

Relationships between overstory and understory structure and diversity in semi-natural mixed floodplain forests at Bosco Fontana (Italy)

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The “Bosco Fontana” natural reserve includes the last remaining mixed floodplain forest in northern Italy and one of the most endangered ecosystems in Europe. Its effective management is hindered by the complexity of interactions of mixed-tree species and the influence of environmental factors on understory plant diversity. In this study we analyzed the patterns of natural evolution in semi-natural floodplain forest stands at Bosco Fontana with the aim of better understanding its current natural processes and dynamics. Stand structure, taxonomic and functional diversity, species composition, and leaf area index (LAI) of overstory and understory layers were surveyed in permanent plots over two inventory years (1995, 2005). The influence of environmental factors on understory plant diversity was assessed using Ellenberg’s indices for light, soil moisture, soil nutrient and soil reaction. Results indicated that overstory species composition varies according to the soil moisture, with hornbeam prevailing in xeric sites and deciduous oak species in mesic sites. Xeric sites showed high functional dispersion in both drought and shade tolerant traits, while it was significantly lower in both overstory and understory in the moist site. Functional dispersion of drought tolerance in the overstory and understory layers was positively correlated, while species richness was negatively correlated between the two layers. Diversity in the understory was mainly correlated with soil conditions. Understory LAI was positively correlated with overstory LAI in xeric and mesic plots, while no correlations were found in the moist plot. Overall, our results suggest that site conditions (soil conditions and water availability) are the major drivers of understory and overstory dynamics in the study forest. Hence, local site conditions and the understory should be carefully considered in the management of mixed floodplain forests.

Keywords: Deciduous Forests, Functional Diversity, Diversity Measure, Hemispherical Photography, Leaf Area Index

Introduction

Only less than 1% of temperate deciduous forests in Europe are undisturbed, free of logging, grazing, deforestation and other intensive uses (Reich & Frelich 2002). Mixed temperate forests show a high level of naturalness, thus becoming a basic reference for forest management (Meyer et al.

2003, Balvanera et al. 2006, Burrascano et al. 2008, Gamfeldt et al. 2013). New silvicultural systems have emerged during recent decades, based on the assumption that diversity patterns and ecological processes are more likely to persist when disturbances due to management mimic the patterns and processes of natural distur-

bances (Decocq et al. 2004, Vandekerckhove et al. 2009). Management regimes mimicking natural disturbances can contribute to diversify stand structure, and this may increase biodiversity through time (Falinski 1989, Frelich & Reich 2003, Campetella et al. 2004) whilst aiming at economic targets and minimizing modifications of the forests (Emborg et al. 2000).

Close-to-nature forest management requires a comprehensive knowledge of the stand structure, diversity and species interactions naturally occurring in forest ecosystems (Butler-Manning 2008). In the last decades, the number of studies conducted in natural forests sharply increased (Falinski 1989, Scheller & Mladenoff 2002, Campetella et al. 2004, Petritan et al. 2012, Sabatini et al. 2013). Forest stand structure is an important factor in determining species diversity (Larsson 2001, Marchetti 2004, Corona & Marchetti 2007) which is a combination of species richness and their relative abundance (Newton 2007). Functional diversity is another component of species diversity which has received much less attention in the scientific literature, though recent studies highlighted its crucial impor-

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