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# Management alternatives on a poorly drained fen peatland

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Even though peatlands cover 3% of the terrestrial surface, they store approximately 30% of the global soil C pool. Peatland drainage promotes peat mineralization and $CO_2$ emissions. Water table is the main controlling factor of $CO_2$ emissions from drained peatlands; however, nutrient status can also affect emissions. Rewetting can reduce emissions, therefore, paludiculture has emerged as an alternative productive management of peatlands under wet conditions. The objectives of this study were to (1) quantify the effect of reed canary grass (RCG) management on a rewetting fen peatland, (2) relate water chemistry parameters to $CO_2$ emission trends, and (3) calculate annual $CO_2$ emissions using detailed water table data. The study was conducted in a fen peatland in central Denmark. Four plots established with RCG in 2019 were selected and subdivided into subplots corresponding to three management (harvest, fertilisation) treatments (0, 2, and 5-cut). The 2-cut and 5-cut harvest treatments received 200 kg N $ha^{-1}$ $y^{-1}$ in equal split doses. $CO_2$ and $CH_4$ measurements were conducted biweekly between May 1$^{st}$ 2021 and April 30$^{th}$ 2022 using a transparent manual chamber connected to a GLA131-GGA Los Gatos gas analyser and manipulating light intensities with four shrouding levels. Water chemistry parameters ($NO_3$, $NH_4$, total N, total dissolved N, total P, total dissolved P, total organic C, dissolved organic C, and Fe) were measured biweekly in water samples collected from piezometers. Auxiliary measurements (water table depth (WTD), ratio vegetation index (RVI), soil and air temperature, photosynthetically active radiation, and redox potential) were taken on each campaign or continually to assist model-based interpolation of measured ecosystem respiration (Reco) and gross primary productivity, the latter calculated as the difference between net ecosystem exchange (NEE) and Reco. Hourly $CH_4$ fluxes were calculated from linear interpolation of measured data. The Reco models gave the best fit to measured data when WTD and RVI were included (Nash-Sutcliffe efficiencies between 0.74 and 0.98). The net ecosystem C balances were between 6.0 and 6.9 t C $ha^{-1}$ $yr^{-1}$ for all harvest treatments, while the NEE was 2.16, 2.18, and 6.90 t C $ha^{-1}$ $yr^{-1}$ for the five, two, and zero cut treatments, respectively. Considerable differences in NEE were found between the studied plots with some plots having as much as 8 times higher NEE than others. Significant differences in water chemistry parameters were found between plots, with the plot farthest from the stream (plot with lowest NEE) having the lowest C, N, P, and Fe concentrations and the plot closest to the stream (plot with highest NEE) having the highest nutrient concentrations. Methane emissions averaged 118 kg $CH_4$ $ha^{-1}$ $yr^{-1}$ with most of the emissions taking place during summer. Results showed considerable differences in NEE among plots with the same management, which could be explained partly by differences in nutrient status of the peat soil. Results also indicated that paludiculture may reduce $CO_2$ emissions from nutrient rich fens in comparison with no biomass

management during the process of peatland rewetting.