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Vegetation and Fauna of Tisza River Basin III.

Edited by

László Körmöczi
and
Orsolya Makra

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INTRODUCTION

László Körmöczi

The basin of River Tisza and its main tributaries – river Szamos, river Körös, river Maros – play very important role in the life of the Great Hungarian Plain. Most of the human activities are coupled with the water regime of the rivers and of their larger surroundings. The rivers also determine the natural vegetation and fauna of several habitats and affect the crop and livestock.

The human activity of the last decades or even centuries transformed substantially the landscapes of the Great Hungarian Plain causing heavy fragmentation and degradation of natural habitats and as a consequence, the loss of substantial natural values. 2010's is the Decade of biodiversity that emphasizes the importance of increasing knowledge on the biota of the Earth, a minor portion of which is the river basin of the Plain.

Large amount of historical and recent data exists on the flora and vegetation types (phytocenoses) of the rivers and the floodplain, but rarely summarized in a comprehensive book (some monographs devote substantial chapters for vegetation description but only for certain areas of river basins, e.g. Hamar and Sárkány-Kiss 1995, 1999, Sárkány-Kiss and Hamar 1997, Tuba 2008). Authors of this monograph decided to collect and evaluate published and unpublished cenological data recorded from the characteristic plant communities of the target area, and to reveal the main rules and relationships in the patterns of the floodplain vegetation. We intended to enumerate all the plant associations in cenotaxonomic order that have been found in and affected by the surroundings of Tisza and its tributaries. In the evaluation, we followed the phytocenological nomenclature of Borhidi (2003).

The total length of the river Tisza section – and also of the river basin – is 596 km in the region of Hungary. This large strip runs through rather different floristic regions therefore the floristic composition of the vegetation units may also differ. On the basis of previous knowledge and the data gathered, the studied area was divided into three sections, as follows: 1. North-Eastern border—Tokaj, 2. Tokaj—Szolnok, 3. Szolnok—Southern border.

Authors of the following chapters intended to collect and evaluate as many recent and historical data as possible. The result of their effort, however, very diverse indicating rather uneven surveys of both phytocenoses and geographical regions. Nearly 1500 cenological relevés were treated from 34 associations. Distribution of the relevés among associations ranges from 10 to 90, but the extremes are one relevé for an association, and the other extreme 429 relevé for an association. This emphasizes the scientific interest regarding the floodplain oak forests. Therefore the cumulative species list is significantly larger in the case of extensively studied communities.

The vegetation of the Tisza river basin was analysed on the basis of recent and historical, published or unpublished relevés available. Time span of the records is also rather wide, the earliest data came from the late 1940-ies. Two types of records were used in the analyses: cover estimation of the plant species was made on A-D scale mainly in the earlier relevés while in the more recent ones percentage cover estimations were applied. The two types were treated separately only in the multivariate analyses since the transformation of data is either ambiguous or causes information loss.

Authors of this book give general description of each community and the habitat conditions on the basis of literature data and their own survey results that is followed by detailed floristic and cenological evaluation of the association according to the river sections distinguished.

The evaluation of the associations is completed by multivariate analyses. Principal component analyses (PCA) were carried out on percentage cover and A-D scale data separately. PCA was based either on covariance (centred PCA) or correlation (standardized PCA). Different traits – species composition, dominant species or geographic position – of the study sites were superimposed on the PCA scattergram to reveal the background of the cluster formation.

Data from the following major groups of associations have been found in the territory of river Tisza. Eleven association groups and 30 associations are evaluated in this book:

I. Duckweed covers – Lemnetalia minoris
   I.1. *Salvinio–Spirodeletum* (Slavnic 1956)
   I.2 *Wolffietum arrhizae* (Miyav. and J. Tx. 1960)
II. Bladderwort colonies – Lemno-Utricularietalia
   II.1. *Lemno–Utricularietum vulgaris* (Soó 1928)
III. Large pondweed beds – Potametalia
   III.1 *Potametum lucentis* (Hueck 1931)
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   III.3 *Nymphaeetum albo–luteae* (Nowinski 1928)
   III.4 *Trapetum natantis* (V. Kárpáti 1963)
IV. Small galingale swards – Nanocyperetalia Klika 1935
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In the second half of the book we summarize the known cenological data for each association, and distinguish the vegetation of each river section and, if available, that of the major tributaries. We also indicated separately A-D and percentage data.

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I. DUCKWEED COVERS – LEMNETALIA MINORIS

Orsolya Szirmai, Zoltán Tuba, László Körmöczi

General description

Species-poor communities forming cover mainly on still- or slowly flowing or sometimes temporary water bodies. Any of the character species can reach considerable cover value. The dynamics of the community is determined by the anatomical characters of the plants forming the association (Borhidi 2003).

I.1. *Salvinio-Spirodeletum* (Slavnic 1956)

Syn: *Lemneto-Utricularietum* cons. *Salvinia natans* Timár 1954 (Soó, 1964); *Lemno-Spirodeletum salvinietosum* Koch 1954 (Soó, 1964); *Lemno-Salvinietum natantis* Ubrizsy 1961 (Soó, 1964)

Habitat conditions

The community was described by Slavnic in 1956 (Slavnic 1956). It is a free-floating vegetation on the surface of still- and slowly flowing water bodies forming thick covers in most cases. The structure of this community is more complex than that of other duckweed communities because the floating plants have also a tiny rhizosphere. Sometimes other species form a second, submerged layer (Borhidi 2003). In respect to the vegetation architecture, the most determining abiotic environmental factors are the water supply, water movement and wind speed. The stands of the community may be degraded by floods several times a year but they can regenerate within a short period (Bodrogközy 1982). The appearance and condition of this community strongly depends on the fluctuation of water level e.g. in lake Bence (Nagy 1996). The increase of the concentration of alkali cations, which can be attributed either to the mineralized water in the dry years or to the decomposition of the vegetation at the end of the summer, is favourable for the community. Dominant anion of the water bodies is hydrogen-carbonate. Total quantity of Na and K ions exceeds that of Ca and Mg ions and this increases the alkalinity of the water (Bölöni *et al.* 2003). This community is sensitive to water pollution (Fekete *et al.* 1997).

