30 YEARS' CHANGES IN THE HARDWOOD GROVES OF THE MARTONVÁSÁR MANOR PARK

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Abstract

The subject of the present study is the monitoring of the hardwood groves at the Martonvásár Manor Park with the involvement of 20 earlier (recorded in 1980-81) and 20 current (recorded in 2011-12) phytocoenological relevés. The manor park was created in the first half of the 19th century. Since then the woods along the St. László stream have developed into species-rich and semi-natural forests which can be identified as related to the oak-ash-elm groves (*Scillo vindobonensis-Ulmetum*) of the Zámoly Basin and the Csepel Island. The results of the current monitoring repeated 30 years after the first survey show momentous changes in forest dynamics such as the ageing-related opening of the upper canopy and an intense closure of the lower canopy and shrub layer. The ratio of the invasive species doubled. Present findings may provide additional information for long term forest ecology research, however, results could be considered as changes of a semi-natural hardwood forest with minimal human impact.

Abbreviations

A1: upper canopy; A2: lower canopy; Agi: *Alnenion glutinosae-incanae*; Ai: *Alnion incanae*; Apa: *Abieti-Piceea*; AQ: *Aceri tatarici-Quercion*; AR: *Agropyro-Rumicion crispi*; Ar: *Artemisietea*; Ara: *Arrhenatheretea*; Ate: *Alnetea glutinosae*; B1: shrub layer; B2: lower shrub layer (saplings); Bia: *Bidentetea*; C: herb layer; Cal: *Calystegion sepium*; Che: *Chenopodietea*; ChS: *Chenopodio-Scleranthea*; Ch-AD: percentage of characteristic species of different syntaxa based on A-D % ('*csoporttömeg*'- hung.); Ch-K: percentage of characteristic species of different syntaxa based on K % ('*csoportrészesedés*'- hung.); Cp: *Carpinenion betuli*; D: dominance classes on a discrete scale of 1-5; Epa: *Epilobietea angustifolii*; EuF: *Eu-Fagenion*; ex verb.: ex verbis (oral statement); F: *Fagetalia sylvaticae*; FBt: *Festuco-Brometea*; FPi: *Festuco-Puccinellietalia*; GA: *Galio-Alliarion*; ined.: *ineditum* (inedited); K: constancy classes on a discrete scale of I-V; Mag: *Magnocaricetalia*; MoA: *Molinio-Arrhenatherea*; MoJ: *Molinio-Juncetea*; OCn: *Orno-Cotinion*; Pla: *Plantaginetea*; Pna: *Populenion nigro-albae*; Pol: *Polygonion avicularis*; PQ: *Pino-Quercetalia*; Prf: *Prunion fruticosae*; Pru: *Prunetalia spinosae*; Pte: *Phragmitetea*; Qc: *Quercetalia cerridis*; Qfa: *Quercion farnetto*; QFt: *Querco-Fagetea*; Qpp: *Quercetea pubescentis-petraeae*; Qr: *Quercetalia roboris*; Qrp: *Quercion robori-petraeae*; S: *summa* (sum); Sal: *Salicion albae*; SBT: Social behaviour types; Sea: *Secalietea*; s.l.: *sensu lato* (in wider sense); Spu: *Salicetea purpureae*; TA: *Tilio platyphyllae-Acerenion pseudoplatani*; Ulm: *Ulmenion*; US: *Urtico-Sambucetea*; VP: *Vaccinio-Piceetea*.

1. Introduction

In Europe, several long term ecological research (LTER) sites have been established. One of these LTER sites can be found in Hungary at the forest of Síkfőkút (Jakucs 1973). Besides natural forests, the study of vegetation at manor parks and botanical gardens may offer interesting findings in spite of the obvious human disturbance on them. There is no sufficient information about how a man-made forest vegetation changes along a stream which can be regarded as an ecological corridor.

In Europe, complex monitoring had been developed at numerous manor parks for adequate management (e.g. Knepp Castle, West Grinstead, UK). Several sources in the Hungarian literature are known which presents important data on the flora of several manor parks in the former and present territory of Hungary. One of the early studies on the flora and vegetation at the Zichy Manor Park at Nagyláng (now: Soponya), Transdanubian Region showed that distinguishing the native and introduced species is quite problematic (Hangay 1889).

