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Effects of topsoil removal on greenhouse gas exchange of fen paludicultures

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Current agricultural practices on peatlands require drainage, leading to substantial emissions of the greenhouse gases (GHGs) carbon dioxide (CO_2) and nitrous oxide (N_2O). Paludiculture is an option to mitigate these adverse environmental impacts while maintaining productive land use. Whereas the GHG exchange of paludiculture on rewetted bog peat, i.e., Sphagnum farming, is relatively well examined, data on GHG emissions from fen paludicultures remain scarce. Considering that typical fen paludiculture species are aerenchymous plants, the release of methane (CH_4) is a crucial aspect when optimizing the GHG balance of such systems. One potential method to reduce CH_4 emissions upon rewetting involves removing the topsoil, but retaining a nutrient-rich topsoil might foster the biomass growth.

In this project, *Typha angustifolia*, *Typha latifolia*, and *Phragmites australis* are grown at a fen peatland formerly used as grassland. Water levels are maintained at the surface or slightly above it. In parts of the newly created polder surrounded by a peat dam, approximately 10 cm of topsoil had been removed before planting. In order to separate the effects of topsoil removal and water level, four smaller sub-polders were installed. Here, the water levels can be adjusted independently from the main polder. Greenhouse gas exchange is measured for all three species with and without topsoil removal. Additionally, a reference grassland site close by and a site on the dam are included in the measurements. Using manual transparent and non-transparent chambers and a portable analyser for both CH_4 and CO_2, GHG measurements are carried out every two to four weeks on a campaign basis. N_2O is measured using non-transparent chambers and gas chromatographic analysis. Here, we present GHG balances of the first three years after planting the paludicultures.

Challenges in water management during the initial year after planting caused an infestation with *Juncus effusus*, especially at the *Phragmites australis* sites. However, despite suboptimal water levels in the first year, all paludiculture species were a net CO_2 sink, irrespective of topsoil treatment. During this period, fluctuating water levels led to very low CH_4 emissions, whereas N_2O emissions played a more significant role in the GHG balance. Even under more stable hydrological conditions in the second year, CH_4 emissions remained rather low, leading to a GHG sink for almost all paludiculture species, even including the first harvest year. Therefore, the current results of our study do not indicate topsoil removal to be necessary as a significant optimization

strategy concerning CH_4 emissions in fen paludiculture.