

TRANSITION OF A MANAGED FOREST TOWARDS A NATURAL ONE – FOREST HISTORY AND STAND SURVEY STUDY IN AN OAK FOREST RESERVE

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Abstract: Pannonian oak woods (91G0, 91H0, 91M0) are the main forest types of the study area – the Várhegy Forest Reserve at Felsőtárkány, Hungary. In this study, our aim was to reconstruct the temporal and spatial variation of stand development in the previous 130 years. Land-use history documents from the past 130 years were analysed and compared with the results of a detailed field survey of forest stands. Four age classes were found for the main tree species – *Quercus petraea*, *Qu. cerris*, *Qu. pubescens*, *Carpinus betulus*, *Fagus sylvatica*, *Fraxinus excelsior* and *Acer campestre*. The most important impacts in this area were the change from forest management (cutting system) to abandonment, and oak decline, which induced natural regeneration processes. Our database and case study give example for the transition of an oak forest after cutting management, and provide lessons for future climate forest restoration.

Keywords: 91M0 Pannonian-Balkan Turkey oak – sessile oak forests; 91G0 Pannonic woods with *Quercus petraea* and *Carpinus betulus*; 91H0 Pannonian woods with *Quercus pubescens*; land use change; oak decline; forest regeneration; restoration of wilderness areas; biodiversity policy; forest reserve

Introduction

In Hungary, similarly to other Central European countries, various forest usage later cutting system was widely used during the late 19th century and throughout the 20th century, therefore virgin forest remnants disappeared 60-100 years ago. In 1991, strictly protected forest reserves were designated supposing that abandonment will promote natural processes. Presently these forest reserves are in a transition state from managed forests towards a spontaneously developed one.



Figure 1. Pannonian-oak dominated forests cover the Várhegy Forest Reserve (Photo: F. Horváth)

In order to understand population changes of trees and predict future forest composition and structure it is essential to reconstruct forest stand development history of the last forestry management period.

The aims of our study were: 1) to reconstruct the main impacts on oak stand dynamics and compositional changes in the past 130 years, from the beginning of cutting management system to the abandonment in the past decades when the site was designated as forest reserve 2) to use the near-natural Várhegy Forest Reserve as a model area for future climate forest restoration (for more details see Balázs et al. 2008, in this conference abstract).

Materials and methods

The Várhegy Forest Reserve was established in the oak woodland zone of the Pannonian Ecoregion, in the Bükk Mountains (northern part of Hungary) belonging to the southernmost part of the north-west Carpathians. The central coordinates are: 47°54' N; 19°57' E, altitude ranges from 300 to 600 m a.s.l. In 2005, a detailed survey of stand structure and dead wood, and soil mapping were carried out in a 50 x 50 m grid system covering the whole 94-hectare core area (Horváth et al. 2006). Land use history from the beginning of cutting management system was reconstructed using management plans dating from 1887, 1896, 1907, 1953, 1963, 1976 1986, 1995, 2006, and land-register maps and descriptions from the end of the 18th century. Based on the soil and stand survey together with historical records, we divided the 94-hectare core area of Várhegy Forest Reserve into 28 area units considered homogeneous from the point of view of site, stand and history. Besides, individual trees were ranged among tree cohorts. Further estimations and modelling refer to these units.

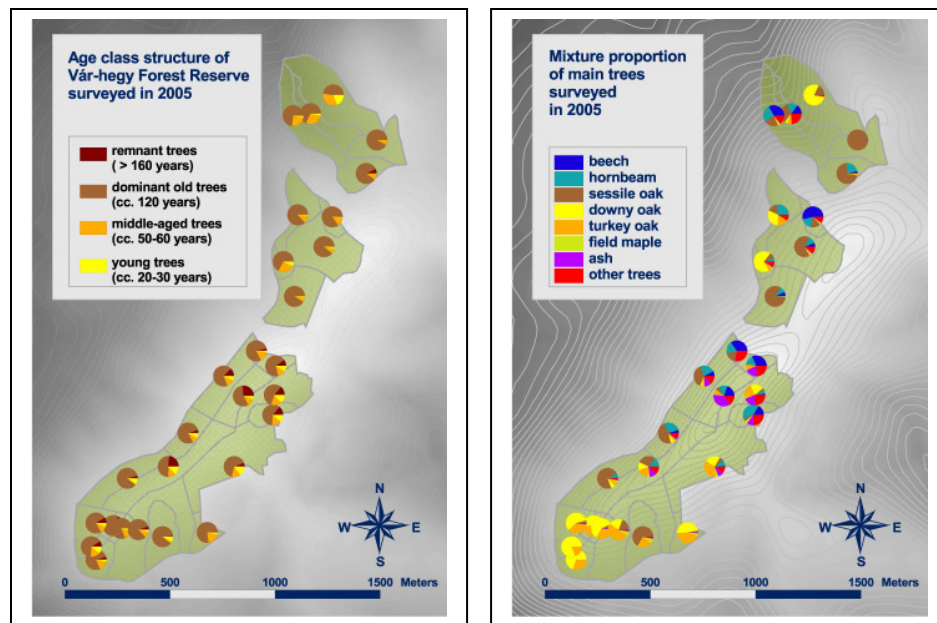


Figure 2. Age class structure of forest area units and mixture proportion of the main tree species in the core area of Várhegy Forest Reserve

