Combining statistical and mechanistic models to unravel the causes of mortality causes within rear-edge beech population.

Cathleen Petit-Cailleux, Sylvie Muratorio, Francois Lefèvre, Hendrik Davi

Combining statistical and mechanistic models to unravel the causes of mortality causes within rear-edge beech population

Cathleen Pet[illegible]*† [1], Sylvie Muratorio , François Lefevre , Hendrik Davi

[1] Unité de Recherches Forestières Méditerranéennes (URFM) – Institut National de la Recherche Agronomique : UR0629 – Domaine saint Paul, 84000,Avignon, France

Several studies report increasing dieback of trees over temperate forests, a major issue in ecology is to understand the mortality physiological drivers. In this study we combine statistical and mechanistic models to investigate the causes of mortality in a major European tree species (*Fagus sylvatica*) at its south margin range, based on individual monitoring of 5600 trees since 2003. First we used logistic regression and survival analysis to characterise the respective effects on individual mortality by exogenous (competition) and endogenous (size, defoliation, fungi presence) biotic factors. Then the effect of annual climatic factors on mortality at population scale. Secondly, we used a process-based model CASTANEA to simulate over time the development of beech trees with different individual characteristics (height, diameter and leaf traits) in different environmental conditions to mimicking the surveyed population. The first analysis shows that a combination of exogenous (climatic and biotic) and endogenous factors caused tree mortality. Drought was associated to increased mortality at population level. At individual scale, crown defoliation and the *Oudemansiella mucida* (fungi) presence were both found to be early signs of mortality. We found that the competition increase the mortality at early life stage and suggest that mortality is driven by light competition. Secondly, we will compare the simulations of CASTANEA model with these statistical predictions, and investigate if extremely low hydric potential occur when mortality is caused by drought. With the combination of these two methods we hope to better understand the whole process driving tree to death.

Keywords: Mortality, Fagus sylvatica, Tree, Mechanistic model, Longitudinal analysis

*Speaker
†Corresponding author