



CESAB
CENTRE FOR THE SYNTHESIS AND ANALYSIS
OF BIODIVERSITY

Project summary

WOODIV

Origin and congruence of taxonomic, phylogenetic, functional and paleoecological diversity patterns: the model of European-Mediterranean woody plant biodiversity

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How can we better protect the biodiversity of trees in the Mediterranean, keystone species of forest ecosystems, in an ecologically rich but threatened region? This crucial question requires an understanding of how this biodiversity has been established over time and how it evolves in a global and dynamic context.

Context and objectives

The Mediterranean basin provides a unique diversity of habitats, within which a succession of colonization events has shaped a remarkable diversity of plant species. Trees are keystone species of terrestrial ecosystems in the region and are relevant surrogates of biodiversity. Plant richness and endemism around the

Mediterranean is concentrated in 50 refugia areas among which 25% are now located in sectors where human density is very high. **In order to anticipate current and future dynamics and needs in terms of conservation, it is of crucial importance to identify how biodiversity was shaped and how it will evolve under a global and dynamic environmental and societal context, in which various parameters are involved.** WOODIV aims to provide insights on the ecological and evolutionary forces that drive tree biodiversity components, identifying the main drivers that may explain the congruence (or lack of) between the current patterns of taxonomic, phylogenetic and functional biodiversity for trees of the Northern Mediterranean. Reliable data on the occurrence, functional traits, and phylogeny of the tree species are crucial for such purposes but are still sparse, not readily available, and count with variable spatial and taxonomic coverage and resolution. WOODIV aims to generate a reliable database which provides such data for all 210 Euro-Mediterranean tree species in order to offer decision support for Mediterranean biodiversity management through the investigation of spatial patterns of the 3 facets of biodiversity (taxonomic, phylogenetic, functional) and their response to environmental gradients.

Methods and approaches used for the project

WOODIV consortium gathered all the taxonomic, evolutionary and functional data for 210 trees in a single database publicly accessible. **The spatial analysis of these data explicated the structure of these three components of biodiversity and their degree of congruence.** Meta-analyses then made it possible to identify the respective contribution of factors that drive the observed patterns, by integrating both environmental variables and land use patterns. Finally, priority areas to be protected were identified, allowing recommendations for effective conservation strategies that will include not only the unique taxonomic diversity of the region.

Principal conclusions

The Mediterranean-European region includes an unsuspectedly high number of tree taxa, almost 200 tree taxa more than in the central European region. This tree diversity is not distributed evenly and culminates in the central-eastern part of the Mediterranean region, whereas some large Tyrrhenian islands shelter several narrow endemic tree taxa. Few taxa are recognized as threatened in the IUCN Red list, and the vulnerability of these species is probably underestimated.

During the project's duration, the WOODIV consortium listed the tree species occurring in the Euro-Mediterranean region. They identified 210 tree species for which they compiled, homogenized and verified datasets on spatial occurrences, four functional traits (plant height, seed mass, wood density and specific leaf area), and sequences from three DNA-regions (*rbcl*, *matK* and *trnH-psbA*).

A first analyse of DNA-region sequences was performed at the general level. WOODIV produced the first time-calibrated phylogeny of all 64 native tree genera occurring on the European side of the Mediterranean Basin. This phylogeny is based on 3 plastid DNA sequences (*rbcl*, *matK* and *trnH-psbA*), 4 recognized fossil dates and 10 secondary calibrations. The four strictly endemic genera of the Mediterranean Basin (*Chamaerops*, *Phillyrea*, *Spartium* and *Tetraclinis*) all showed emergence dates (11–72 Ma) long before the onset of the Mediterranean climate. They also showed that the presence of species at risk of potential extinction within a given genus was randomly distributed along the phylogenetic tree. WOODIV analysis closes knowledge gaps and provides a valuable basis for studying the biogeographical and ecological processes that have generated the Mediterranean tree flora. It can also inform conservation planning strategies that aim at broadening traditional taxonomy-focused perspectives with components of evolutionary history and phylogenetic singularity.

Anticipated (or actual) impact of these results for science, society, and public and private decision making

WOODIV was able to produce the first time-calibrated phylogeny of all 64 native tree genera occurring on the European side of the Mediterranean Basin. Based on the inferred topology, they then tested whether the investigated tree flora exhibits phylogenetic clustering in both life-history traits known to influence reproduction and species' vulnerability to extinction but found that the presence of species at risk of potential extinction within a given genus was randomly distributed along the phylogenetic tree.

Using the same phylogenetic tree, they also calculated phylogenetic diversity for all 50 × 50 km² grid cells spanning Mediterranean Europe and compared values with those obtained for genus-level taxonomic diversity. They found that Southern Spain, Cyprus and some Aegean islands contained areas of disproportionately high phylogenetic diversity and a concentration of phylogenetic paleo-endemics, while phylogenetic neo-endemism was high in eastern Sicily (see Figure).

In addition to the database itself, WOODIV produced various results and assessment tools:

- maps of current hotspots and coldspots of the taxonomic, phylogenetic and functional diversity of the species;
- maps of preferred conservation areas;
- new biodiversity measures for use in more pro-active conservation;
- indicators of the effectiveness of current conservation policies and proposals for new conservation strategies

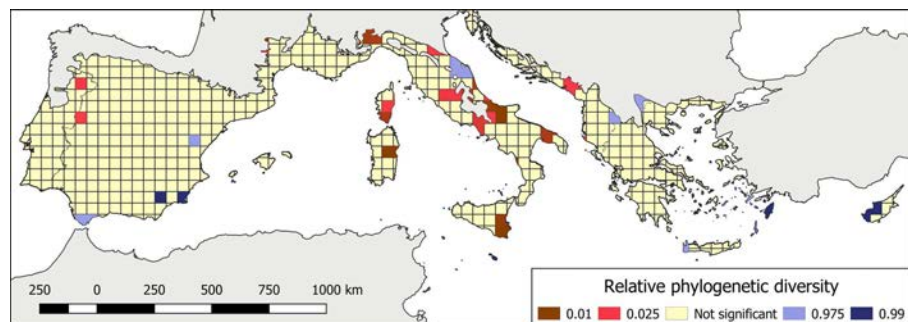


Figure : Map of the relative phylogenetic diversity (RPD) significance in Mediterranean Europe. Areas in blue have a concentration of significantly longer branches than expected; whereas, areas in red have a concentration of significantly shorter branches than expected

The results of the WOODIV project can serve as a basis for a more effective, as well as more pro-active (due to the integration of evolutionary and functional processes), biogeographic conservation of Mediterranean biodiversity.

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