



Effect of species composition on carbon and nitrogen stocks in forest floor and mineral soil in Norway spruce and European beech mixed forests

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Management of existing forests has been identified as the main strategy to enhance carbon sequestration and to mitigate the impact of climate change on forest ecosystems. In this direction, the conversion of Norway spruce monospecific stands into mixed stands by intermingling individuals of European beech is an ongoing trend in adaptive forest management strategies, especially in Central Europe. However, studies assessing the effect of changes in tree species composition on soil organic carbon (SOC) and nitrogen stocks are still scarce and there is a lack of scientific evidence supporting tree species selection as a feasible management option to mitigate the effects of predicted future climatic scenarios. We compared C and N stocks in the forest floor (litter and humus) and the top 10 cm of mineral soil in two monospecific stands of Norway spruce and European beech and in a mixed stand of both species. The effect of tree species composition on the C and N stocks and its spatial distribution was evaluated based on litterfall, root production, elevation and canopy opening, and by using a combination of modelling and geostatistical techniques. C stock was highest in the Norway spruce and the mixed stands, while N stock was highest in the mixed stand and lowest under European beech, with intermediate values in the Norway spruce stand. Each forest type showed differences in forest floor properties, suggesting that species composition is an important factor governing forest floor characteristics, including C and N stocks. The distribution of C and N stocks between forest soil layers was different for each forest type. C and N stocks were highest in the humus layer under Norway spruce, whereas both stocks were lowest in the European beech stand. On the other hand, the mixed stand showed the highest C and N accumulation in the uppermost mineral soil layer, while the monospecific stands showed similar values. Litterfall was the main contribution to C and N stocks of the humus layer in monospecific stands. Forest floor stocks were also influenced by microelevation and canopy opening in the European beech stand and by microelevation in the Norway spruce stand. Root turnover and Norway spruce litterfall proportion directly increased C stocks in the mineral soil of the mixed stand. Additionally, N stock in the forest floor of the mixed stand was positively correlated with the Norway spruce litterfall proportion. Spatial analyses further confirmed that species composition was the main source of spatial variability of SOC stock in mixed stands. These results suggest that the admixture of individuals of European beech and Norway spruce may lead to a translocation of SOC from the forest floor to the better protected mineral soil layer, which might be beneficial for long term SOC sequestration.