Early renowned botanists of Hungary have already found the Martonvásár Manor Park remarkable for its natural-like groves. Ádám Boros mentioned several interesting plants in his 1933 travel diary [e.g. *Allium ursinum, Arum orientale* (known as *A. maculatum* at that time), *Helleborus dumetorum*], and he recorded that there were *"semi-wild areas at the lakeside"* which were *"natural woods-like at some places"* although *"the plants were likely to have been partly acclimated"* (cf. Kevey 1987). In 1954, Sándor Jávorka collected the *Allium ursinum* from the park and handed it over to the Herbarium of the Hungarian Natural History Museum (cf. Kevey 1979). In 1974, Adolf Olivér Horváth visited the park with one of his students (cf. Manninger 1989). The park itself has survived in relatively good condition. It was designed by Christian Heinrich Nebbien, one of the best landscape architect of his age. Natural forest fragments have formed thanks to the English style. According to the original concept of the English garden, the park merged unnoticeably into the local landscape without distinct boundary or fences. This intention has been prevailing in Martonvásár too. The guiding principle was to build a park that reflects the characteristics of the climate, landscape and vegetation. It could be created only by taking the local vegetation into account. Thus, its final look shows as if it was naturally formed and does not reveal any violence carried out on the environment (Pückler 1834 in Ormos 1967, Zádor 1973). In 1945, the park lost 70% of its territory. The area was divided and managed by forestry. However, the remaining 70 ha territory still shows the characteristics of the English garden.

The first botanical monitoring at the Martonvásár Manor Park was carried out in 1980-81 when more than 30 coenological relevés were taken in the park's woods (mainly in oak-ash-elm groves, secondarily in alder groves and hornbeam- and oak-woods). The study with the title of "The oak-ash-elm groves of the Martonvásár Manor Park" (Kevey 1987) was prepared based on 15 selected relevés of the 30 original ones. The records were analysed and described in synthetic tables. After 30 years, the authors took the relevés at the same places thus making it possible to reveal the changes in these habitats. The coenotaxonomical status of the studied grove was also determined.

2. Materials and methods

2.1 Characterization of the research area

The research area is located at the North-Eastern territory of the Brunszvik Manor Park that lays mainly at the alluvial bottom of the St. László stream's valley and secondarily on the stream's terraces which are covered by muddy, loessy and sandy fluvial alluvium. This alluvium consists of nut sized quartz, limestone (originating from the Gerecse) and dolomite pebbles (Ádám et. al. 1959). On the pebbly alluvium, poured forest soil mixed with loess was formed. Intense water management was carried out during the shaping of the manor park in the 19th century. During this process, the stream and its fork, which feeds the lake and flows back to the main branch through the Malom-árok (Mill-ditch), were controlled by embankments. In the middle of the man-made lake, the implementer created an island and drained the marshes along the stream. These works only slightly affected the forest areas, therefore, the St. László stream still has an advantageous effect on the microclimate and provides optimal growth conditions for the hardwood groves. In years with plenty of precipitation (e.g. 1996, 2010), mainly in spring, the lower areas were flooded for even 1 month. There is a gradient in the vegetation according to the microrelief and soil water level. The water regime of the St. László stream is considerably erratic. Its water yield mainly comes from rainfalls and an 8000-fold difference between its highest and lowest water yield can be observed (Ádám et. al. 1959).

According to the forest climate typology, the climate of the study area can be described as forest steppe showing strong continental characteristics. Its average annual temperature is 10.5 °C. Extreme values such as -32,1 °C (January 1942) and 37,4 °C (August 1972) were observed. The stream valley location favours long periods with subzero temperature conditions. The average annual precipitation is 550 mm which has a maximum in the summer. In recent years, a second maximum was observed in the winter due to the intensification of the Sub-Mediterranean influence. Recently, there were intense fluctuations observed in rainfall [maximum: 2010 (1014 mm), minimum: 2011 (296 mm)].

