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Ph.D thesis

THE ANALYSIS OF THE FOREST HABITATS AND HERBACEOUS PLANT SPECIES OF THE RABA-VALLEY

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1. Questions and aims

The forests of the flood areas along the great rivers are among the most endangered forest habitat types of Hungary. Once it was frequent habitat on the higher flood area of the plane landscapes and it could be widespread on the hilly areas too but the river regulation works and the intensive use of the flood areas reduced its expanse radically. The transformation of the circumstances at the habitat effected basic changes in the forest structure therefore the floodplain forests which prefer the more wet circumstances evolved into oak-hornbeam forests. The fragmentation of the forest stands was followed by the decay of the original species composition and during this process many eurytopic species, not typically of forests, from the surrounding areas interpenetrated. The conversion of the species composition was boosted by the forest management. Despite of that fact the circumstances of the growing sites would make possible the formation of alluvial hardwood forests the last survey (BÖLÖNI et al. 2011) showed the habitat type covers only 16 500 hectares at all. The alluvial forests are evaluated as rare habitat types on the Western rimland of Hungary too. More extensive forest blocks can be found only along the Mura and Raba rivers. Because the latter flows mostly on Hungarian terrain the habitats of the flood area can be researched principally here in the Western-Transdanubia.

Albeit that the survey of the natural values and vegetation of the Raba-valley has a history longer than a century, the flora, vegetation and their processes are only poorly known. The detailed survey of the plants, vegetation and natural values of the Raba-valley is only expected until nowadays.

The researches, which support and reinforce the nature conservational management and nature friendly land use, are having greater importance in the last decade. The aim of this thesis is to find correlation between the species diversity and the forest management activities.

The concrete aims of the actual analysis are the followings:

- Overview of the silvicultural history of the extending forest blocks of the Raba-valley by the discovery of the former human activities, forms of the forest use and the evaluation of the actual vegetation on this basis.
- Mapping and detailed description of the habitat types in the forest blocks, considering especially the herbaceous species. Drawing the vegetation maps of the sample areas.
- Survey and evaluation of the vascular plant species of the forests, with emphasized attention on the important species for the nature conservation and phytogeography.
- Examination of diversity in herbaceous layer of forest types with different ages, species composition and origin. Through this analysis the effects of the forest management activities on the naturalness of the forests can be evaluated.
- The examination of the range of herbaceous accompanying species of the natural forests (oak-hornbeam and alluvial hardwood forests) moreover the evaluation of their frequency in the forest stands with different age, origin and wood species.

1. The research area and the applied methods

1.1. Description of the research area

The Raba is the most important river in Western Hungary and the Raba-valley is the main valley in the Western Transdanubia. By the national classification of landscape geography (ÁDÁM 1975) the *Raba-valley* itself is a small landscape unit which belongs to the *Sopron-Vas plan*e middle landscape unit and to the *West-Hungarian rimland* large landscape unit.

The Raba-valley extends along the all West-Hungarian rimland and its climate is defined usually by Atlantic (Alpine, Oceanic), Mediterranean (Southern) and Continental (Eastern) effects. The annual precipitation at the Western borderland is about 800 mm (at Körmend was measured more than 1000 mm in some years) but at the South-Western section of the valley reaches only 600-750 mm.

The section of the Raba river above Sárvár is more or less unregulated while below Sárvár it flows between dykes and affected by riverbed crosscuts. At this section the riverbed is considerably deepened because of the regulations. The floods primarily flow in the valley of Csörnöc-Herpenyő because its valley lies at deeper elevation than the valley of the Raba. In the last 40 years the medium discharges of the river lowered but the frequency of the floods not changed fundamentally.

The soil formation processes of the Raba-valley primarily affected by the river itself and the periodically repeating inundations, mainly by their measure and frequency. The Raba and its tributaries flowing from the Eastern appendices of the Alps therefore they has calc free holocenic alluviums and it results acidic soils. The physical character of the soils depends on the quality of the alluvium, among them clay, mud and sand can be found.

