well as lying tree, baumstein, root baumstein, infilling stump, hole after trunk fall, stemwash, trunkwash.

Any biomechanical phenomena were recorded in 59% of standing and 51% of lying dead trees (excluding the pervasive soil displacement by thickening trunk and roots and the converse infilling of the space freed during their decay with surrounding soil). Approximately one tenth of the trees expressed simultaneously opposing phenomena such as blocking of slope processes and their intensification. Different tree species and DBH categories exhibited significantly different structure of biomechanical effects in soil.

Bioprotective function represented the most frequent process. However, concerning area and volume of affected soil, treethrows were an even more important phenomenon. Total area influenced by the studied biomechanical effects of current generation of trees was 343 m^2ha^{-1}. Additional 774 m^2ha^{-1} were occupied by older treethrow pit-mounds with already decayed uprooted trunk. Total volume of soil associated with studied phenomena was 228 m^3ha^{-1}, predominated by material affected by treethrows followed by stump infilling. Other processes were not so frequent but still important in forest dynamics, biogeomorphology and soil genesis. We assume significant differences in the structure of biomechanical effects of trees in managed forests.