2.2 Applied methods

The coenological relevés were taken according to the traditional quadrat method of the Zürich-Montpellier Plant Coenological School (Becking 1957; Braun-Blanquet 1964). "NS" computer software package was used to compile the records in tables and calculate the percentage of character species of different syntaxa based on K% (Ch-K) and A-D % (Ch-AD) (Kevey and Hirmann 2002). The methods of recording and the slightly modified method of the traditional statistical calculations were published by Kevey (2008). Identifying the nativity of species emerged as a problem during the analysis. Therefore, to calculate the ratio of character species, we chose the following solution: those species that were found to be native elsewhere in Hungary were not classified as adventive species even if it was sure that they came to the manor park through introduction or they might have been planted.

Phytocoenological relevés originates from two relatively close area were investigated to elucidate the similarity of the associations *Scillo vindobonensis-Ulmetum* in different localities [10 relevés in Zámoly Basin (Kevey ined.); 25 relevés in Csepel Island (Kevey ined.)]. Binary cluster analysis (Method: Complete link; Coefficient: Baroni-Urbani and Buser) and ordination (Method: Principal coordinates analysis; Coefficient: Baroni-Urbani and Buser) were carried out using the SYN-TAX 2000 program (Podani 2009).

In case of the species, we used Király's (2009) nomenclature, and in case of communities Borhidi et Kevey's (1996), Kevey's (2008) and Borhidi et al.'s (2012) nomenclature were used. The structure of the phytocoenological was based on the modified coenological system (Oberdorfer 1992, Mucina et al. 1993, Borhidi et al. 2012, Kevey 2008) of Soó (1980). By the coenosystematic classification of the plants, also Soó's Synopsis (1964, 1966, 1968, 1970, 1973, 1980) was used but more recent researches were also taken into account (cf. Borhidi 1993, 1995; Horváth et al. 1995; Kevey ined.).
Digitalization of the paper map of the quadrats from 1981 was carried out using the Quantum GIS 2.2.0 (Valmiera) open source GIS software (QGIS Development Team. 2014) (Fig. 1, Table S1).
The results were the means of 5 individual measurements and were statistically evaluated using the standard deviation and T-test methods.

3. Results

As the coenological characterization of the oak-ash-elm groves of Martonvásár can be read in the study of Kevey (1987), we would like to draw the attention only to the changes occurred during the past three decades (cf. Table S2-S3 and Table 1–2).

3.1 Physiognomy

Compared to the survey made in 1980-81, the trees proved to be higher both in the upper (A1) and lower canopy (A2). The average trunk diameter also increased. The coverage of the A1 decreased in most of the studied areas. In contrast to this, the coverage of the A2 increased in the quadrats in general. There was negligible change in the constancy (K, discrete scale I-V) of the canopy's elements. Their A-D class (D, discrete scale 1-5) value also increased with one grade only. Thus, in A2 level, the coverage of *Acer campestre* increased from 2 to 3 in several quadrats and the D value of *Acer platanoides* from 1 to 2.
Both the height and the D value of the shrub (B1) layer became larger. Mainly the shrub-sized specimens of trees proliferated but their K and D values changed only with 1 grade. The exception is *Viburnum opulus*: its K decreased with 2 grades. Furthermore, in certain quadrats, the D of *Padus avium* and *Staphylea pinnata* increased from 3 to 4 and from 2 to 3, respectively. The D value of the lower (B2) shrub layer also increased in most cases. The K of *Viburnum opulus* also decreased with 2 grades in this level. The most striking finding is the spreading of *Hedera helix*. In some of the quadrats, its D increased from 1 to 4 and from 2 to 5.

At some places, the D value of the herb (C) layer did not change while it increased at other places. In general, their K and D values of the herbaceous species changed with 1 grade only, however, the K of some species reduced even with 2-3 grades: *Carex sylvatica*, *Chaerophyllum temulum*, *Festuca gigantea*, *Milium effusum*, *Viola reichenbachiana*. It is worth noting *Campanula latifolia* separately as its D decreased from 3 to 1 in one of the relevés. Similarly, the prevalence of *Ranunculus ficaria* decreased from 4 to 2 in one of the studied area. In contrast, the D of other species (*Allium ursinum, Galeobdolon luteum, Mercurialis perennis, Stachys sylvatica*) increased in several quadrats (see chapter 'Ratio of character species') (Table 1).