The present condition of the forests along the Raba river is mainly affected by the river itself and the former use of the flood area therefore it is important to know the landscape history. On the base of contemporary descriptions and available forestry management plans the forest use of the earlier times can be summarized in the followings:

- Until the mid-1700s the forests on the right side of the Raba were used relatively less because this area was controlled by the Turkish Empire. The forest stands of the right banks almost disappeared because of the intensive logging and grazing activities.
- Until the end of the 1800s the forest management was carried out planlessly, the grazing in the forests and other types of additional use (gall collecting, oak-mast, haymaking) was characteristic. The use of the tree stand was done with single-tree selection cutting.
- Since the end of the 1800s until nowadays many areas became afforested. The plantation and the renewal of the forest stands were carried out along intercropping. From the 1920-30s the grazing in the forests was ceased. In this period only at the Szatmári-forest persisted considerable grazing.
- From the 1950s until the beginning of the 1990s the use of alien species in the replantation was general, the stands were not kept adequately therefore the proportion of the degraded stands increased characteristically with the dominancy of hornbeam. The final cutting was generally clear cutting and in the process of renewal the soil preparation was often applied.
- Since the 1990s the replantations are carried out primarily with native species and in the final cutting the aspects of the nature conservation are taken into consideration. Nowadays the additional use of the forest stands is not characteristic.

1.2. Methods

For sampling extending forest blocks were chosen at flood areas which are in good natural condition in general and are not separated from the river. In the Hungarian part of the Raba-valley the 4 largest forest blocks were chosen in this way (Körmend: Dobogó-forest, Egyházashollós: Hollósi-forest, Rum: Rumi-forest, Sárvár: Szatmári-forest), which are situated mainly along the relatively unregulated section of the river.

1.2.1. The exploration of the species composition of the sample areas

The survey of the species were carried out from 2004 to 2012 on 134 field work days at the 4 forest blocks. Through the field survey the name of the found species were recorded in field register. The surveys were carried out in the vegetation period from March to end of September and the expended time was proportional to the size of the sample areas. The grouping of the species by their social behaviour types and ecological indicator values were done on the base of BORHIDI's (1995) work and it was corrected with the frequency value in each sample area.

The values of frequency were determined by the following principles:

Rare (1): Not recorded more than 10 occurrences at the sample area.
Sporadic (2): The occurrences at the sample area are between 10 and 50.
Common (3): The number of recorded occurrences is above 50 and the species is generally distributed at the adequate habitats.

1.2.2. The survey of the habitats at the sample areas

The habitat maps of the forest blocks taken into the researches were produced in 2011-2012 on base of 6 days field work.-The habitat mapping was carried out in the vegetation period from May to September. In this work the methods of the National Biodiversity-monitoring System were the essential which is written in the handbook of the NBmS (Kun & Molnár 1999, Takács & Molnár 2009). On the base of this field work and ortophotos of the FÖMI (Institute of Geodesy, Cartography and Remote Sensing) from the year 2005 the homogenous patches were outlined which get descriptions on the base of the later field surveys. The scale of the mapping was 1:10000 so the size of the smallest mapped patches is 50 m^2. At the field survey the habitat types (Á-NÉR – General National Classification System of Habitats) of the actual plots were recorded with list of the characteristic species and occurrent endangering factors, moreover other comments if needed. The habitat types are given according to the work of BÖLÖNI et al. (2011). After the field survey the collected data were processed in geoinformatical database (Arc GIS 9.1). In the characteristic habitats coenological samples were also listed and the habitat types were described on the base of these records.

1.2.3. Analysis of diversity

The analysis of diversity in the herbaceous layer of the forests was surveyed by microquadrats. The method of the sampling was elaborated on the base of the works of BARTHA (2008) and STANDOVÁR et al. (2006). During marking off the quadrats it was important to pay attention to the proportion of the number of samples according to the size of the sample areas. Our aim was to represent exactly the forest stand types, age groups, plantations and original forests in the sampling. The forest parts were grouped into two classes on the base of their origin: natural (Nat.) and artificial (Art.). The stands were considered as natural if on the available earliest and relatively accurate maps were shown as forests, independently from their actual dominant species. The later afforested areas were considered as artificial forest stands.

