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Effects of Ungulate Herbivory on Post-Disturbance Forest Soil Carbon Dynamics in the Northern Calcareous Alps

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Ungulate herbivores (e.g. red deer, chamois) play a crucial role in the establishment of tree regeneration after forest disturbance. This might affect the post-disturbance carbon dynamics of forest ecosystems. Information on the effects of ungulate herbivory on soil carbon processes after disturbance is, however, sparse. Since forest disturbances are expected to increase with changing climate, more studies are required to close this gap in knowledge. The present study investigates how soil respiration (Rs) and its autotrophic (Ra) and heterotrophic (Rh) components are affected by ungulate herbivores at two windthrown forest sites in the Northern Calcareous Alps, Austria. The sites were south exposed and differed with regard to the time since windthrow (9 and 13 years after disturbance). To study the effects of ungulate herbivory, measurement plots were established within fenced and non-fenced treatments at both sites. Tree regeneration at both windthrow sites was drastically reduced by ungulate herbivory. A re-establishing vegetation at non-fenced plots was dominated by herbs and grasses. The differences in vegetation were, however, less pronounced at the younger windthrow site. This was assumed to be the main reason that neither Rs, Ra, nor Rh showed a treatment effect. At the older windthrow site Rs and Rh were significantly ($p < 0.05$) lower at the fenced plots. The lower rates were mainly related to lower soil temperatures underneath the trees (crown shading). The results suggest that ungulate herbivory represents an important driver of post-disturbance soil carbon dynamics in the Northern Calcareous Alps.