3.2 Plant species composition

3.2.1 Distribution of constancy classes

In essential, the distribution of constancy classes did not change. A remarkable increase was observed in the number of accidental species (K I) (Fig. 2.).

3.2.2 Ratio of character species

In the past three decades, no great changes detected in the ratio of character species (Table 1). However, it is remarkable that the Ch-K and Ch-AD of syntaxa related to wet soils (i.e. *Galio-Urticetea* s.l., *Salicetea purpureae* s.l., *Alnetea* s.l., *Alnion incanae* s.l.) decreased slightly. Similarly, the K of the *Alnion incanae*-related *Viburnum opulus* decreased from constant (K V) to subaccessoric (K II) level (Table S2).

Fagetalia species still play dominant role (Table 1). Their Ch-K has slightly decreased; however, interestingly, their Ch-AD has increased. From among the species belonging to this order, the constancy of *Carex sylvatica*, *Festuca gigantea* and *Viola reichenbachiana* has decreased by 2 grades. The most striking, however, is the case with *Milium effusum* which proved to be an accessoric species (K III) during the 1980-81 monitoring while it did not even turn up in 2011-12. In turn, the D of some *Fagetalia* elements has increased: this has happened mainly with *Allium Ursinum,* but the local dominance of *Galeobdolon luteum*, *Mercurialis perennis* and *Stachys sylvatica* has increased strikingly.

The adventive elements have been spreading prominently (Tables S2, 2 and 3; Fig. 3, 4 and 5): their Ch-K has increased from 8.5% to 14.9% and their Ch-AD from 3.0% to 5.1%. For example, *Juglans nigra* did not even turn up during the 1980-81 monitoring but advanced to be an accidental species (K III), and the constancy of some other species (*Celtis occidentalis*, *Phyladelphus coronarius*, *Phytolacca Americana*) has increased with 2 grades as well. The D of some adventive woody plants has increased too: *Acer negundo*, *Celtis occidentalis*, *Robinia pseudo-acacia*. Especially, *Acer negundo* shows spreading to a serious extent at some places. However, interestingly, its D has remained unchanged at some sample areas.

3.2.3 Ratio of social behaviour types

The social behaviour types of Borhidi (1993) show similar correspondence to the ratio of character species. Primarily, the increased ratio of the introduced alien species (I) and aggressive alien species (AC) is striking, while the naturalness of these hardwood groves has slightly decreased (Fig. 4 and 5, Table 2).

3.2.4 Results of multivariate statistical analyses

In order to evaluate the syntaxonomycal status of the park's monitored forest groves, we incorporated the semi-natural oak-ash-elm groves of the neighbouring Zámoly-basin and those of Csepel Island into the multivariate analysis as well. Both the dendrogram and scatter plot illustrate that the relevés of the Zámoly-basin are located relatively close to those of Martonvásár, while the material coming from the Csepel Island is more distinct (Fig. 6 and 7).

4. Discussion

4.1. Questions arising to the naturalness of the manor park

According to the memoir of Therese von Brunswick written in 1846, *"nothing but a few trees could have been seen at the eight thousand acres estate"* at the beginning of the 1700's, and neither the map of the 2nd military survey of the Austro-Hungarian Empire indicated any forest at the territory of the park (cf. Póka 1978, Kevey 1987). The formation of the semi natural forest groves happened later, during the construction of the Brunszvik Manor House.

Nevertheless, this does not mean that most of the plants of the manor park came here through introduction. It is known that certain earls would passionately collect the seeds of wild plants and sow them at their estates (cf. Hangay 1889). Therefore, in case of the majority of the plants, it is already impossible to tell which one got there naturally or by human intervention.

Part of the naturalized plants, however, may have got here naturally. The St. László stream offered excellent diaspora route for this purpose. According to the climazonal map of Borhidi (1961), Martonvásár is located at the border of the lowland forest steppe zone. The continental climate impact on the vegetation is compensated by the St. László stream. Due to this, the sub-montaneous elements (*Fagetalia* species) could survive here regardless of whether they got here naturally or by human intervention.