On the base of the collected data 124 quadrats were signed at the 4 sample areas. The size of the sample quadrats was 50x50 m and inside these 100 pieces of 10x10 cm sized microquadrats were sampled at random location. In this way the overall number of microquadrats is 12.400 in the 124 quadrats. In the microquadrats the presence-absence of the rooted plant species were recorded. The data of the counting were analysed with generalized linear models (GLM) searching for the relations between the simple diversity indexes and the variables of the origin, age, type and area. The microquadrat analysis was done with the PRIMPRO1 software (BARTHA et al. 1998) which gave the average species number and the number of found species combinations.

1.2.4. Analysis of species ranges

At the 4 sample areas the range of herbaceous forest species were examined. Into this research the generally distributed species of the forests along the Raba river were taken, thus the accompanying species of the hardwood alluvial forests. Among the aspects of selection the relatively homogenous dispersion of the habitats of the actual species was important because of their occurrence may not be rhapsodic. Spring and summer flowering species both were taken into the analysis.

On the base of the written guidelines the range of the following species were analysed: *Leucojum vernum, Galanthus nivalis, Isopyrum thalictroides, Scilla drunensis, Anemone nemorosa, A. ranunculoides, Corydalis cava, C. solida, Aegopodium podagraria, Galeobdolon montanum, Stellaria holostea, Carex brizoides.*

The field survey happened in the main flowering season of the species. From 2008 to 2011 the data collection needed 32 days of field work. Inside the outlined area of the researches (Annex 2.) the occurrences of the species were recorded with GPS. The occurrences out of the 5 m radius of the other individuals were recorded as different points and the continuous stands were recorded in polygons with vertexes. Beyond the field survey data we collected the important variables of the forest subcompartments (age, stand-forming species, area) too. The recorded points and polygons were transformed into shape files which are compatible with the used ArcGIS 9.1 software. With the aid of this software the coverage value of the species became calculable per forest subcompartments. For the analysis of these data the 2.15.0 version of the R statistical software was used.

Results of the researches

1.3. The analysis of the species composition of the sample areas

Along the 8-year-long survey presence of 330 herbaceous species became known in the 4 sample areas altogether. The highest number of species was recorded in the Rumi-forest where 245 herbaceous plant species were recorded overall. In the Dobogó-forest near Körmend was experienced the lowest species diversity which inferable partly from the small size of the sample area and on the other hand from its relatively high coverage. The diversity of the other 3 areas were increased mainly by the clear cutting sections and the enclaved opened habitats.

The number of species is increasing principally because of the presence of clear cutting forest subcompartments, roads and glades. Along the linear structures numerous species of opened habitats penetrate into the forest blocks. The amount of invading species is proportional to the width of the roads because at the wider roads the amount of incoming light is higher. The growing density of the forestry roads and glades causes fragmentation and its effect can be increased by the plantation-like cultivation of alien or exotic species. In the esteem of the author the fragmentation is well characterizable with the proportion of the forestal species (stress tolerant and accompanying species equally) to the total species number. The survey discovered that the ratio of the forestal herbs is highest (51%) in the Dobogó-forest because it is the most closed forest block among all of them and the proportion of the plantations is also low. In the other forest blocks the share of the forestal herbs is 30% or lower and lowest is in the Szatmári-forest (24%). The latter was grazing forest for long time, formed by dispersed forest patches, where the grazing surely decreased the number of typical forestal species.

In the survey of the herbaceous vegetation numerous species became known with outstanding importance for the area moreover in some cases nation-wide. Majority of these species were not detected from the Raba-valley earlier, others are important from the viewpoint of phytogeography or insufficiently known in Western Hungary.

