The role of tree uprooting in cambisol development

Pavel Šamonil [a,*], Barbora Šebková [a,c], Václav Tejnecký [b], Luboš Borůvka [b], David Janík [a], Ondřej Šebek [d]

[a] The Silva Tarouca Research Institute for Landscape and Ornamental Gardening , Department of Forest Ecology, Lidická 25/27, CZ-60200 Brno, Czech Republic
[b] Czech University of Life Sciences Prague, Faculty of Agrobiology, Food and Natural Resources, Department of Soil Science and Soil Protection, Kamýcká 129, 165 21, Praha 6, Suchdol,Czech Republic
[c] Mendel University in Brno, Faculty of Forestry and Wood Technology, Zemědělská 1, 613 00 Brno, Czech Republic
[d] Charles University in Prague, Faculty of Science, Laboratories of the Geological Institutes, Albertov 6, 128 43 Prague 2, Czech Republic
* Corresponding author: Tel.: +420 541 126 260; Fax: +420 541 246 001; E-mail: pavel.samonil@vukoz.cz

Objectives

We attempted to verify the hypothesis that pit-mounds significantly affect the development of soil in Cambisol zone.
• Research objectives: **(i) to assess the course of soil formation on the fine spatial scale of pit-mound microsites, (ii) to assess the significance of the absence of pit-mound dynamics in managed forests at the forest ecosystem scale.**

Study area

The spruce-fir-beech natural forest Razula (**Razula National Nature Reserve**):

• Situated in the Outer Western Carpathians (Fig. 1).
• A total area 23,5 ha (a study area 10,8 ha).
• Under strict protection since 1933.
• Dominant soils Haplic Cambisols.
• *Dentario enneaphylli-Fagetum* and *Dentario glandulosae-Fagetum associations.*

Fig. 1. Location of study site.

Method

• Properties of pit-mounds (total 1562 pit-mounds) were studied.
• The development of soils was studied for **14 pit-mounds** dendroecologically dated (**19 - 191 years**) (Šamonil et al. 2009).
• Soil samples (total 210 samples) were taken from **the depths 0–10, 15, 30, 50 and 100 cm** from **microsites at mounds, pits, and currently non-disturbed ground** in **natural forest**.
• 45 samples were taken from **9 profiles** in **managed forests** (Fig. 2).
• Each sample was analyzed for 38 chemical and physical soil characteristics.
• Multidimensional statistical methods were used to evaluate the significance of (i) sampling depth, (ii) microsite, and (iii) disturbance age.
• The development of soil properties in time was modelled using GML models.

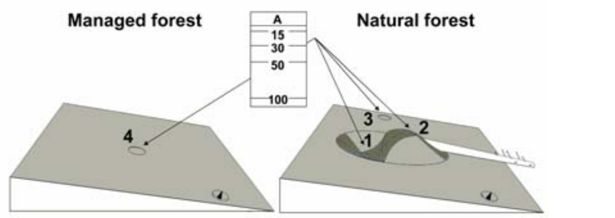

Fig. 2. Position of sampling depths and microsites (1 – pit, 2 – mound, 3 – undisturbed control site in the natural forest, 4 – undisturbed site in the managed forest) within the „naturally disturbed" (natural) forest and forest with soil disturbance prevented (managed). Sampling horizons and depths are shown.

Results and discusion

Significant differences were observed between particular microsites across the range of pit-mounds ages and sampling depths.

• The highest values of Ca, Mg, C, CEC and soil reaction were found in pits, whereas mounds had the highest values of labile Al and exchangeable acidity. Currently non-disturbed soils had values close to the average between mound and pit values. These findings resulted mainly from (i) modification of soil formation processes by climatic, hydrological and erosive-accumulative conditions of microsites (e.g. Schaetzel 1990), (ii) the low maximum age of pit-mounds, (iii) relict traits of the soil.

• Despite generally higher values of sorption complex characteristics, pits showed leaching of the sorption complex, leaching of C and mild clay illuviation up to about 100 years of age.

• Mounds showed increasing CEC values over time, as well as an increasing proportion of humic acids. Significant trends were observed both in pits (development of Mn forms) and on mounds (development of Fe, Al and Si forms).

• Some soil characteristics had a unimodal time course (Fig.3). This indicates the possibility of retrograde development (Skvorcova et al. 1983).

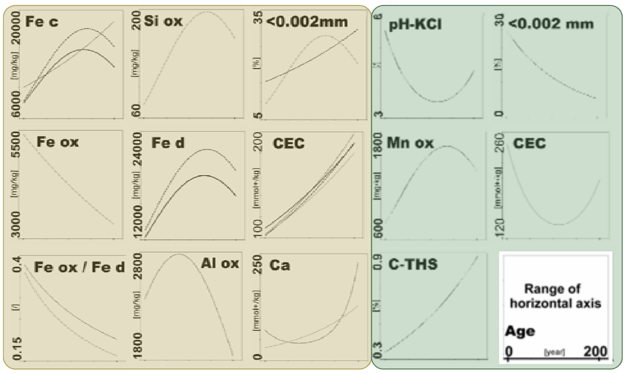

Fig. 3. Exhibition of some models of soil characteristics development within mounds (brown) and pits (green). Gradient of age – 0-200 years (range of all horizontal axes); black solid – A horizon, black dashed – 15 cm, black dotted – 30 cm, gray solid – 50 cm, gray dashed – 100 cm.

The most influential variable was sampling depth (Fig. 4) explained 12.1% of the data variability ($p<0.001$). Microsite and age explained 7.5% ($p<0.001$) and 1.8% ($p=0.048$) of the variability, respectively.

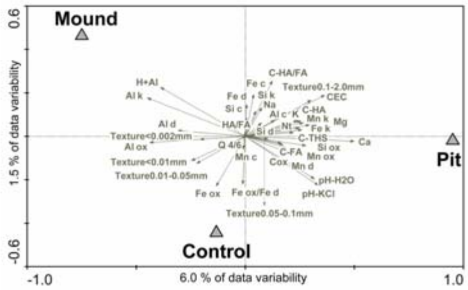

Fig. 4. Ordination diagram for projection of the canonical axes 1 and 2. Soil data were explained using redundance analysis by depth of sampling. Age of pit-mounds and microsite were used as covariables.

Unlike the natural forest, the managed forest soils had considerably higher contents of the crystalline forms of Fe, Al and Mn (Fig. 5), reflecting a more advanced stage of soil formation. However, the different disturbance regimes did not affect the course of clay illuviation, sorption complex leaching, or the content of organic matter.

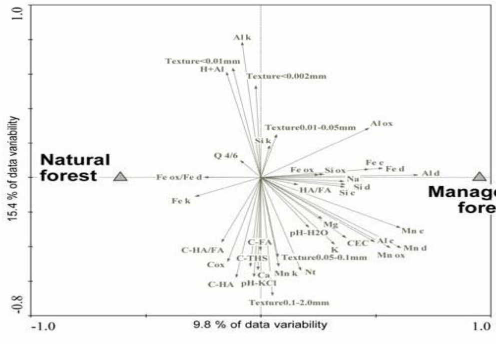

Fig. 5. Ordination diagram for projection of the cannonical axes 1 ans 2. Long-term presence (natural forest) or absence (managed forest) of natural soil disturbances were used as environmental predictors in the redundancy analysis. Depth of soil samples was used as the covariable.

Note: Information from this poster were accepted for publication in the journal Geoderma.

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