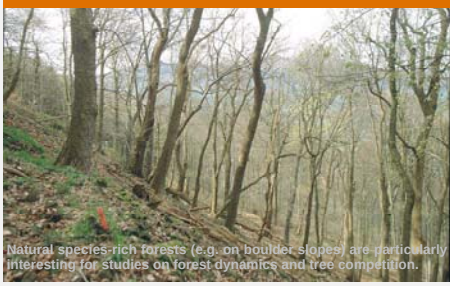
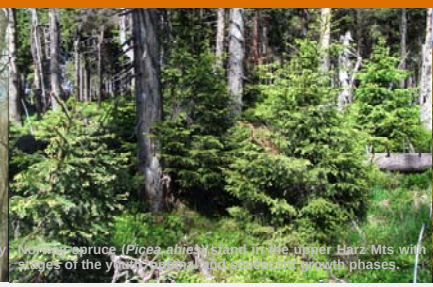
Department of Plant Ecology and Ecosystems Research

Forest Dynamics Research


Natural species-rich forests (e.g. on boulder slopes) are particularly interesting for studies on forest dynamics and tree competition.


Norway spruce (*Picea abies*) stand in the upper Harz Mts with stages of the young, mature and old-growth phases.

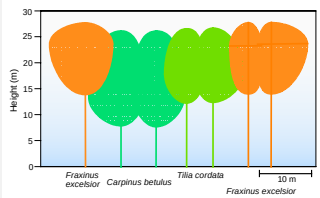

Strong above- and below-ground competition ability of *Fagus sylvatica* has led to a dominance of beech over other tree species.

Background

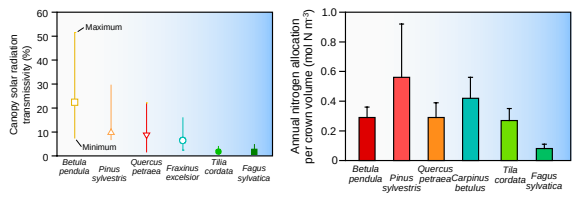
The dynamics of forests is directly driven by inter- and intra-specific competition processes between trees. Hence, studies on forest dynamics focus on biotic interactions between trees as well as on species-specific abilities of resource-use (e.g. of light, water and nutrients) and on the fundamental ecological niche of different tree species. Particularly, the knowledge about competition processes in the crown and in the rhizosphere of mature trees is still incomplete. Moreover, the research on forest dynamics is hampered by the prevailing forest use practice in most parts of the world.

Research

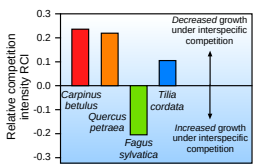

The Göttingen canopy walkway in the Experimental Botanical Garden is a novel facility enabling ecological studies in the crown of adult trees of 9 different species.



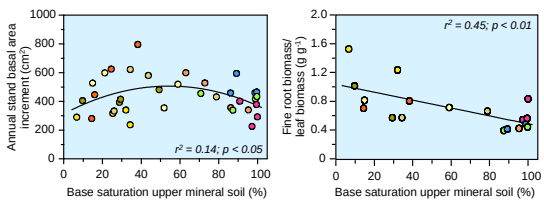
For the assessment of above-ground competition for light among different tree species, it is crucial to study species-specific differences in crown architecture and how these attributes enables an effective canopy occupation.



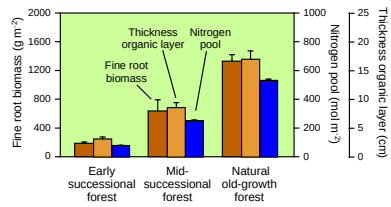
An effective light capture in the canopy is an important above-ground competition mechanism that largely differs among different tree species (left). Since the establishment of an unit of crown volume is not for free (regarding e.g. the N costs, right), the economical effectiveness of light capture largely depends on the cost-benefit ratio of building an unit of crown volume.



Studies on below-ground competition among tree species are still rare. Results from the application of *in situ* root growth chambers suggest that European beech has a strong below-ground competition ability.



Investigations of mature European beech stands along the entire range of soil nutrient site conditions revealed an surprisingly weak influence of this factor on stem growth (left). However, the carbon investment into the fine root system *versus* that into leaf biomass was found to increase markedly towards beech stands at more nutrient-poor sites (right).



Along a forest succession chronosequence in the upper montane rainforest (Costa Rica), standing fine root biomass markedly increased with stand age. This increase of the fine root system goes along with a strong accumulation of organic matter in the forest floor containing large amounts of nutrients.

Major projects: *BEN "Biodiversity and Ecology in National Parks" - project "Significance of old and decaying trees in montane coniferous forests for plant diversity and element cycling*
DFG Research Training Group 1086 "The Role of Biodiversity for Biogeochemical Cycles and Biotic Interactions in Temperate Deciduous Forests"

Key results

- The marked dominance of European beech in Central Europe is due to its strong competition ability in the crown but also in the rhizosphere.
- Beech trees respond only weakly in their above-ground growth to differences in nutrient availability, while the dry mass partitioning into fine roots *versus* leaves is markedly affected by soil nutrient conditions.
- Secondary forest succession at nutrient-poor sites is characterized by an increase in nutrient pools with stand age stored in the accumulated litter layer on the floor. This is found in temperate forest ecosystems as well as in the tropics.