1.4. The survey of the habitats of the sample areas

At the sample areas 13 natural and 17 transformed habitat types became detected and described. The area is mostly covered by forest habitats, opened vegetation can be found only on 4,3 % of the surface. Among the opened habitat types the reed stands and tall sedge communities of the oxbows are characteristic which exist in the Hollósi- and Rumi-forest with considerable extent. Few enclaved grass habitats can be found in the Hollósi-forest which are abandoned nowadays – the hayfields of the other sample areas were afforested earlier. Among the forests and arboraceous habitat types the proportion of the natural forest communities is 26,7% and the remnant forested habitats can be defined as degraded forests or artificial tree plantations. The natural forest habitats are exclusively edafic plant communities. The stands of non native or alien species has 42% contribution, these are mainly black locust, noble poplar and black walnut plantations. The main mass of the forests are strongly transformed, characterless stands and the near natural forests in good condition are relatively rare habitats. Some of the habitat types (opened water surfaces and vegetation of wet surfaces) are represented only on few quadratmetres but most of them were represented with mappable sized occurrences.

The thesis laid emphasis on the difficulties of the segregation of the swamp forests, hardwood alluvial forests and oak-hornbeam forests in the Raba-valley. In this research the characteristic species of the different forest types became known:

- Species of swamp forests: *Fritillaria meleagris, Carex riparia, C. acuta, C. strigosa, C.remota, Iris pseudacorus, Rumex sanguineus, Deschampsia caespitosa.*
- Hygrophilous species of the hardwood alluvial forests: *Omphalodes scorpioides, Veronica montana, Stellaria nemorum, Leucojum vernum, Ranunculus lanuginosus, Ranunculus auricomus, Paris quadrifolia.*
- Species abundant in hardwood alluvial forests but representing in oak-hornbeam forests also: *Isopyrum thalictroides, Galeobdolon montanum, Stellaria neglecta, Viola riviniana, Lamium maculatum, Anemone ranunculoides* (excluding Szatmári-forest).
- Characteristic species of the oak-hornbeam forests: *Corydalis cava, C. solida, Adoxa moschatellina, Aegopodium podagraria, Arum maculatum, Asarum europaeum, Brachypodium sylvaticum, Carex brizoides, Circaea lutetiana, Gagea lutea, Galanthus nivalis, Galium odoratum, Geranium phaeum, Polygonum latifolium, P. multiflorum, Pulmonaria officinalis, Stellaria holostea, Viola reichenbachiana*

The oak-hornbeam forests and hardwood alluvial forests of the Raba-valley differentiate from the similar habitats existing at other parts of Hungary therefore they worth extra attention for their protection and not at last for their sustainable use.

1.5. Analysis of diversity

At first I compared the overall number of species and the characteristics of the forest stands because I was curious to know the effects of the variables to the species number. This number is not a sensitive indicator for the changes of the plant communities but can be considered as the base of the traditional diversity indexes. On the figures it seems clearly the natural forest stands has larger species pool than the afforested plots. This result is absolutely logical because in the plantations the number of the forestal species is still low after more decades, their vegetation underlayer is formed mostly by natural disturbance tolerant and adventive species. In the long term establishing forests despite of the intensive management we can find the accompanying species of the natural forests and beside these the adventive and natural disturbance tolerant elements exist too. The species number was not affected significantly by the age of the tree stocks. On the base of these it is verifiable the species number alone is not enough in every case for the evaluation of the naturalness of the forest stands – as it is shown by earlier international researches (NAGAIKE et al. 2005). In the larger forest blocks of the sample area (Rumi-, Hollósi-forest) the species numbers were higher than in the smaller patches but it is caused by the greater amount of silvicultural infrastructural roads where the number of the distrubant tolerant cosmopolitan species is higher.

Among the different forest types the spruce plantations can be characterised with the lowest species number. The artificial plantations of the spruce have very poor light conditions therefore inside the forest only few herbaceous species can be found and most of them exist preferably at the opening parts of the stands. The thick litter layer of fallen leaves also considerably inhibits the settling of new species. The low species number of the planted oak forests is neither striking because there the thick leaf-litter counteracts the settling of most species and this circumstance does not change greatly with the aging. The relatively high species number of the noble poplar plantations is owing to the variability of the habitats. Meanwhile the herbaceous layer of the noble poplar stands planted at the growing sites of softwood alluvial forests is poor enough and can be described with monodominant stand of few species, the plantations at the growing sites of oak-hornbeam forests has very similar underlayer to the original forest type. The forest stands with rich light conditions has relatively high number of species (black walnut and black locust plantations) but the highest diversity is shown by the transition stands of natural hardwood alluvial and swamp forests. The degree of herbaceous diversity of the oak-hornbeam forest is comparable to the black walnut stands.