According to the results of the analyses (Table S2 and Table 1, Fig. 6 and 7), the current manor park corresponds to a semi natural oak-ash-elm forest grove. It can be interpreted as a man-made habitat which further evolved by the ecological succession (in more detail, see: Kevey 1987). Thus, the case of the Martonvásár Manor Park may be interpreted as an unintentional habitat restoration as well.

4.2. Changes in constancy classes

Regarding the constancy classes, the number of accidental species (K I) has greatly increased (Table S2, Fig. 2). The majority of the newly appeared species are indifferent (e.g. *Ballota nigra, Leonurus cardiaca, Plantago major, Poa annua, Solanum nigrum, Sonchus oleraceus, Taraxacum officinale*), adventitive (e.g. *Ambrosia artemisiifolia, Erigeron canadensis, Gleditsia triacanthos*, *Juglans regia, Morus alba, Oxalis fontana, Solidago canadensis*) or they were planted as garden plants (e.g. *Deutzia scabra, Fritillaria meleagris, Galanthus plicatus, Gymnocladus dioica, Sophora japonica*). Although the presence of these plants is not dominant, their appearance denotes degradation to a certain extent. In small number, such plants have also been found that were present in the 1981-82 relevés but they were not found during the repeated monitoring. More than one half of these species consist of forest character species (*Fagetalia*, *Alnion incanae*, *Quercetea pubescentis-petraeae*): *Adoxa moschatellina*, *Anemone nemorosa*, *Campanula rapunculoides*, *Cornus mas*, *Dryopteris filix-mas, Impatiens noli-tangere*, *Malus sylvestris*, *Melittis melissophyllum*, *Milium effusum*, *Viola reichenbachiana* etc. It is striking that *Milium effusum,* which turned up during the 1981-82 monitoring as accessoric species (K III), completely lacks from among the species nowadays. We suppose that the only possible explanation for this phenomenon is that it has been superseded during the competition between the species. The absence of these character species also suggests slight degradation.

4.3. Changes of the forest dynamics

From the 1960's, the 20th century's botanical garden style has been prevailing in the park. Today, the characteristics of this period are still reflected by the horticultural rarities which can be found throughout the whole park. In the 1980's, new approaches appeared in the park management: the former landscape design trend – the formation of a botanical garden which went against the concept of the English garden style – was replaced by the idea of reconstructing the English garden. Cutting back the characteristics of a dendrological collection, the park management aimed at reconstructing the English garden that features groups of trees and great lawny areas. Károly Örsi's reconstruction plan gave considerable impetus to this trend in 1989. The formation of greater clearings, grove-like structure and the application of mowing (which destroyed the forest undergrowth) did not favour the development of shrub layer of the hardwood grove that already begun to revert into its natural condition. At the frequently visited sites (e.g. the island), the hardwood grove refugia were more heavily affected by the treatment than those at hidden places thus leaving space for spontaneous forest dynamic processes. Therefore, the height and average trunk diameter of these trees have increased continuously in the last 30 years. The upper canopy has grown somewhat thinner at several places as the crowns of the pedunculate oak and narrow-leaved ash (ssp. *hungarica*) tree, which dominate the upper canopy, rarefies with ageing. Additionally, some old trees fell, too. Today, large trees die from diseases, pest insects or extreme weather. As more light reaches to the lower canopy this way, the trees at this level could start growing: both of their height and coverage have increased. This serves as an explanation for the fact that the D of *Acer campestre* in the lower canopy grew from 2 to 3 in several quadrats. At the beginning of the 1980's the shrubs were cleared at certain parts of the forest (Manninger ex verb.: 1983). Still, the coverage of the shrub layer and the D of certain shrubs continued to grow (e.g. *Padus avium, Staphylea pinnata*). All this shows the signs of the natural regeneration process of the hardwood groves.

