

ABSTRACT

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Title:

“Herbaceous and shrub diversity in relation to tree diversity and other environmental factors: a study in the broadleaf forests of central Tuscany”

Background and Aims: Biodiversity is widely acknowledged as a key issue for the conservation of ecosystems (Myers, 1993). The functionality of especially complex systems such as forests is likely to depend on tree species richness and diversity (Scherer-Lorenzen et al. 2005). The current trend in forestry is therefore to favour woodlands as close as possible to natural conditions. Diversity of the understory vegetation is also an important issue in forest ecology, because despite its low biomass compared to the forest overstory, most of plant diversity in temperate woodlands is found in the understory and especially in the herb layer (Gilliam 2007). However, the relationships between forest overstory and understory diversity are still poorly known. This issue is therefore one of the numerous tasks tackled by *FunDiv* Europe, an FP7 broad-scale project to quantify the effects of forest biodiversity on ecosystem functions in major European forest types (<http://www.fundiveurope.eu/>). The thermophilus deciduous woodlands of Tuscany are among the major forest types selected for this project. In the initial phase it was necessary to characterize the diversity of the selected stands, offering the opportunity to test the relationships between understory diversity and tree species richness in the overstory. This work provides a first evidence about this aspect based on data from 49 stands representing a gradient of tree species diversity with very similar environmental conditions and structural features.

Materials and Methods Studied areas are located on the hills of Tyrrhenian Anti-Appennine system in central-southern Tuscany, provinces of Siena, Grosseto and Pisa. The stands are mainly included in Nature Reserves and/or Sites of the Natura 2000 Network and consist of old, abandoned coppices under natural development and relatively undisturbed, dominated by more or less thermophilus broad-leaf trees.

The studied sites are quadrats of 30 m x 30 m, established during the preselection phase of the FunDiv Europe Exploratory platform. They represent a gradient of tree species diversity based on different mixtures of five focal species: *Quercus cerris*, *Q. petraea*, *Q. ilex*, *Castanea sativa* and *Ostrya carpinifolia*. Environmental and structural characters were kept as constant as possible, to isolate the tree diversity effect from confounding factors.

The 49 plots were subject to structural and floristic analysis, layer by layer, using percentage intervals of soil cover adapted from the Braun-Blanquet method (Braun-Blanquet, 1932). The resulting data were processed to:

- 1) Calculate diversity values such as Species Richness (SR), Shannon index (H') and Evenness index (J), separately for the herbaceous (0-0,5 m), shrub (0,5-5 m) and tree (> 5 m) layer. The effects of the main ecological variables on herbaceous diversity was also analysed using Elleberg values as reported in Pignatti (2003).

2) Perform multivariate and univariate analyses to identify the relationships between independent (tree diversity indexes, structural measures and Elleberg-Pignatti indexes) and dependent variables (herb and shrub diversity indexes).

Key Results: The obtained data confirm the relatively high diversity of the understory vegetation of the examined stands and suggest that minimum diversity values of both the herbaceous and shrub layers are higher in the richest tree mixtures. In addition, some species showed a higher frequency in the 4-species mixtures.

Among the dependent variables, the H' diversity and species richness of the shrub layer resulted positively correlated with the number of tree species in the overstory. This is confirmed by the significant increase in shrub diversity along the gradient of tree species richness. Shrub species richness also increased with tree canopy cover, whereas H' diversity of the herbaceous layer was negatively affected by tree cover. Overall, variations in herbaceous diversity were not found to depend on the number of the dominant tree species in the stands. Rather, they seem to depend more on ecological factors, as suggested by the positive correlation found with light, soil humidity and nutrients and the negative one with temperature and soil pH.

Conclusions: The present study provides first quantitative data on understory vegetation diversity of thermophilus deciduous forests in Tuscany and suggests that the richness of the shrub layer may be positively affected by tree species richness. This supports the importance of forms of silvicultural management favouring the maintenance of mixed stands. Functional aspects of diversity should be experimentally investigated to bring more light on such relationships and especially the ecological role of the understory vegetation, including effects on humus layer dynamics, litter decomposition, tree regeneration and nutrient cycling.

References:

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