The diversity of the species combinations shows the collective behaviour of the species existing in direct conjunction. This index characterizes the coexistence of the populations in details and reacts more sensitively to the changes of environment than the similar indexes based on the species number. As it was expectable the number of species combinations was higher in the more natural stands than in the plantations. The difference between the two types was more pronounced in this relation than in the total amount of species, consequently the species existing in the artificial forest stands also has lower capability for combination.

If we analyse the number of species combinations by forest types we get the lowest values in case of the spruce plantations similarly to the above written. Because this habitat had the lowest number of species the possible number of combinations is poor logically too. The number of the coexisting species is also relatively low in the planted stands of pedunculate oak. In this case I call the attention for the thick leaf-litter layer because it inhibits the germination of many herbaceous species therefore the continuous underlayer is formed rarely. The synbiological diversity of the black walnut and black locust stands is similar to the natural-like oak-hornbeam stands and on the base of this fact we could think they preserve the species of the original habitat. But the reality differs because in the black walnut and black locust stands the high number is produced by combinations of disturbance tolerant species while in the oak-hornbeam forests the accompanying species form primarily the combinations, accordingly the higher index does not mean better naturalness of the habitat necessarily. Knowing all these information the relatively high value of species combination in the black locust stands is still amazing.

The analysis of the age of tree stands versus species combination shows definite positive connection: the synbiological diversity increases with the age both in the natural forests and plantations.

1.6. Analysis of the species ranges

The 12 examined species are generally spread over the hilly region of Western-Hungary, some of them became sporadic through the direction to the Kisalföld. In the oak-hornbeam and hardwood alluvial forests at the border areas of Western Hungary they can be found at the most locations therefore the macroclimatic differences does not affect their range.

The differences of frequency values can be interpretable by mesoclimatic reasons in case of the *Corydalis solida-C. cava* and *Anemone nemorosa-A. ranunculoides* amongst the examined species. The rarefying of *Anemone nemorosa* and *Corydalis solida* is also detectable in the adjoining areas of the Kisalföld (e.g. Répce-valley) accordingly the different behaviour of these species can be reducible to regional reasons too. Because the soil conditions of the sample areas are nearly similar too, we can assume that the presence-absence is not driven by pedological reasons. The water balance of the soils shows some difference between the sample areas. Because the Raba section near the Szatmári-forest was totally regulated earlier, the floods do not flush the forest anymore and the ground water level lowered radically too.

With the drying of the habitat some mezophilous species (*Corydalis cava, Stellaria holostea*, and the not analysed species of the *Galium odoratum* also can be named) spread over while the hygrophilous species became rare (*Galeobdolon montanum*) or disappeared (*Leucojum verum*). The linkage to the more wet forests was also verifiable at the other sample areas in the latter case as for the *Anemone ranunculoides* too. Albeit this species exists in the oak-hornbeam forests too its maximum frequency – at least in the Hollósi- and Rumi-forest - was achieved at the deeper parts of the flood areas. Generally the descending species of mountains (*Veronica montana, Omphalodes scorpioides, Isopyrum thalictroides*) in the Raba-valley are linked to the more wet forest habitats. In the majority of the cases the frequency of the species is affected considerably by the forest management activities nowadays or of the past.

During the forest clear cuts the populations of almost every species were damaged because of the drastically changed light, water and concurrence circumstances. The fall in the number of individuals is detectable principally among the summer flowering species but some of the early spring geophyta (*Isopyrum thalictroides, Scilla drunensis*) almost completely disappeared after the logging. The *Galanthus nivalis* and *Scilla drunensis* are often existing abundantly at the bushy forest margins therefore the remnant growing sites can serve as valuable source of propagulum in the process of recolonization for such species. Among the examined species the *Isopyrum thalictroides* seems the most sensitive because it is linked to the forest stands with good naturalness, undisturbed soil and generally old age moreover almost never can be found in plantations. Because the seeds of the species is propagated by ants its expansion is rather slow, additionally it does not form as strong colonies as the *Anemone* species which has similar strategy for propagation. The individuals of some myrmechocorous species (*Corydalis cava, Galanthus nivalis*) often occurs more far from the continuous stands and in these cases it is possible the game species also play role in their propagation. The examined species generally colonized the plantations very slowly – it is given mainly by their propagation strategies – but some species (*Galanthus nivalis, Corydalis sp*.) appear relatively early in the planted forests.

