Above- and belowground biomass of boreal understorey vegetation

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Introduction

This study is a part of the EU co-funded project "The role of understorey vegetation, forest litterfall and forest floor in the carbon and nutrient fluxes of boreal coniferous forest ecosystems". The project is investigating the functional relationships between the understorey vegetation, tree litterfall and organic layer along a climatic gradient and a range of forest site types in Finland.

The size of the belowground components, as well as the annual amount of biomass and litter produced by the understorey vegetation, represent a poorly known part of carbon and nutrient cycling in forest ecosystems. The understorey vegetation may represent over 60 % of the total aboveground production in young succession phases of boreal forests (Helmisaari 1995). Especially the leaf litter of deciduous dwarf shrubs (e.g. *Vaccinium myrtillus*), herbs and grasses has a higher rate of decomposition than the litter produced by conifers. This means that the understorey vegetation is likely to have a major impact on carbon cycling and microbiological processes in forest soil.

In this poster we present preliminary results on:

1) the division of the biomass of understorey vegetation into above- and belowground parts.

2) the biomass production of the understorey vegetation (proportion (%) of different functional plant groups). The annual production is assumed to correspond to the annual litter production over a long time period.

Material and methods

The project was carried out on 11 of the EU/Forest Focus Level II intensive monitoring plots and on one control plot of a fertilization experiment in 2002 and 2003. Six of the plots are located in Scots pine stands and six in Norway spruce stands. The plots are 30 m x 30 m in size, and the samples have been taken from the buffer zone located around the plots. The sample points consist of 30 cm x 30 cm squares, seven squares on each side of the plot, giving a total of 28 sample points per plot.

The organic layer and all the understorey vegetation growing on each square were removed in one intact piece and frozen prior to pre-treatment. After fractionation, the biomass of the plant material was dried at 70 ^{o}C/2d before weighing. The estimates for the belowground biomass in the mineral soil layer have been modelled using coefficients obtained from other samples collected on the Forest Focus Level II plots. The estimates of the annual biomass production of bryophytes were obtained by dividing the total living biomass by three, and that of lichens by five (average number of annual growth sections on the living plants).

Results

Vaccinium myrtillus. Data from Scots pine stands.
The average amount of living aboveground biomass of the understorey vegetation ranged from 1900 to 2000 kg/ha in the northern and from 1400 to 2500 kg/ha in the southern pine stands. The corresponding values for the spruce stands were 1600 - 3000 kg/ha (North) and 700 - 1100 kg/ha (South). Bryophytes and ericaceous dwarf shrubs were the most important components in the aboveground biomass. The proportion of dwarf shrub biomass increased towards the north. The relative abundance of bryophytes was highest in the herb-rich (OMT) spruce stands.

Overall, 40 - 60 % of the total living biomass was allocated to the belowground parts. The proportion of the belowground biomass increased towards the north in both the pine and spruce stands (Fig. 1a,b). The major part of the belowground biomass was concentrated in the organic layer.

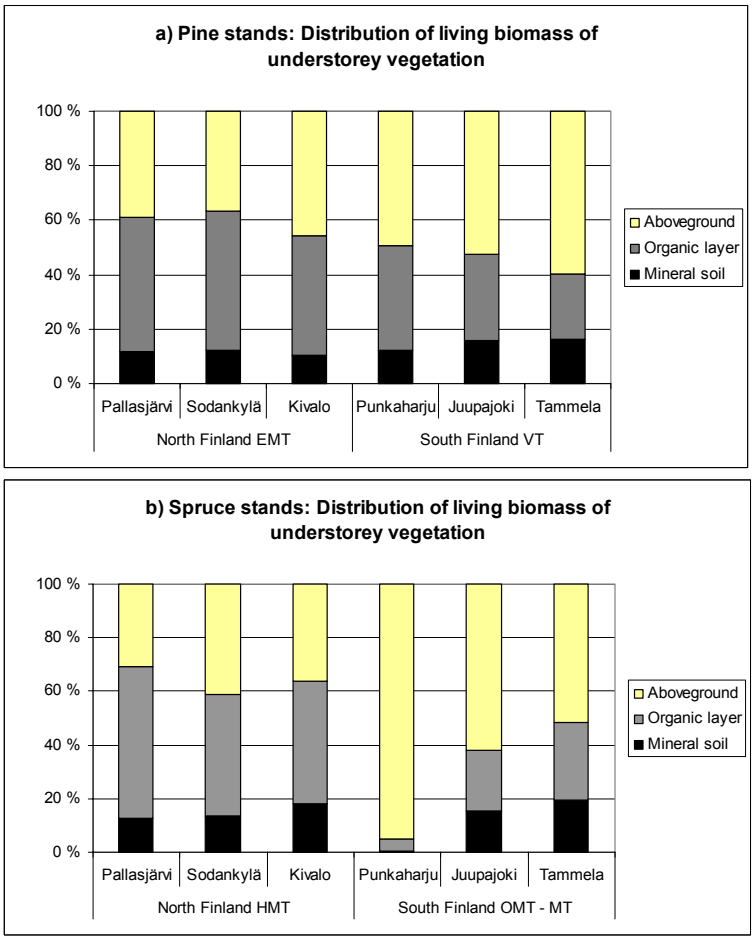

Figure 1. Distribution of the living biomass of the understorey vegetation into above - and belowground parts in a) Scots pine and b) Norway spruce stands.

Dwarf shrubs produced over half of the total annual biomass of the understorey vegetation in the northernmost stands. The importance of bryophytes and grasses in biomass production increased towards the south.

Conclusions

The belowground parts of the understorey vegetation account for a considerable portion of the carbon stores in the organic layer, especially in the forest ecosystems in the north. In addition, the litter production of dwarf shrubs and bryophytes represents a significant input of carbon to forest soils. It is therefore essential to include the understorey vegetation when calculating carbon balance estimates

Reference

Helmisaari, H-S. 1995. Nutrient cycling in *Pinus sylvestris* stands in eastern Finland. Plant and Soil 168-169:327-336.