The last 30 years' natural regeneration process was facilitated by the fact that no renewal was attempted. In the period of the study (1981-2011), only one occasion was recorded (in 1992) when renewal of a European beech (*Fagus sylvatica*) was attempted in the quadrats 6, 7, 10 and 12. Perhaps the planting was inspired by the presence of older beeches in the quadrat 18. The above mentioned quadrats lie at the lowest areas, thus they are often covered by inland water in early spring. The wet climate of hardwood groves could ensure favourable conditions for the beeches, however, the high level of water logging has negative effects on them. (Gencsi and Vancsura 1992). That is why the renewal attempt – with some exceptions – was not successful.
In several cases, the coverage of the natural saplings (lower shrub layer) and herb layer increased mainly due to the spreading of *Hedera helix*, *Allium ursinum* and – at certain places – *Galeobdalon luteum*. Probably this is the reason why some forest plants disappeared during the last 30 years: e.g. *Adoxa moschatellina, Anemone nemorosa, Campanula rapunculoides, Carex sylvatica, Dryopteris filix-mas, Festuca gigantea, Impatiens noli-tangere, Malittis melissophyllum, Millium effusum, Viola reichenbachiana*. The case of *Campanula latifolia* should be mentioned here too: in one quadrat during the 1980-81 monitoring, its D was identified as 3 but in 2011-12 its coverage was already only 1 (Table S2).

4.4. Changes in the ratio of character species

In general, the ratio of character species did not change substantially. The slight aridification implies that the ratio of certain hygrophilous syntaxa (*Galio urticetea* s.l., *Salicetea purpureae* s.l., *Alnetea* s.l., *Alnion incanae* s.l.) dropped slightly. Perhaps this is related to the drop from K V to K II in the stability of *Alnion incanae*-like *Viburnum opulus* and the decrease from 4 to 2 in the coverage (D) of *Ranunculus ficaria*. Several Fagetalia character species (e.g. *Adoxa moschatellina, Anemone nemorosa, Carex sylvatica, Dryopteris filix-mas, Festuca gigantea, Milium effusum, Viola reichenbachiana*) disappeared from these hardwood groves. Thus, their Ch-K reduced somewhat in 30 years, but their Ch-AD increased slightly mainly due to the spread of *Hedera helix, Allium ursinum* and – at certain places – *Galeobdalon luteum* (Table S2). However, the spread of adventive species implies degradation. Their Ch-K and Ch-AD nearly doubled in 30 years (Tables 2 and 3; Figures 3 and 5).

4.5. The status of the Martonvásár oak-ash-elm groves in the coenotaxonomy

According to the comparison carried out with the neighbouring oak-ash-elm groves, the oak-ash-elm groves in the manor park and those in the Zámoly Basin show relatively great similarity. The hardwood groves of the Csepel Island are somewhat different from them (Fig. 6 and 7). Still, in spite of the differences, the groves in Martonvásár can be identified with these neighbouring areas' oak-ash-elm groves. The coenotaxonomic ranking of this association can be represented in the following way:

Division: **Querco-Fagea** Jakucs 1967

Class: **Querco-Fagetea** Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi in Borhidi et Kevey 1996

Order: ***Fagetalia sylvaticae*** Pawłowski in Pawłowski et al. 1928

Group: **Alnion incanae** Pawłowski in Pawłowski et al. 1928

Subgroup: ***Ulmenion*** Oberd. 1953

Association: *Scillo vindobonensis-Ulmetum* Kevey in Borhidi et Kevey 1996

Another, recently published study of the oak-ash-elm groves of Pácin Manor Park (Bodrogköz, Northern Hungary) referred to the Kevey's (1987) relevés. The comparison showed that the groves in Pácin and Martonvásár are relatively similar, however, in Pácin, the ratio of the *Fagetalia* elements was lower and the number of the indifferent species was higher (Tuba and Szirmai 2008).

