IMPACT OF FOREST DIEBACK ON FOREST FLOOR WATER BALANCE IN NORWAY SPRUCE MONOCULTURES

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INTRODUCTION The forest floor is a defining feature of forest ecosystems. Also known as the detritus or O horizon, it consists of one or more organic subhorizons termed the litter (OL), fragmentation (OF) and humus (OH) horizons (Zanella et al. 2009). While it also plays a significant role in terrestrial ecosystems and in controlling water loss, few studies have examined how forest disturbance and subsequent restoration affect water storage in the floor cover (Xia et al. 2019). Moreover, forest floor characteristics (e.g. thickness, coverage and soil organic matter) may cause changes at the microsite level (e.g. litter decomposition, soil moisture, carbon and nitrogen stock) that subsequently influence rate of forest succession (Wang et al. 2021).

STUDY OBJECTIVE

The aim of this study was to quantify how forest post-disturbance management conditions affect floor moisture regime in Norway spruce monocultures.

MATERIAL AND METHODS This study expands on a previous project (IGA project LDF_TP_2021006) by including the issue of forest floor moisture regime on the same spruce monoculture study sites, i.e. Vilémov in Bohemia and Černá Hora, Velká Bíteš, Vranov in Moravia (Czech Republic). The design strategy used ensured that each locality included three different treatments representing i) living forest, ii) disturbed forest with dead trees and iii) clear-cut sites, each with similar soil and climatic conditions.

Floor moisture was measured 5 cm below the surface using TMS-4 sensors (Tomst, Czech Republic), each sensor being fixed in a "bed" of the organic horizon 2 mm fraction.

Triplicate undisturbed soil samples were used to determine physical a hydrophysical soil parameters at each site and treatment. In addition, a ca. 5 L disturbed sample was homogenised, air-dried and sieved to a obtain a 2 mm fraction, which was then used to calibrate the TMS-4 sensors in the laboratory using standard calibration methods. The calibration equations were then used to convert "raw moisture data" into actual volumetric soil moisture values for each treatment and site, the final values being aggregated into daily averages.

Figure 1. Sensors TMS-4 at the plots representing i) living forest, ii) disturbed forest with dead trees and iii) clear-cut sites (source: Tomáš Vichta)

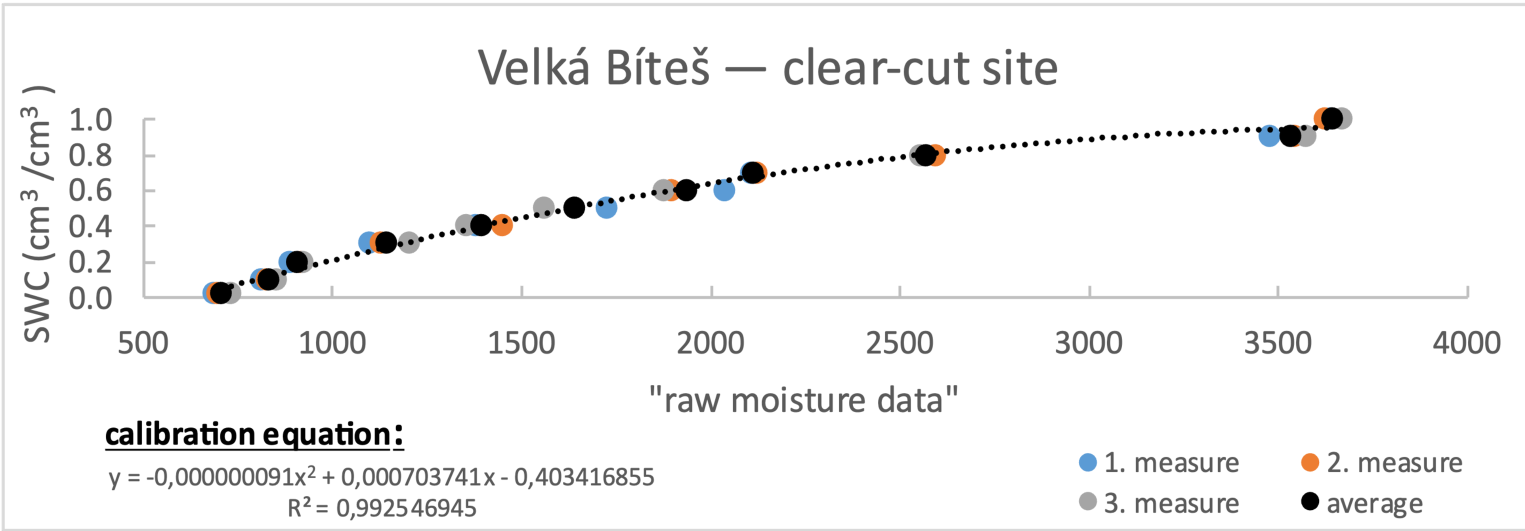

Figure 2. Example of calibration curve and equation of the TMS-4 sensors for soil organic horizons

