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Carbon allocation patterns in boreal and hemiboreal forest ecosystems along the gradient of soil fertility

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Carbon (C) allocation plays a critical role in forest ecosystem carbon cycling. Changes in C allocation alter ecosystems carbon sequestration and plant-soil-atmosphere gas exchange, hence having an impact on the climate. Currently, there is lack of reliable indicators that show the direction of C accumulation patterns in forest ecosystems on regional scale.

The first objective of our study was to determine the variability of carbon allocation in hemiboreal coniferous forests along the gradient of soil fertility in Estonia. We measured C stocks and fluxes, such as litter, fine root biomass and production, soil respiration etc. in 8 stands of different site types - Scots pine (Cladonia, Vaccinium, Myrtillus, Fragaria) and Norway spruce (Polytrichum, Myrtillus, Oxalis, Calamagrostis alvar). The suitability of above- and belowground litter production (AG/BG) ratio was analysed as a carbon allocation indicator. The second aim of the study was to analyse forest C allocation patterns along the north-south gradient from northern boreal Finland to hemiboreal Estonia. Finally, C sequestration in silver birch and grey alder stands were compared with coniferous stands in order to determine the impact of tree species on carbon allocation.

Preliminary results indicate that estimated AG/BG ratio (0.5 ... 3.0) tends to decrease with increasing soil organic horizon C/N ratio, indicating that in less fertile sites more carbon is allocated into belowground through fine root growth and in consequence the soil organic carbon stock increases. Similar trends were found on the north-south forest gradient. However, there was a significant difference between coniferous and broadleaf stands in C allocation patterns.

Net ecosystem exchange in Estonian coniferous stands varied from -1.64 ... 3.95 t C ha-1 yr-1, whereas older stands tended to be net carbon sources.