

Is tree species diversity or tree species identity the most important driver of European forest soil carbon stocks?

Lars Vesterdal (1), Seid Muhie Dawud (1,2), Karsten Raulund-Rasmussen (1), Leena Finér (3), and Timo Domisch (3)

(1) University of Copenhagen, Dep. of Geosciences and Natural Resource Management, Frederiksberg C, Denmark (lv@ign.ku.dk), (2) Wollo University, Department of Forestry, Dessie, Ethiopia, (3) Natural Resources Institute Finland -Luke, Joensuu, Finland

Land management includes the selection of specific tree species and tree species mixtures for European forests. Studies of functional species diversity effects have reported positive effects for aboveground carbon (C) sequestration, but the question remains whether higher soil C stocks could also result from belowground niche differentiation including more efficient root exploitation of soils. We studied topsoil C stocks in tree species diversity gradients established within the FunDivEurope project to explore biodiversity-ecosystem functioning relationships in six European forest types in Finland, Poland, Germany, Romania, Spain and Italy. In the Polish forest type we extended the sampling to also include subsoils.

We found consistent but modest effects of species diversity on total soil C stocks (forest floor and 0-20 cm) across the six European forest types. Carbon stocks in the forest floor alone and in the combined forest floor and mineral soil layers increased with increasing tree species diversity. In contrast, there was a strong effect of species identity (broadleaf vs. conifer) and its interaction with site-related factors. Within the Polish forest type we sampled soils down to 40 cm and found that species identity was again the main factor explaining total soil C stock. However, species diversity increased soil C stocks in deeper soil layers (20-40 cm), while species identity influenced C stocks significantly within forest floors and the 0-10 cm layer. Root biomass increased with diversity in 30-40 cm depth, and a positive relationship between C stocks and root biomass in the 30-40 cm layer suggested that belowground niche complementarity could be a driving mechanism for higher root carbon input and in turn a deeper distribution of C in diverse forests.

We conclude that total C stocks are mainly driven by tree species identity. However, modest positive diversity effects were detected at the European scale, and stronger positive effects on subsoil C stocks in Poland were associated with higher subsoil root biomass. In order to maintain or increase soil C stocks in these common European forest types, this study indicated that targeted selection of tree species with desired characteristics is a stronger management approach for mixed forests than increasing tree species diversity per se.