Project Database of ICP Forests
PROJECT DESCRIPTION

PROJECT INFORMATION

Project title: **FORBIO Climate - Adaptation potential of biodiverse forests in the face of climate change**

Project ID: 105

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Climate change is expected to have a large impact on the distribution, composition and functioning of forest ecosystems worldwide due to the limited migration and adaptation potential of trees. Creating resistant and resilient forests is thus a key challenge for forest management. It has been suggested recently that epigenetic mechanisms may increase the capacity of trees to survive in a changing environment, but the extent and importance of these mechanisms in seedlings and saplings are still unknown. Research has also shown that more biodiverse ecosystems are better buffered against disturbances. Yet, these studies were predominantly performed in grasslands. More insight into the adaptive capacity of trees (in their consecutive life stages) and forests to climate change is thus badly needed.

FORBIO Climate wants to scrutinize the adaptive capacity of tree species and predict the future performance of tree species in Belgium under different scenarios of climate change. The project will focus on oak (*Quercus robur/petraea*) and beech (*Fagus sylvatica*), two tree species with high ecological and economic significance in Belgium (and Europe). FORBIO Climate will capitalize upon two unique research infrastructures available in Belgium, i.e. the FORBIO experimental sites and the Observational Biodiversity Platform, to test the following hypotheses: (1) epigenetic inheritance mechanisms can increase the adaptive capacity of trees to climate change during the reproduction stage; (2) across subsequent tree development

stages, tree performance in more biodiverse forests is more resistant and resilient to climate change.

In this project, we merge approaches and methodologies typical of research on climate change with those of functional biodiversity research. By merging these so far separate worlds, we enable the two unique biodiversity functional research platforms in Belgium to become a climate change adaptation research platform.

We expect gap-filling results, which, fed into predictive models, will be able to give better predictions on the behaviour and performance of mixed forests under climate change scenarios. Hence, FORBIO Climate will produce innovative research results with impact in the international scientific community. Towards policy makers, FORBIO Climate will contribute to more realistic trend analyses on the sustainable supply of forest resources under climate change, at least for oak and beech in the climatic and environmental context of Belgium's regions. Towards forest managers, FORBIO Climate will produce recommendations for tree species choice and optimal tree species mixtures in order to reduce risk and increase resistance and resilience in adaptive forest management. Towards the large public, FORBIO Climate will provide more tangible information on how oak and beech forests, some of the most characteristic landscapes of Belgium's regions, will evolve in an unsure and changing future.

Detailed description:

To meet the objectives of FORBIO Climate and to test the hypotheses, the project has been structured in five scientific Work Packages (WP). We are in charge of WP5, which final output will be an integrated risk and performance model for oak and beech in changing climate conditions. We will use the results gained from the three empirical work packages (WP2-4) and the future climate simulations of WP1 in advanced predictive modelling techniques for modelling the performance of oak and beech under various climate change scenarios for the different tree life stages. Results will be complemented with data from the literature and using regional forest inventory data of Flanders and Wallonia.

With this in mind, we designed a case-study where we aimed at: (1) investigating the conditions influencing tree vitality in Belgian forests and (2) whether the resistance, resilience and recovery after extreme drought events of oak and beech in mixed stands differ from their performance in pure stands.

Using data from the ICP Forests monitoring plots in Flanders and Wallonia, Belgium, we have analyzed the response of oaks and beeches to climate change, with special focus on the role species diversity plays in building climate resilience. Also, we have investigated the response of these trees to extreme drought years and investigated to what extent peaks in defoliation occur after such events, which in case of Belgium has proven to be true. Consequently, we are now interested to investigate if the same holds true for the other European countries.

Hypotheses to be tested:

- drought conditions will trigger and expedite the defoliation process along the time
- the most defoliated trees will show the lowest post-drought resilience capacity
- it is expected to detect these patterns more clearly in European beech than oak species since the former is considered to be more vulnerable to drought
- defoliation severity is expected to be higher in pure than in mixed plots

Statistical methods to be used:

- Linear mixed models will be used to determine the importance of stand structure, climate and diversity (i.e. functional diversity and species identity) as predictors of tree defoliation. A number of alternative mixed effects models of defoliation were fitted and compared using based on a multi-model inference approach.

Data to be used:

- Regional forest inventory data of Flanders and Wallonia, Belgium
- Data on forest vitality from the ICP Forests plots in Flanders and Wallonia, Belgium
- Meteorological data for local-scale models provided by RMI (Royal Meteorological Institute of Belgium)
- Climate data for Europe downloaded from the WorldClim database (www.worldclim.org)
- Soil information from the European Soil Data Base