

Optimizing *Sphagnum* paludicultures under challenging conditions

Interactions of climate change, nutrient depositions, peat properties and vascular plant invasion

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Background

- **Global change** is expected to have adverse effects on productivity and greenhouse gas mitigation potential of *Sphagnum* paludicultures.
- An associated threat is the ongoing **expansion of vascular plant species**.
- **The impact of different aspects of global change and their interactions, including indirect effects via the promotion of vascular plant encroachment, on moss growth and ecosystem carbon exchange have not been assessed systematically yet.**
- **Former peat extraction sites with agricultural after-use and degraded agricultural sites on organic soils offer an enormous area potential.** Therefore, it is of special interest to identify key challenges for successful *Sphagnum* farming on such sites under future environmental conditions.

Central research questions

How do peat properties, climate change and nitrogen eutrophication affect moss photosynthesis and ecosystem carbon exchange?

Which environmental factors enforce vascular plant emergence and establishment?

What is the impact of vascular plant encroachment on carbon exchange and moss growth?

Study design – environmental treatment variation

- Greenhouse experiment with fully factorial study design
- Packed peat columns (60 cm depth, 20 cm diameter)
- Moss planted on each column (micropropagated *Sphagnum papillosum*)
- Seed of *Molinia caerulea* and *Betula pubescens* sown on *Sphagnum* cover (on one third of each column) at the start of the second study year

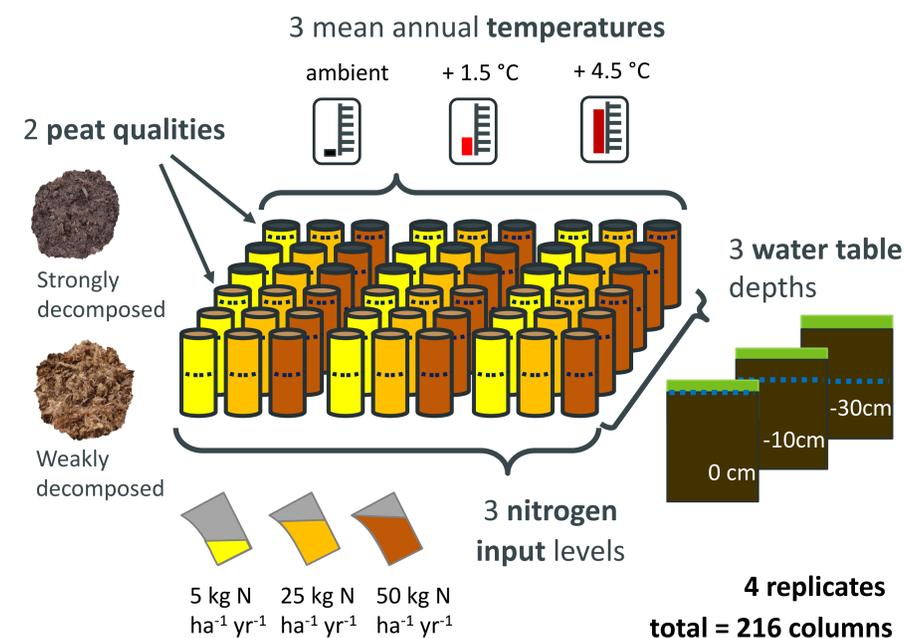


Fig. 1: Study design, environmental factors varied and treatment levels. Treatment combinations are arranged randomly in the greenhouse. N: nitrogen.

Methods – measurement of carbon exchange and photosynthetic capacity

- Measurement of CO₂- exchange and CH₄- emissions at different levels of irradiation and soil temperatures in late summer 2021 and 2022
- Greenhouse- gas analyzer (LosGatos) and manual chambers:
 - Opaque chamber -> ecosystem respiration
 - Illuminated chamber (multiple PAR levels)-> net ecosystem exchange
 - Flux measurements per vegetation treatment
- Statistical models describing relationships between carbon fluxes and environmental variables → calculation of carbon balances

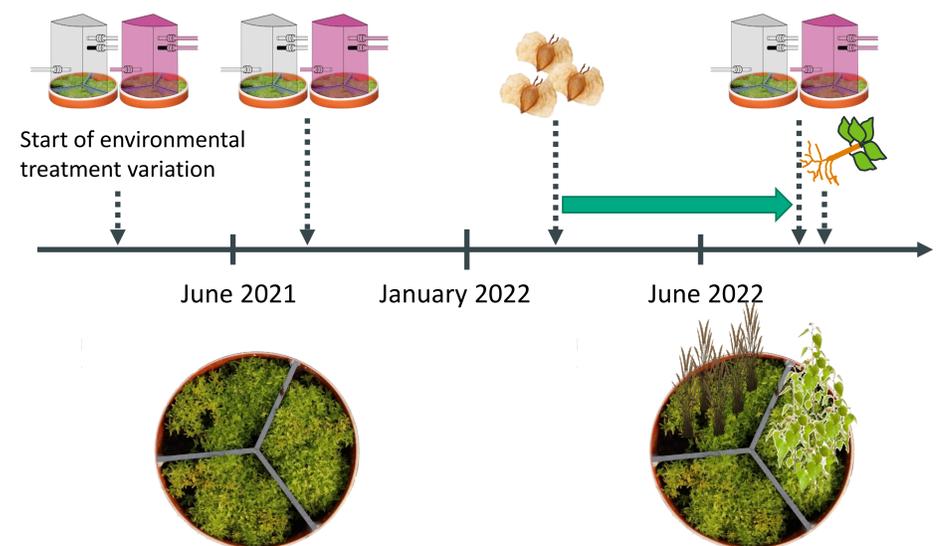


Fig. 2: Project schedule. Chambers: dates of chamber measurement campaigns, seed: point of time *Molinia caerulea* and *Betula pubescens* are sown, green arrow: period of monthly assessment of germination and survival rates, number and length of leaves and plant height, dead tree: point of time of destructive measurement of rooting depth and biomass allocated above and below ground.