TipTree – Scenarios for forest biodiversity dynamics under global change in Europe: Identifying micro-evolutionary scale tipping points

Predicting the response of forest trees to ongoing global change is a critical ecological, societal and economic issue. Indeed, forests cover nearly 40% of Europe and around 23% of emerged land worldwide and most "hot spots" of biological diversity (where biodiversity is both high and vulnerable) are actually forests. Besides biodiversity sustainability, forests provide a multiple source of ecosystem services and well-being to human populations, including carbon sequestration and freshwater availability.

Impacts of climate and land-use changes on forests are expected to be acute. Environmental tipping points may be reached where tree populations collapse suddenly with irreversible effects on ecosystem functioning. Adaptive potential could nonetheless be high in tree populations: besides tracking their ecological niche spatially through migration (without adapting), tree populations could adapt to the ongoing climate change (CC) in the short-term through individual physiological tolerance (plasticity), and/or in the longer term through evolutionary response to climate-induced selection. However, observed and predicted rates of climate and environmental changes, far above past natural oscillations, raise the issue of how quickly tree species can adapt to CC.

TipTree will investigate to what extent trees have the evolutionary potential to adapt to ongoing CC, evaluate the existence of tipping points in adaptive genetic diversity below which adaptation to degraded environments is not possible anymore, and assess how human actions interfere in the adjustment between the rate of evolution and the velocity of CC. A main originality of Tiptree is to investigate tree abilities of rapid adaptation (in 1 to 10 generations), in different parts of the range (and in particular in warm margins where tipping points are most expected). Another originality is to rely on a new generation of simulations models accounting for key environmental, ecological and genetic processes.

Using these models, TipTree will investigate the demographic and evolutionary dynamics of tree populations for a range of forest management scenarios established by our stakeholder group and under scenarios of CC provided by IPCC. These simulations will provide forecasts of tree persistence, ecosystem services (carbon sequestration, wood production, sustain of forest cover for recreation) and decision support for management.

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