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The role of *Juncus effusus* litter quality and nutrient availability on organic matter decomposition in restored cutover bogs

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More than 90% of peatlands in Europe are degraded by drainage and subsequent land use. However, beneficial effects of functioning peatlands, most of all carbon storage, have long been recognized but remain difficult to recover. Fragmentation and a surrounding of intensively used agricultural catchments with excess nutrients in air and waters further affects the recovery of sites.

Under such conditions, highly competitive species such as *Juncus effusus* colonize restored peatlands instead of peat forming *Sphagnum*. While the specific stoichiometry and chemical composition makes *Sphagnum* litter recalcitrant in decomposition and hence, effective in carbon sequestration, we know little about dynamics involving *Juncus*, although this species provides organic matter in high quantity and of rather labile quality.

To better understand decomposition in context of litter quality and nutrient availability, we incubated different peat types for 70 days; I) recent, II) weakly degraded fossil, and III) earthyfied nutrient rich fossil peat, amended with two ^{13}C pulse-labelled *Juncus* litter types (excessively fertilized "F", and nutrient poor "NF" plants grown for three years watered with MilliQ only), respectively. We determined anaerobic decomposition rates, compared potential rates extrapolated from pure materials with measured rates of the mixtures, and tracked the ^{13}C in the solid, liquid, and gaseous phase. To characterize the biogeochemical conditions, inorganic and organic electron acceptors, hydrogen and organic acids, and total enzyme activity were monitored. For characterization of dissolved organic matter we used UV-Vis and fluorescence spectroscopy (parallel factor analysis), and for solid organic matter elemental analysis and FTIR spectroscopy.

There were two main structural differences between litter types: "F" litter and its leachates contained more proteinaceous components, the C/N ratio was 20 in contrast to 60 of the "NF" litter. However, humic components and aromaticity were higher in "F" litter. Generally, decomposition rates of litter were 5-30 times higher than of peat. Rates in batches amended with "F" were lower compared to "NF" for the respective peat, opposing typically reported observations. Nevertheless, the ^{13}C label suggested that in case of peat I and III preferably the litter was decomposed, decomposition of peat II was apparently stimulated when "NF" was added, albeit this litter was poor in nutrients. Multiple linear regression identified specific absorption at 254 nm (SUVA), a measure of aromaticity representative for an array of inter-correlating spectroscopic features, and enzyme activity as most important predictors for C-mineralization rates. These two parameters explained 88% of the variance. Although enzyme activity and SUVA did not correlate in the mixed assays, this was the case for the pure materials (R^2=0.95), suggesting an inhibitory effect of aromatic components on enzyme activity.

This study confirms that generally litter quality is a major control for mineralization and hence, carbon storage in peatlands. Interestingly, in the case of *Juncus effusus*, high nutrient availability in peat and litter did not lead to enhanced degradation of the litter itself or priming of decomposition of the surrounding peat. Furthermore, the results underline the substantial contribution of *Juncus* biomass to C-cycling and potentially high C-emissions in restored peatlands.