5. Conclusions for nature conservation

Since 1953, the territory of the Martonvásár Manor Park is a nature reserve area and has national importance. As the last fragments of the oak-ash-elm groves of the 'Mezőföld' were preserved in its late landowners' manor parks (Martonvásár, Dég; Zólyomi 1967), the hardwood groves in Martonvásár are of great nature conservation significance. This is not to be changed by the fact that the park was created by human intervention which means that – even if it was not a conscious act – this can be considered as an "unintentional habitat restoration".
Six protected plants were found in the 20 quadrats: *Campanula latifolia, Cyclamen purpurascens, Galanthus nivalis, Lonicera caprifolium, Lunaria rediviva, Scilla vindobonensis*. Additionally, *Fritillaria meleagris* and *Helleborus dumetorum* are of particular importance from among the species coming from outside of the quadrats. Further natural values of the areas are those *Fagetalia* species that are typical in our mountains and hilly landscapes but are very rare in the Great Hungarian Plain: *Adoxa moschatellia, Allium ursinum, Anemone nemorosa, Corydalis cava, C. pumila, Galeobdolon luteum, Galium odoratum, Geranium phaeum, Mercurialis perennis, Milium effusum, Myosotis sylvatica, Pulmonaria officinalis* etc. Partially, they may be considered as relict species of the once more balanced and humid climate of the paleobotanical 'Bükk1' phase (vö. Zólyomi 1936, 1958, 1952; Járai-Komlódi 1966, 1968, 1969, 2000).
From the point of view of nature conservation, the spread of invasive species are considered as a problem – their ratio in the past 30 years nearly doubled. There was a comparative analysis in the hardwood floodplain forests of Slovak and Hungarian datasets over decades carried out by Petrášová et al. (2013). They found a significant increase in the number and cover of recorded neophytes from 1940 until present in both countries. In a broader analysis, time emerged as one of the most significant factors positively affecting the number of neophytes. Beside the species richness of native species, other ecological factors such as the amount of nutrients, light, soil reaction, cover of herb layer and moisture were found important in the spread on the invasive species.

This also explain our present results in the Martonvásár hardwood groves from 1980 to 2012. Factors listed above and have impact on the spread of invasive species, cover of the herb and schrub layers, local nitrogen accumulation, changes in the ambient light in the forest layers can contributed to the changes in the dominance of invasive plants in Martonvásár.

At this point, it is important to mention the effect of an intense increase in the populations of wild herbivorous mammals. The study area is surrounded by fences thus, limited number of wild animals (mainly deers) can pass through. However, if this happens, its population may overgrow. They highly harmful since they chew the saplings off of the endemic tree species. They prefer the ash trees but do not spare the saplings of other trees either. According to observations, they do not harm introduced tree species as much as endemic ones and thus they facilitate their spread. The decline of the stand of *Campanula latifolia* also can be explained by the chewing of the deers which made the species unobserved for long time in the area. Since 2007, measures have been taken to reduce surplus of the wildlife populations which led to the reappearance of *C. latifolia*.

In conclusion, the oak-ash-elm grove forests in the Martonvásár Manor Park can be corresponded to those that can be found the neighbouring areas. The results of the 30-year-long study pointed that natural-like regeneration process started in the park (growth of the canopy and shrub level, growth of the coverage, and average trunk diameter). Unfortunately, this process was somewhat slowed down by such horticultural activities such as the removal of fallen trees, twigs and boughs. Instead of these unnecessary works it would have been more important to take care about the suppression of the invasive trees and herbaceous plants.

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Table captions

Table S1. Geocoordinates and size of the quadrats.

Table S2 Phytocoenological table of *Scillo vindobonensis-Ulmetum* (A1: upper canopy; A2: lower canopy; Agi: *Alnenion glutinosae-incanae*; Ai: *Alnion incanae*; Apa: *Abieti-Piceea*; AQ: *Aceri tatarici-Quercion*; AR: *Agropyro-Rumicion crispi*; Ar: *Artemisietea*; Ara: *Arrhenatheretea*; Ate: *Alnetea glutinosae*; B1: shrub layer; B2: lower shrub layer (saplings); Bia: *Bidentetea*; C: herb layer; Cal: *Calystegion sepium*; Che: *Chenopodietea*; ChS: *Chenopodio-Scleranthea*; Cp: *Carpinenion betuli*; D: dominance classes on a discrete scale of 1-5; Epa: *Epilobietea angustifolii*; EuF: *Eu-Fagenion*; ex verb.: ex verbis (oral statement); F: *Fagetalia sylvaticae*; FBt: *Festuco-Brometea*; FPi: *Festuco-Puccinellietalia*; GA: *Galio-Alliarion*; ined.: *ineditum* (inedited); K: constancy classes on a discrete scale of I-V; Mag: *Magnocaricetalia*; MoA: *Molinio-Arrhenatherea*; MoJ: *Molinio-Juncetea*; OCn: *Orno-Cotinion*; Pla: *Plantaginetea*; Pna: *Populenion nigro-albae*; Pol: *Polygonion avicularis*; PQ: *Pino-Quercetalia*; Prf: *Prunion fruticosae*; Pru: *Prunetalia spinosae*; Pte: *Phragmitetea*; Qc: *Quercetalia cerridis*; Qfa: *Quercion farnetto*; QFt: *Querco-Fagetea*; Qpp: *Quercetea pubescentis-petraeae*; Qr: *Quercetalia roboris*; Qrp: *Quercion robori-petraeae*; S: *summa* (sum); Sal: *Salicion albae*; Sea: *Secalietea*; s.l.: *sensu lato*; Spu: *Salicetea purpureae*; TA: *Tilio platyphyllae-Acerenion pseudoplatani*; Ulm: *Ulmenion*; US: *Urtico-Sambucetea*; VP: *Vaccinio-Piceetea*).