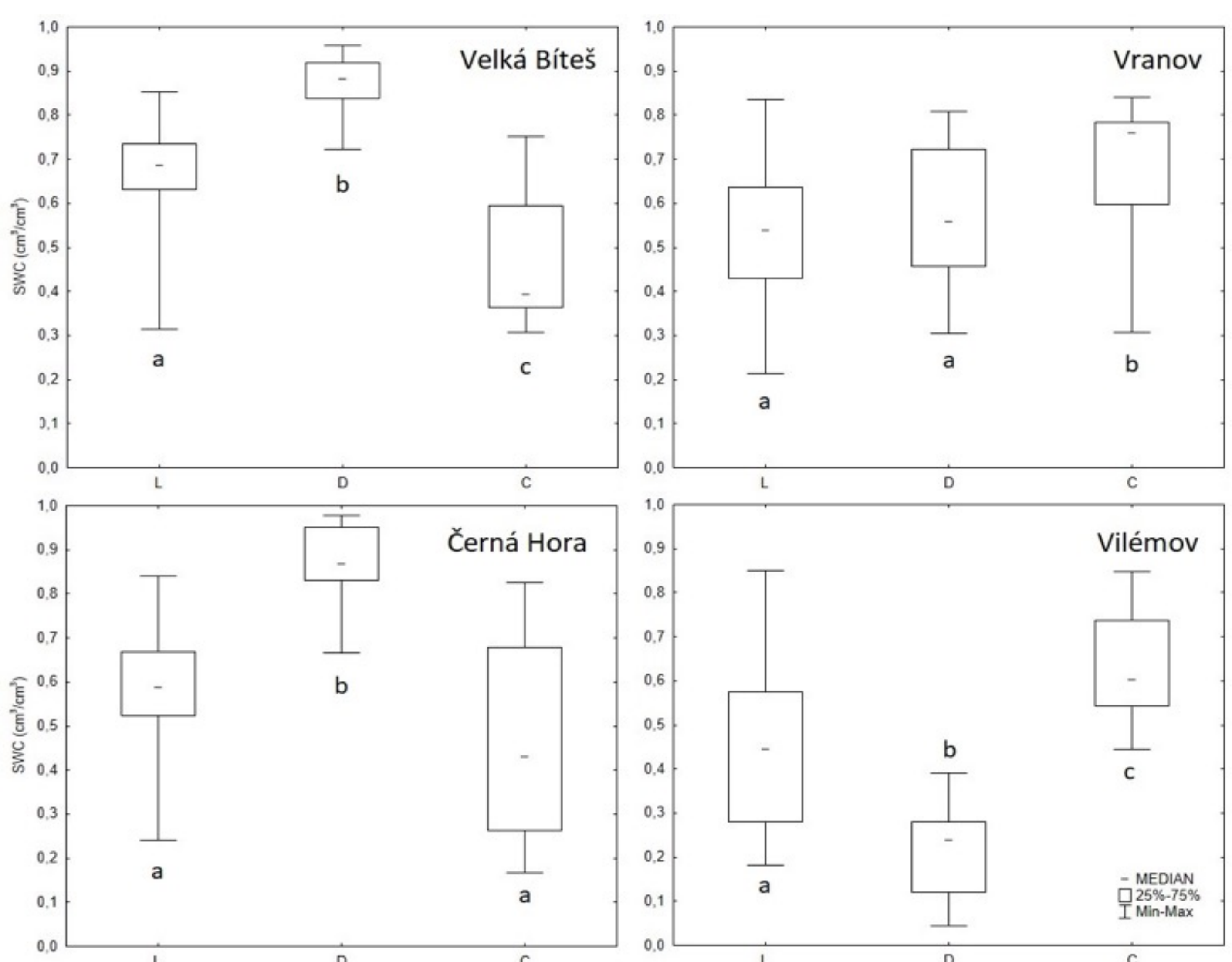

Figure 3. Floor moisture regime for all stand treatments at all localities (L = living forest, D = disturbed forest with dead trees, C = clear-cut sites)

RESULTS AND DISCUSSION While significantly higher forest floor moisture was recorded in disturbed forest with dead trees at Velká Bíteš and Černá Hora (Fig. 1), it was significantly higher in clear-cut sites at Vranov and Vilémov, with living stands always mid-way at all localities. These differences are most likely due to differences in understory coverage at each site, which in turn is related to the number of trees per hectare. While clear-cut sites at Vranov and Vilémov had lower herb coverage than Velká Bíteš and Černá Hora, they had higher coverage of undergrowth comprising compact grass turf. Our results showed that forest stand undergrowth coverage can have a significant effect on the main hydrological processes (i.e. preci-pitation, infiltration, runoff, evapotranspiration) and, consequently, on subsequent development of terrestrial ecosystems.

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REFERENCES

Wang, B., Liu, D., Yang, J., Zhu, Z., Darboux, F., Jiao, J., & An, S. (2021). Effects of forest floor characteristics on soil labile carbon as varied by topography and vegetation type in the Chinese Loess Plateau. Catena, 196, 104825.
Xia, L., Song, X., Fu, N., Cui, S., Li, L., Li, H., & Li, Y. (2019). Effects of forest litter cover on hydrological response of hillslopes in the Loess Plateau of China. Catena, 181, 104076.
Zanella, A., Jabiol, B., Ponge, J. F., Sartori, G., De Waal, R., Van Delft, B., ... & Brêthes, A. (2009). Toward a European humus forms reference base. Studi trentini di scienze naturali, 85, 145-151.

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