PROJECT INFORMATION

Project title: FunDivEUROPE (FUNctional significance of forest bioDIVersity in EUROPE – EU project number 265171).

Project ID: 23

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PROJECT DESCRIPTION

Objectives of the project:
Our major aim is to understand and quantify how tree species diversity can be used to foster the provision of ecosystem services such as timber production, carbon sequestration and freshwater provisioning, among others.

Scientific background of the project:
There are three research platforms in the project: the Experimental Platform, consisting of several large functional biodiversity research experiments (TreeDiv_Net); the Exploratory Platform, a specifically designed network of approximately 300 plots in natural mature forests, replicated across wide gradients of tree diversity in Europe (Spain, Italy, Germany, Romania, Poland and Finland); and the Inventory Platform, where national forest inventory data will be analysed for potential diversity signals, extending the scope of the Experimental and Exploratory Platforms to larger temporal and spatial scales. It is within the Inventory Platform project that we would very much like to complement the data we have already received from the German, Spanish, Finnish and Romanian NFIs, and will receive from the French NFI, with data from the ICP Forest Network.

There are three research avenues that we will take using the inventory data:
1. NFI data will be used to characterise aspects of forest diversity (species richness, species diversity, functional richness and diversity) as predictors to estimate growth and mortality rates.
2. The role of forest management practices on modifying various facets of functional diversity across Europe will be studied using near-natural species composition from forest reserves as reference point.
3. A map of the functional diversity of the European forests will be developed based on a large trait database of European tree species compiled within the FunDivEUROPE project.

The following are some of our hypotheses that we would like to test using the inventory data:
1. productivity is positively related to diversity, even when confounding environmental effects are considered,
2. measures of functional diversity are better predictors of productivity than species richness,

3. functional diversity decreases with increasing latitude and decreasing resource availability due to trait convergence as a consequence of strong environmental filtering. The reduction of functional diversity relative to near-natural background levels is thus strongest under suitable climatic and edaphic conditions,
4. the relative importance of complementarity (reflected by a high explanatory power of functional diversity), as a predictor of productivity, decreases with the harshness (cold or dry) of the environment, whilst the importance of functional identity increases, and
5. models reflecting the hierarchical integration of different modes of trait influence are superior in explaining ecosystem-level functions than non-hierarchical models.

The statistical analyses will not be finalised until we have received all the inventory data because of the different sampling designs of each dataset. However, Generalised Linear Mixed Models and Bayesian Hierarchical models, where the effects of the different sampling methods can be incorporated, will be tested. Hierarchical models will be used to test hypotheses about the multiple roles of traits, multiple modes of trait influence, and the pathways of functional diversity measures as predictors of productivity and mortality. We will implement both Structural Equation Models and Bayesian Hierarchical Models; however, we envisage that Bayesian models may be more suitable given the heterogeneity of datasets.

Forest management substantially modifies functional diversity patterns through artificial plantations in order to maximise economic requirements. Structure and composition data from unmanaged forest reserves will be used to quantify management-related changes in functional diversity in relation to the recent natural background provided by the Inventory Platform. In particular, we will assess which forest management practice leads to impoverishment versus enrichment in functional diversity across different scales of spatial aggregation. In a synthetic approach regression models will be used to predict functional diversity in response to management, developmental stage and environmental covariates

Additional datasets

Data compilations from the German, Spanish and Finnish NFIs provided by the companion EU project CarboEXTREME have been used as a backbone for the Inventory Platform. In addition we have received data from the Romanian NFI and are in the process of acquiring a dataset from the French NFI.

To control for the confounding environmental effects, ancillary data on climate, soil conditions and topography have been compiled from external spatial datasets, in addition to the plot-level abiotic attributes available in the NFI datasets. The spatial datasets we have processed to date are: WorldClim (Hijmans et al., 2005) providing monthly temperature and precipitation data; The European Soils Database (Heineke et al., 1998) providing 73 attributes of soil types and descriptions based on FAO nomenclature; GTOPO30 (US Geological Survey, 1998) a Digital Elevation Model (DEM) from which we have extracted elevation, slope and aspect attributes for each plot; and CGIAR-CSI's Potential Evapotranspiration and Aridity indices (Trabucco and Zomer, 2009).

In addition, trait information has been compiled for almost 200 European tree species. Data has come from the TRY database (Kattge et al., 2011) and from literature sources. The trait data will be used to describe functional richness and diversity measures and to map the functional diversity of European forests.