THE INFLUENCE OF STAND AGE STRUCTURE ON SOIL MOISTURE ACROSS THE SOIL DEPTH GRADIENT

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INTRODUCTION

This study evaluated soil properties across four developmental stages of forest stands to assess the influence of stand age on soil moisture distribution within the soil profile. The analysis focused on bulk soil moisture (BulkMoist, *Theta – Θ*), which, in contrast to gravimetric moisture content (w), more accurately represents the physiologically available water regime in the forest stand. Statistically significant differences in soil gravimetric moisture were observed not only among the individual developmental stages but also across the various soil horizons. The results indicate that forest developmental stage strongly structures the vertical distribution of available water and reflecting differences in stand structure, rooting depth, and organic matter inputs.

THE METHODS AND MATERIALS

The research was conducted in the University Forest Enterprise in Křtiny. Four research plots (16x16 m) were established, representing forest stands aged 40, 60, and 123 years, as well as uneven-aged *Fagus sylvatica* stands. At each site, a geodesic grid with 1x1 m was established to facilitate systematic soil sampling at 2 m intervals and depths of 10–60. Volumetric (Θ) and gravimetric (w) soil moisture were measured during five consecutive rain-free days to minimize the influence of recent precipitation events.

Fig. 1: View of the research plot during ongoing pedological soil sampling.

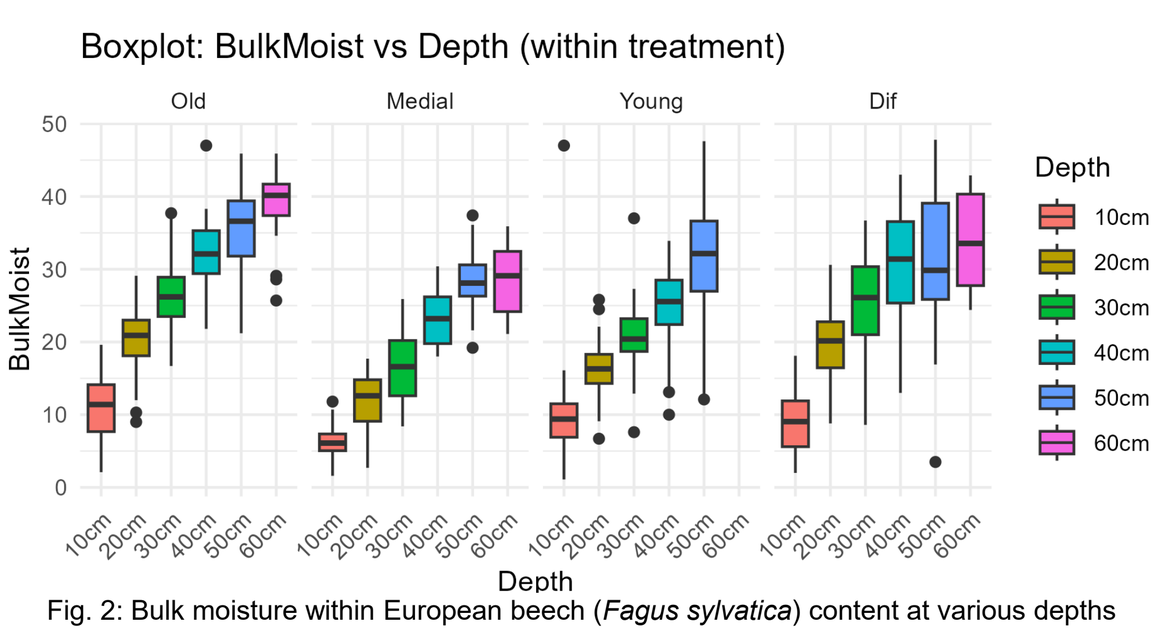

Fig. 2: Bulk moisture within European beech (*Fagus sylvatica*) content at various depths