Table S3 Data of the relevés. (1) 1980-81: Bedrock: 1-20: loess; Soil: 1-20: Fluvisol (brown lowland soil); Recorded by: 1-20: Kevey (ined.), (2) 2011-12: Bedrock: 1-20: loess; Soil: 1-20: Fluvisol (brown lowland soil); Recorded by: 1-20: Kevey - Majláth - Molnár (ined.).

Table 1 Changes in the ratio of the syntaxa [Ch-K: percentage of characteristic species of different syntaxa based on K % (‘*csoportrészesedés*’- hung.), Ch-AD: percentage of characteristic species of different syntaxa based on A-D % (‘*csoporttömeg*’- hung.)].

Table 2 Changes in the ratio of social behaviour types (SBT) [Ch-K: percentage of characteristic species of different syntaxa based on K % (‘*csoportrészesedés*’- hung.), Ch-AD: percentage of characteristic species of different syntaxa based on A-D % (‘*csoporttömeg*’- hung.)].

Figure captions

Figure 1. Location of the quadrats in the study area.

Figure 2. Distribution of constancy classes.

Figure 3. Ratio of adventive elements [Ch-K: percentage of characteristic species of different syntaxa based on K % (‘*csoportrészesedés*’- hung.), Ch-AD: percentage of characteristic species of different syntaxa based on A-D % (‘*csoporttömeg*’- hung.)]. *** and * represent significant differences between 1980-81 and 2011-12 at the 0.001 and 0.05 levels, respectively.

Figure 4. Ratio of introduced alien species (I) [Ch-K: percentage of characteristic species of different syntaxa based on K % (‘*csoportrészesedés*’- hung.), Ch-AD: percentage of characteristic species of different syntaxa based on A-D % (‘*csoporttömeg*’- hung.)]. ** represents significant differences between 1980-81 and 2011-12 at the 0.01 level.

Figure 5. Ratio of agressive alien species (AC) [Ch-K: percentage of characteristic species of different syntaxa based on K % (‘*csoportrészesedés*’- hung.), Ch-AD: percentage of characteristic species of different syntaxa based on A-D % (‘*csoporttömeg*’- hung.)]. * represents significant differences between 1980-81 and 2011-12 at the 0.05 level.

Figure 6. Similarity of the oak-ash-elm groves relevés of the study illustrated on a binary dendrogram [1/1-20: Martonvásár ”Manor Park” (Kevey ined.: 1980-1981); 2/1-20: Martonvásár ”Manor Park” (Kevey, Majláth et Molnár ined.: 2011-2012), 3/1-10: Zámoly Basin (Kevey ined.); 4/1-25: Csepel Island (Kevey ined.); (Method: Complete link; Coefficient: Baroni-Urbani & Buser)].

Figure 7. Similarity of the oak-ash-elm groves relevés of the study on scatter plot illustration [1/1-20: Martonvásár ”Manor Park” (Kevey ined.: 1980-1981); 2/1-20: Martonvásár ”Manor Park” (Kevey, Majláth, Molnár ined.: 2011-2012), 3/1-10: Zámoly Basin (Kevey ined.); 4/1-25: Csepel Island (Kevey ined.); (Method: Principal coordinates analysis; Coefficient: Baroni-Urbani & Buser)].