On base of field experiences it is statable at the lower lying areas the speed of the colonization is faster because the floods also play a role in the propagation of the seed. Because in the areas with this character (like the forests along the Csörnöc-Herpenyő) the plantations are very rare this statement is not verifiable statistically because of the low possible number of samples.

The examined species can be classified to the following groups on the base of their behaviour shown in the range analysis:

Species sensitive to the forest management activities: *Isopyrum thalictroides*
Relatively fast spreading species: *Aegopodium podagraria, Carex brizoides, Corydalis solida, Galanthus nivalis, Leucojum verum*
Slow spreading species: *Anemone nemorosa, A. ranunculoides, Isopyrum thalictroides, Scilla drunensis*
Species sensitive to the age of the forest stands: *Galanthus nivalis, Galeobdolon montanum, Scilla drunensis*
Species expanding after abandoned grazing: *Carex brizoides, Stellaria holostea*

2. The functional applicability of results

The results of this dissertation can give useful information for practical national conservation and forest management. The sample areas of the research are under nature conservational protection and among the reasons of the protection the rareness of natural-like forests in the Raba-valley and the nation-wide endangered situation of the forestal habitats are important. The hardwood alluvial forests and oak-hornbeam forests are listed in the Habitat directive as important habitats for the European Union therefore their significance is higher than the Hungarian national level. On the base of my researches in the scope of landscape history became visible the fact that in the forest blocks drastic management methods were often practised (as grazing and intercropping), moreover the area of the forest was smaller than nowadays. The afforestations since the end of the 19^{th} century increased the total area of the forests but the accompanying species of the natural forest stands were not able to recolonize the plantations even if native tree species were planted.

On the other hand the forest stands could save their species pool despite of the forest management methods of the past with lack of nature conservational aspects.

The afforestations carried out from the end of the 1800s increased the overall area of the forest blocks along the Raba river and in this way statistically improved the forest coverage. But the plantations could not become "real" forests during a century, their underlayer is still formed mainly by disturbance tolerant species. In the recent decades the use of native species came to the fore in plantations because these plantations expectably will become forests faster. On base of my researches it is not deducible the plantation of native species means advantage for the colonization of the forestal species. The planted species can affect the species composition of the underlayer through the modification of the circumstances at the growing site and in some cases by allelopathic effects.

With my work I clarified the occurring habitat types of the sample areas moreover I gave proposals for the possibilities of dividing the habitat types with community importance (oak-hornbeam forests vs. hardwood alluvial forests) what can determine the directions of the natural conservational management. The exact knowledge of surface area of the actual habitat types and species composition has important information for the preparation of the management plans of the Natura 2000 sites.

Articles related to the subject of the present dissertation

KIRÁLY G. – **MESTERHÁZY A**. –KIRÁLY. A. – PÁL R. – PINKE GY. (2008): Occurrences of Nanocyperion species in West Hungary – role of moist plough-lands in conservation. – Journal of Plant Diseases and Protection, Special Issue 21.

MESTERHÁZY A. – VIDÉKI R. (2004): A gyökerező erdeikáka (*Scirpus radicans* SCHKUHR.) előfordulása Magyarországon.-Flora Pannonica 2(2): 129-139.

MESTERHÁZY A. – KIRÁLY G. (2005): *Zannichelia palustris* L. a Nyugat-Magyarországi peremvidéken.- Flora Pannonica 3: 177. Apró Közlemények.

