The long-term effect of forest drainage on fine roots in hemiboreal Scots pine (Pinus sylvestris L.) dominated forested peatlands.

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Soil is an important carbon pool in forests. The capacity of it to capture and store carbon in forested peatlands in hemiboreal forest zone is scarce and fragmented. Fine root data can provide valuable insight into soil carbon fluxes. The aim of the study is to provide estimates of fine root biomass (FRB), production (FRP) and turnover rate by tree species and other functional groups in unmamanged forested peatlands dominated by Scots pine (*Pinus sylvestris* L.) with and without the effect of forest drainage.

Material and Methods

The FR characteristics were studied in six old-growth (>130 years) Scots pine stands, representing drained (ditches established in 1960ties) and control (un-drained) sites with deep mesotrophic peat soil.

We used sequential soil coring method (Ostonen et al., 2005) for estimating fine root biomass and production (Brunner et al., 2013). Sampling was carried out in May, August and October 2021, and in March 2022. In each stand, fine root samples were collected from three circular sampling plots and analysed in laboratory.

Results

The mean Scots pine FRB was significantly higher in the sites without drainage (6.8 t ha^{-1}) than in the drained sites (4.0 t ha^{-1}). The significantly higher mean FRB of Norway spruce (1.4 t ha^{-1}) in the drained sites than in sites without drainage (0.7 t ha^{-1}) is likely explained by higher proportion of spruce in stand composition. Such observation was also supported by stepwise regression analysis which showed that an increase of Norway spruce FRB was best explained with increasing yield (m^3 ha^{-1}) of Norway spruce. The dwarf shrub FRB (2.4±0.2 t ha^{-1}) was the largest part of the total FRB in the sites without drainage, and the second largest (1.2±0.1 t ha^{-1}) following Norway spruce in the drained sites. The total FRP was similar between both contrasting forest site types 2.1±0.31 t ha^{-1} yr^{-1} and 1.8±0.26 t ha^{-1} yr^{-1} in the sites without drainage and drained sites, respectively; still considerable variability was observed between different sites of the same forest site type. The turnover rate of Scots pine fine root was two-fold higher in the drained sites than in unrained, suggesting faster nutrient and carbon input to soil than in the sites without drainage.

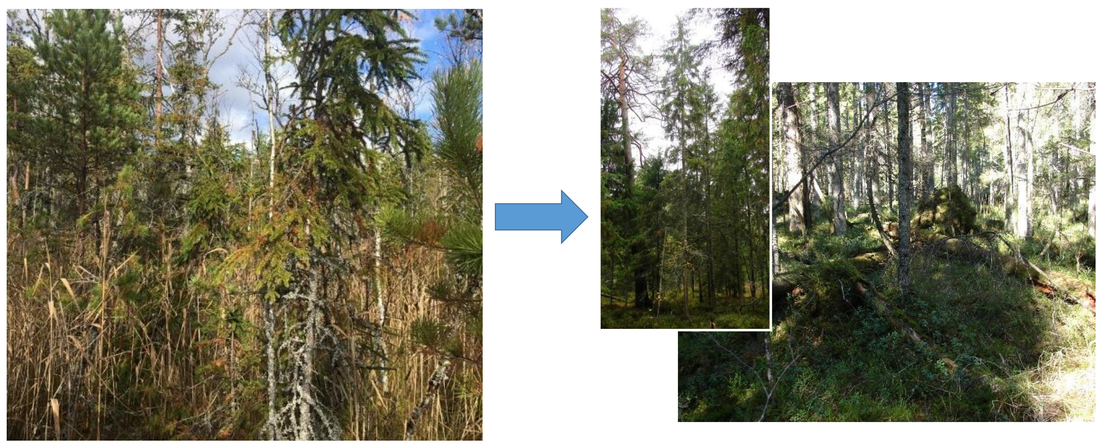
Conclusions

The effect of forest drainage has altered the stand developmental trajectory, characterized by the differences in stand composition, soil chemical analysis and FR characteristics. Scots pine, which was the dominant tree species in our stands, FR differences between the two forest site types suggested adaptation of extensive foraging strategy.

The obtained estimates of FRB, FRP and turnover rate for different functional groups can be used in the C cycle modelling and further calculations to estimate carbon budgets (balance) in forested peatlands.

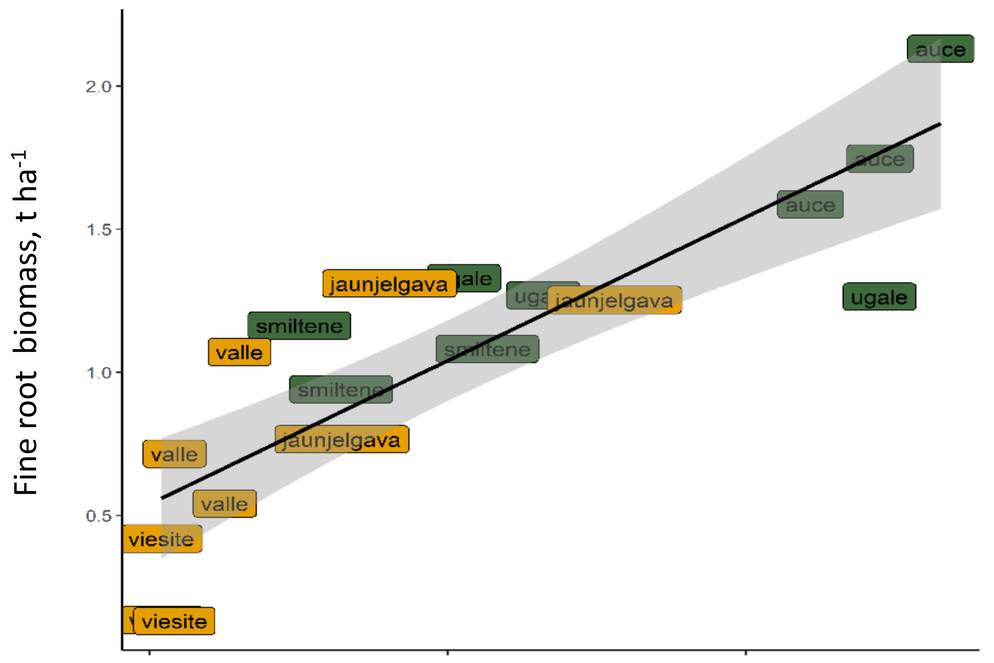
As for the management – our study clearly demonstrates the long-term positive effect of forest drainage on carbon balance in forests as well as potentially in wood products. Consequently, the rewetting project, returning the areas to a pre-drainage state while simultaneously killing the trees, might be beneficial for biodiversity in particular areas but will be detrimental to climate change mitigation.

Source
Based on a submitted manuscript of Samariks et al.



Typical changes of forest state after the drainage: increase of tree increment, yield (standing volume), presence of spruce

Fine-root samples of spruce and pine after separation from the soil and sorting in the laboratory.



Increase of fine root biomass as a result of ingrowth of Norway spruce in undrained (orange) sites after the drainage (green)

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