ELASTICITY OF TREE RADIAL GROWTH TO ENVIRONMENTAL STRESS

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Elasticity of tree growth to environmental disturbances is an important component and determinant of forest ecosystem resilience. It is also an important information for modellers of forest growth under future climate regimes who need to capture in their models how tree growth is affected by extreme events. This paper focuses on statistical analyses of the growth response kinetics of Norway spruce (*Picea abies* L. Karst.), silver fir (*Abies alba* Mill.) and common beech (*Fagus sylvatica* L.) trees to environmental stress under field conditions. The analyses are based on retrospective growth data of forest trees from selected sites in south-western Germany. Long-term tree-ring time series are analysed using super-posed epoch analysis, and response surface models are parameterized to determine growth elasticity as a function of the initial stress intensity and the elapsed time since the stress event.

Over all data sets the maximum recovery time after severe stress was between 2.5 and 5 years for spruce, 3 to 4 years for fir, and around 4 years for beech. At low elevation sites and low initial stress intensity, recovery of beech and fir was distinctly faster than of spruce. At high elevation sites and at more severe stress intensity, recovery of spruce was faster than of beech and fir. Older spruce trees showed higher rates of growth elasticity than younger trees at low stress levels; at high stress levels it was reverse. Growth elasticity of spruce varied by eco-region and was also not constant between time periods.

Most of the years with severe growth depressions coincided with drought events. Thus the results particularly refer to the impact of drought on tree growth. Modelling approaches linking process-based knowledge with insights from long-term retrospective empirical studies are considered to have a high potential for a more reliable assessment of the impacts of extreme events on forest ecosystems.

Key words: dendroecology, drought stress, growth elasticity.

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