MESTERHÁZY A. – KIRÁLY G**.** (2006)**:** A *Carex repens* BELLARDI Magyarországon. – Flora Pannonica 4: 99-110

KIRÁLY G. – **MESTERHÁZY A**. – KIRÁLY A. (2008): Adatok a Nyugat-Dunántúl flórájához és növényföldrajzához. – Flora Pannonica 5: 3-64.

Book chapters

MESTERHÁZY A. (2009): Rábai teraszos sík. In KIRÁLY G. – MOLNÁR ZS. – BÖLÖNI J. – CSIKY J. – VOJTKÓ A. (eds.): Magyarország földrajzi kistájainak növényzete. MTA ÖBKI, Vácrátót. p. 102.
MESTERHÁZY A. (2009): Rába-völgy. In KIRÁLY G. – MOLNÁR ZS. – BÖLÖNI J. – CSIKY J. – VOJTKÓ A. (eds.): Magyarország földrajzi kistájainak növényzete. MTA ÖBKI, Vácrátót. p. 103.

Posters at conferences

MESTERHÁZY A. – BARTHA D. (2010): Forest management effects on understory. A case study along Rába river. 19th International Workshop of European Vegetation Survey. Flora, vegetation, environment and land-use at large scale. 29 April - 2 May, 2010, University of Pécs, Hungary. Book of Astracts, pp. 107.
MESTERHÁZY A. – BARTHA D. (2012): A *Carex brizoides* L. és a *C. repens* BELL. előfordulásának és társulástani viselkedésének vizsgálata a sárvári Szatmári-erdőben. Aktuális flóra- és vegetációkutatás a Kárpát-medencében IX. Gödöllő 119 p.

Oral presentation at conference

KIRÁLY G.-**MESTERHÁZY A.** (2006): A Dunántúl flórakutatásának legjelentősebb eredményei (2000-2005).- Aktuális flóra- és vegetációkutatás a Kárpát-medencében VII. Debrecen 9 p.

Essay in manuscript

MESTERHÁZY A. 2010: A Gemenc-Béda területen tervezett GEF-Tápanyagcsökkentési projekt beavatkozásainak monitorozása. Kutatási jelentés, Budapesti Műszaki Egyetem, Budapest 13. pp.

Other publications with botanical subject

In international periodicals

PINKE GY. – PÁL R. – KIRÁLY G. – SZENDRŐDI V. – **MESTERHÁZY A.** (2006): The occurrence and habitat conditions of Anthoxacum puelii Lecoq&Lamotte and other Atlantic-Mediterranean weed species in Hungary.-Journal of Plant Diseases and Protection 587-596
KIRÁLY G. – PINKE GY. – **MESTERHÁZY A**. (2006): Verbreitung und Vergesellschaftung ausgewählter Segetalpflanzen in Westungarn: verschiedene Reaktionen auf Veränderungen der Landwirtschaft. – Journal of Plant Diseases and Protection, Special Issue **20**: 557-566.
KIRÁLY G.-**MESTERHÁZY A**. – BAKAN B. (2008): *Elodea nuttalii* (Planch.) H. St. John, *Myosotis laxa* Lehm. and *Pyrus austriaca* Kern., new for Slovenia, as well as other floristic records. – Hladnikia
PINKE GY. – PÁL R. – KIRÁLY G. – **MESTERHÁZY A**. (2008): Conservational importance of the arable weed extensively managed fields in Western Hungary. – Journal of Plant Diseases and Protection, Special Issue 21.
BARINA Z. –PIFKÓ D. – **MESTERHÁZY A.** (2009): Contributions to the flora of Albania. – Willdenowia **39**: 293-299
CSIKY J. – **MESTERHÁZY A.** –SZALONTAI B. – POTTÓNÉ OLÁH E. (2010): A morphological study of *Ceratophyllum tanaiticum*, a species new to the flora of Hungary. Preslia **82**: 247-259.

