INTERPLAY

Résistance à la sécheresse des écosystèmes d'espèces mixtes résultant de l'interaction entre l'hydraulique des plantes et l'interaction des espèces

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Summary

Context — Plants compete for light above the soil surface and for nutrients and water below ground. Interactions between different plants and plant species can be an interplay of many factors such as different rooting depths, different water spending strategies, sheltering effects, or increased resource availability. Plant diversity can have beneficial effects for the whole ecosystem, e.g. when grasses increase infiltration of precipitation into the soil. Or species can be detrimental to co-existing species, e.g. if invading shrubs use up all of the water in the upper soil layers, leaving trees no or only deeper, nutrient-poor soil water. In general, denser vegetation needs more resources, leading to that density reduction is one of the recommended management strategies to increase resilience of ecosystems to environmental stresses such as droughts.

Objectives — This project aims to inform understanding of the resilience of both, individual plant species and a mixture of species, to withstand and recover from droughts, due to emerging comprehension of the links between detailed plant hydraulics and other ecosystem components.

Approaches — Here we propose to build on two current European research projects that study species interactions under different stand densities – a Portuguese cork-oak plantation invaded by cistus shrubs, and an experimental thinning trial of single-species and mixed Norway spruce and silver fir stands in the low-mountain ranges of Southern Germany. We propose to combine compartment-specific hydraulic descriptions, carbon storage, and species interactions above- and below-ground in an established, detailed ecosystem model. Comprehensive hydraulic and physiological information is currently being assembled at the cork-oak plantation against the background of an increasing shrub invasion, together with a rain exclusion experiment.

Expected results and impacts — Combining the extensive data with the enhanced ecosystem model will allow us to disentangle physiological and ecophysiological responses of cork-oaks to biotic (cistus shrubs) and abiotic (drought) stressors. The same ecosystem model will allow us to look at interactions between plant hydraulics and carbon storage in trees at the mixed Norway spruce and silver fir stands, where data has been collected for almost 50 years. We will thus be able to examine, for example, legacy effects in plant growth following severe droughts such as during the heat wave of 2003. The results will feed into risk assessment analyses, performed in the two European projects, of ecosystem sustainability and economic profitability in the current climate and under projected future climate change.