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Carbon Exchange Response Of Sphagnum Dominated Peatland To Multiple Aspects Of Global Change

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Global change is expected to have adverse effects on the carbon (C) storage function of *Sphagnum* peat bogs. However, the consequences of the interaction of different aspects of global change for peatland C dynamics have not been systematically assessed yet.

The aim of this study is to examine how interactions between rising air temperatures, declining ground water levels (WL) and nitrogen eutrophication affect C exchange of both natural and degraded *Sphagnum* bog ecosystems.

A greenhouse experiment with *Sphagnum papillosum* planted on packed bog peat soil columns has been carried out in the vegetation period of 2021. Three different mean annual air temperature and WL treatments (ambient, + 1 °C, + 3 °C and 0 cm, 7 cm,15 cm below peat surface, respectively), three different amounts of nitrogen (N) input (5, 25 and 50 kg N/(ha*a)) and two different types of peat substrate (slightly and highly decomposed) were combined in a fully factorial design.

Three measurement campaigns with manual chambers were conducted over the course of the vegetation period to quantify CO_2 and CH_4 fluxes for each treatment combination. Soil temperature was measured continuously as explanatory variable. During each measurement campaign, three or more measurements using opaque chambers were conducted per soil column to assess the variation of ecosystem respiration (R_{eco}) and CH_4 exchange over the range of soil temperatures. To quantify the impact of the imposed environmental treatments on moss C-uptake capacity (GPP_{sat}), one measurement at an irradiation close to moss light saturation point (ca. 600-800 µmol/(s*m^2); determined prior to the experiment) was conducted per column using a chamber illuminated by a LED grow light. Directly before each of these measurements, the mosses were light adapted to this irradiation intensity for 15 minutes.

Linear flux calculation and several steps of automated and manual filtering were applied to the data and a model describing the relationship between soil temperature and R_{eco} was fitted.

Preliminary results indicate that GPP_{sat} was affected negatively by higher air temperatures in summer, but positively in autumn. A negative response to a drop in WL was observed only after several weeks.

R_{eco} increased in columns with lower WL and at higher temperatures and showed a fast response

to treatment variation (< two weeks). The effect of the lowered WL seemed to increase at higher temperatures.

WL strongly affected CH_4 fluxes with highest emissions observed in high WL treatments. In contrast, there seemed to be a net uptake of CH_4 in low temperature and low WL columns. No effect of diurnal air or soil temperature variations on CH_4 exchange could be observed, but emissions were higher in summer than in autumn. No short term effect of N eutrophication on any flux component could be detected.

The results of the study will provide insights into the effects of projected future environmental changes on *Sphagnum* bog peatlands. The findings can be used to optimize the management of natural, rewetted or commercially used *Sphagnum* peatlands with regard to the reduction of greenhouse gas emissions.