MESTERHÁZY A. – KIRÁLY G. – WALLNÖFER B. (2010): On the occurrence of *Carex randalpina* B.WALLNÖFER (Cyperaceae) in Hungary. Ann. Naturhist. Mus. Wien, B. **112**: 177-180.
BARINA Z. –PIFKÓ D. – **MESTERHÁZY A.** (2011): Contributions to the flora of Albania 3. – Willdenowia **41**: 329-339
PINKE GY. – KIRÁLY G. – BARINA Z. – **MESTERHÁZY A.** – BALOGH L. – CSIKY J. – SCHMOTZER A. – MOLNÁR V. A. – PÁL R. (2011): Assessment of endangered synanthropic plants of Hungary with special attention to arable weeds. Plant Biosystems 145 (2): 426-435.
LYE K.A. –**MESTERHAZY A.** (2012): Studies of African Cyperaceae 35: Kyllinga carinaleavis spec. nov. from west tropical Africa. Nordic Journal of Botany 30: 385-388.

In Hungarian periodicals

MESTERHÁZY A. – KULCSÁR L.(2002): A magas borsó (*Pisum elatius* STEV.) előfordulása a Somlón. - Kitaibela (2): 280 Apró közlemények.
MESTERHÁZY A. – BAUER N. – KULCSÁR L. (2003): A kisalföldi bazalt tanúhegyek edényes flórája.- Tilia Vol. XI. 7-165.
MESTERHÁZY A. – KIRÁLY G. (2005): Iszapnövény tanulmányok I.: Az *Isolepis setacea* (R.Br.) L. előfordulása Magyarországon.- Flora Pannonica 3: 79-89.
MESTERHÁZY A. (2006): A *Cyperus glaber* L. újabb magyarországi adatai. [New localities of *Cyperus glaber* L. in Hungary]. – Flora Pannonica **4**: 136.
MESTERHÁZY A – KIRÁLY G. – LUKÁCS B. A. – VIDÉKI R. (2008): A *Lemna minuta* KUNTH előfordulása Magyarországon. – Flora Pannonica 5: 165-172.
KIRÁLY G. – **MESTERHÁZY A.** (2005): A *Vulpia bromoides* (L.) S. F. GRAY Magyarországon.- Flora Pannonica 3: 3-15.
KIRÁLY G. – **MESTERHÁZY A.** (2005): A *Potamogeton compressus* L. magyarországi adatának helyesbítése.- Flora Pannonica 3: 57-58.
KIRÁLY G. – BARINA Z. – HORVÁTH T. – **MESTERHÁZY A.** (2005): Az *Orobanche pancicii* BECK előfordulása Magyarországon.- Flora Pannonica 3: 17-26.
PINKE GY. – PÁL R. – KIRÁLY G. – SZENDRŐDI V. – **MESTERHÁZY A.** (2006): Atlanti-mediterrán gyomnövények előfordulása Magyarországon.- Flora Pannonica 3: 59-68.
PINKE GY. – PÁL R. – **MESTERHÁZY A**. – KIRÁLY G. – SZENDRŐDI V. – SCMIDT D. – UGHY P. – SCMIDMAJER A. (2006): Adatok a Dunántúli-középhegység és a Nyugat-Magyarországi peremvidék gyomflórájának ismeretéhez. Kitaibelia 10(1): 154-185.
FISCHL G. – JANDRASICS L. – KIRÁLY G. – **MESTERHÁZY A** (2007): A szakállas orbáncfű (Hypericum barbatum JACQ.) új gombás betegsége Magyarországon. – Növényvédelem 43(8): 364-366.
MOLNÁR CS. – MOLNÁR ZS. – BARINA Z. – BAUER N. – BIRÓ M. – BODONCZI L. – BÖLÖNI J. – CSATHÓ A. I. – CSIKY J. – DEÁK J. Á. – FEKETE G. – HORVÁTH A. – JUHÁSZ M. – KÁLLAYNÉ SZERÉNYI J. – KIRÁLY G. – MAGOS G. – MÁTÉ A. – **MESTERHÁZY A.** – MOLNÁR A. – NAGY J. – ÓVÁRI M. – PURGER D. – SRAMKÓ G. – SZÉNÁSI V. – SZMORAD F. – TÓTH T. – VIRÓK V. (2009): Vegetation-based landscape regions of Hungary [1.0]. – Acta Botanica Hungarica **50** (Suppl.): 47-58.