Results and discussion

The area had been an estate of the Episcopate in Eger from the 13th century until the Second World War. Later it was owned by the state, with increasing nature conservational importance.

Based on forest history and stand survey, four age classes were recognised for the main tree species – *Quercus petraea*, *Qu. cerris*, *Qu. pubescens*, *Carpinus betulus*, *Fagus sylvatica*, *Fraxinus excelsior* and *Acer campestre*. These are: AGE-1) as historical records prove, the existing remaining of old, seed dispersing trees, dating from the era prior to the onset of management system (1887) AGE-2) dominant, 120 years old cohorts - mainly sessile oaks, most of them with coppice origin, from the times around the first management plan (1880) AGE-3) middle-aged cohorts originating from natural succession and replacement planting after irregular cuttings around the Second World War, and AGE-4) young cohorts filling the gaps and openings after the oak-decline of the 1970-80s. About 10 tree species are frequent. Fig. 2. shows also the spatial distribution of forest types expressed as the mixture proportion of tree species.

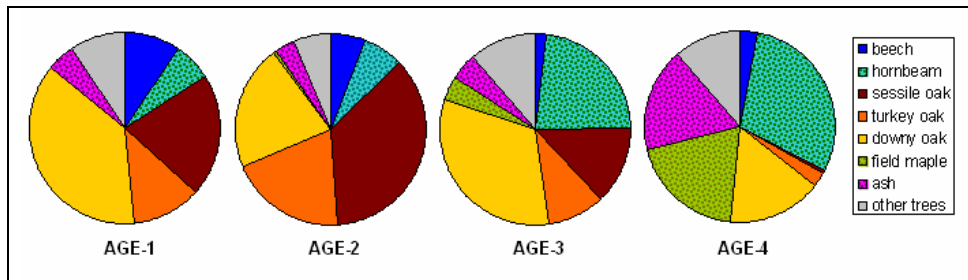


Figure 3. Comparison of tree species composition among the four age classes (%)

The tree species composition of the four age classes shows a remarkable decrease in the ratio of all oak species, but first of all in that of *Quercus petraea* in the middle-aged and young age classes, due to blocking the oak regeneration by overpopulated wild-boar, see Fig. 3. As the role of natural succession increased (around the Second World War, and after the oak decline from in the 1980s), the proportion of *Fraxinus excelsior*, *Acer campestre*, *Carpinus betulus* and other associate tree species also increased.

Table 1. Comparison of tree species composition among the four age classes, expressed in stem/hectare

Tree species	Remnants (AGE-1)	Dominants (AGE-2)	Middle-aged (AGE-3)	Young trees (AGE-4)
Beech	31	220	22	79
Hornbeam	20	250	263	782
Sessile oak	68	1332	154	16
Turkey oak	38	733	112	64
Dawny oak	121	774	374	432
Field maple	0	21	48	519
Ash	15	122	52	459
Other trees	31	240	130	305
Total	324	3642	1155	2656

Conclusions

Productive oak forest types are poorly represented in the European forest reserve network (Parviainen 2005). The old-growth Várhegy Forest Reserve is an earlier managed but now close-to-nature oak dominated forest representing Pannonian oak woods - Natura 2000 habitat types 91G0, 91H0, 91M0. In order to maintain these habitat types we need to predict future forest development. However, the prediction of future forest composition is couldn't based only on the existing old stands (Drury & Runkle 2006). Natural regeneration processes and pathways are highly depend on actual ecological conditions (i.e. canopy closure, seed dispersal, game density). We argue that detailed stand survey and forest historical data analysis, together provide a better prediction for future forest stand structure and development.

Our results also show that beside management, unexpected events (like the impact of war and later the serious oak-decline) also play a significant role in forest development. After the Second World War the oak species were able to regenerate spontaneously although to a lesser degree than earlier. Due to the high rate of game, spontaneous regeneration after the oak decline (in the 1980th) started another pathway, resulting a mixed forest stand with high proportion of *Fraxinus excelsior*, *Acer campestre* and *Carpinus betulus*. Pannonian forests whose canopy layer is actually dominated by oaks, left for free development, will change in the future towards species rich, mixed forests with a lower proportion of oak.

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