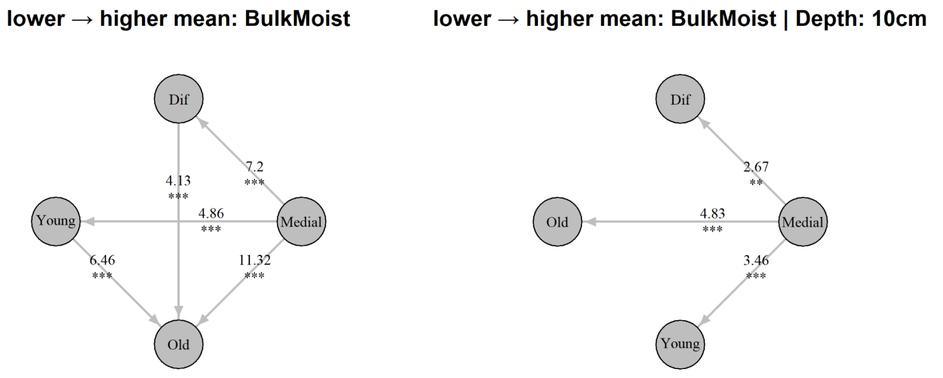

Fig. 3: Bulk soil moisture content within the grid-based analysis of the entire profile and at 10 cm depth

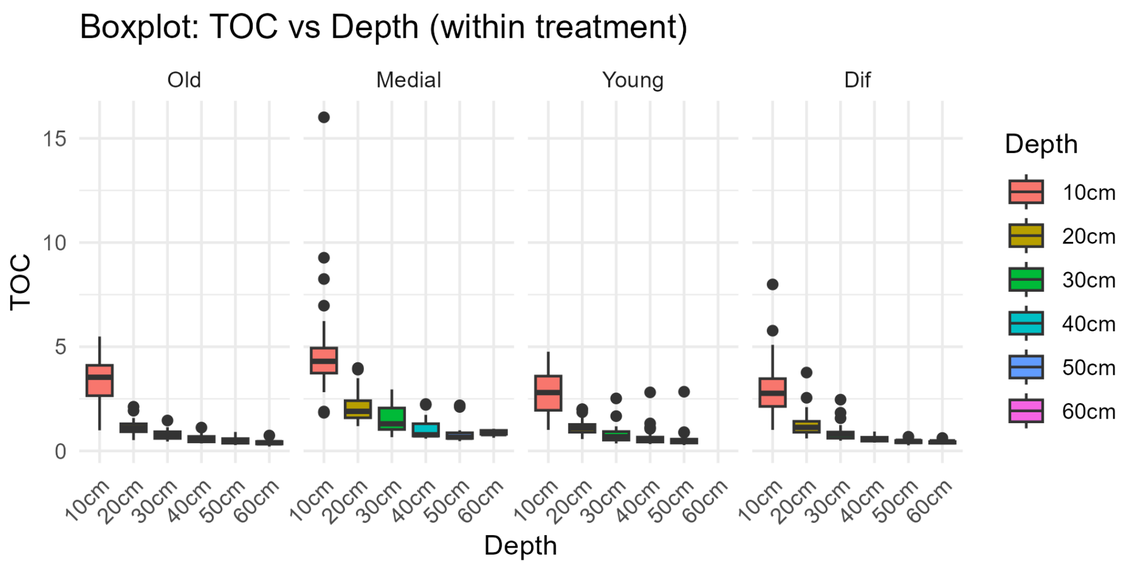

Fig. 4: TOC within European beech (*Fagus sylvatica*) content at various depths

RESULTS

Bulk soil moisture content within Fagus sylvatica stands

Statistically significant differences in soil moisture were observed among the various forest developmental stages and distinct soil horizons. The influence of developmental stage on soil moisture was non-linear; at certain depths, the uneven-aged stand exhibited higher moisture values than the mature stand, whereas in other layers the opposite pattern was observed.

Bulk soil moisture content within the grid-based analysis of the entire profile and at 10 cm depth

Grid-based analyses confirmed significant differences among developmental stages, particularly in the surface soil layers, where moisture is most susceptible to variation. The lowest moisture values occurred in structurally complex stands, probably due to deeper and more heterogeneous root distribution in the soil profile.

TOC (Total organic carbon) within beech stands

The organic carbon content increases with stand age and volume, as litter production rises and humus accumulation intensifies over time. Younger beech stands exhibit lower TOC, reflecting faster decomposition rates and a smaller organic matter reservoir. Overall, older forest stands serve as a more significant pool of soil organic carbon, with TOC values gradually decreasing with depth in all cases.

CONCLUSIONS

The results support the hypothesis that forest stand developmental stage affects not only overall soil moisture but also its vertical distribution and temporal dynamics, depending on soil properties. These findings may be crucial for understanding the water dynamics in forest ecosystems in relation to stand age.

ACKNOWLEDGEMENT

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