Characterization of stands along River Tisza and its tributaries

Salvinio-Spirodeletum is evaluated on the basis of 28 relevés that were taken between 1982 and 2005. Further details are listed in the Appendix at page 153. This community consists of two strata: the species with tiny rhisosphere form the upper stratum and the submerged species form the second one. The surface layer is dominated mainly by *Salvinia natans* and in the submerged layer *Ceratophyllum demersum* is frequently the dominant species. Other species that are constant in this community such as *Spirodela polyrrhiza*, *Lemna minor, L. trisulca* and *Urticularia vulgaris* may become locally dominant. In the relevés recorded along the River Tisza, we found certain differences compared to the literature community descriptions (Borhidi 2003). The dominant species of other communities can be present in these duckweed stands because of their mosaic-like structure. For example *Trapa natans, Hydrocharis morsus-ranae, Glyceria maxima* and *Stratiotes aloides* can occur in these stands and they may be even accompanying species.

From among the protected species *Salvinia natans* occurred in each stand. *Trapa natans* was present in the following stands: Lake Tisza (Kisköre), Berettyó (Karcag-Püspökladány), oxbow lake of Tisza (Tisza-oxbow of Szóró, Besenyszög), oxbow lake of Körös (Körös-oxbow of Dan-zug, Gyomaendrőd), oxbow lake of Tisza (Körtvélyes-oxbow, Mártély).

Salvinia natans was dominant in most of the relevés and was monodominant in the half of them. In the relevés of the oxbows of Bodrogköz, *Lemna triscula* and *Sparganium erectum* were codominant or subdominant. A similar phenomenon can be observed with *Trapa natans* in the relevés from Körös-oxbow and in one case this species was even dominant in the surface layer. The other characteristic species, *Spirodela polyrrhiza* occurred more than 2/3 of the relevés (it was present for example in each sample in Körös-oxbow) and it was dominant in the surface layer in two relevés. In 3/4 of the relevés a submerged layer was formed in most cases by *Ceratophyllum demersum*, and in one sample by *Urticularia vulgaris*. Total vegetation cover of the relevés was much less in Körös-oxbow than in the other relevés.

Multivariate statistical analysis

We carried out a centred principal components analysis (PCA) ordination on the relevés. Considering the eigenvalues, 5 components are important which account for 96 % of the total variance of data. The relevés can be divided into 3 groups but several samples are separated on the scattergram (Fig. 1). It appears that *Salvinia natans* and *Ceratophyllum demersum* are responsible for the formation of the groups. Former species is in close connection with axis 1 while *Ceratophyllum demersum* with axis 2. The cover value of *Salvinia natans* increases from the left to the right along axis 1 and that of *Ceratophyllum demersum* increases from the bottom to the top along axis 2. *Salvinia natans* is dominant in the relevés that compose group A. In several cases *Trapa natans* becomes subdominant. Another common feature of the relevés in group A is that in most cases the submerged layer did not develop, except for 2 relevés in which the cover of *Ceratophyllum demersum* is between 0.1 % and 10 %, (Fig. 1.). In the quadrates of group B, *Ceratophyllum demersum* forms a submerged layer and its cover value is between 40 and 70 %. *Salvinia natans* is also dominant. In the surface layer of relevés of group C the cover of *Salvinia natans* is lower (10-20 %). The relevés can be characterized with the dominance of *Trapa natans* and *Ceratophyllum demersum* in the submerged layer. The quadrates of group D are slightly separated from those of group A due to the codominance of *Lemna trisulca*. Also *Sparganium erectum* and *Utricularia vulgaris* may be codominant. In quadrates 6 and 20, the coverage of *Salvinia natans* is low (1-3 %), and the surface layer is dominated by *Spirodela polyrrhiza*. The separation of these units is caused by the presence and high coverage of *Ceratophyllum demersum* in quadrate 6 while being absent from quadrate 20.

Relevés recorded on AD scale consist of 15 species, many of them are reed bed and large sedge community elements. These two quadrates were not included in the multivariate analyses.

The aggregations of ordination plot (Figure 1.) do not coincide with Tisza river sections. Although the most important accompanying species of the community were recorded with different rate in each relevé, but this phenomenon did not cause any separation among the units/sections. *Ceratophyllum demersum* was absent only from two relevés of oxbow lakes of Tisza (Tokaj-Szolnok and Szolnok-Southern border). *Lemna minor* was present in every section except for Szolnok-Southern border. *Lemna trisulca* was recorded from two sites: oxbow lake of Bodrog and Lake Tisza. *Trapa natans* is not a character species here, but occassionally it reaches a considerable cover value. The number and proportion of accompanying species may be determined by plenty of biotic and abiotic factors, like species composition and propagule pool of neighbouring stands, abundance of water birds, the degree of eutrophisation, the depth and transparency of waterbody, drifting of water, degree of habitat disturbance.

The examination of euhydrophyte communities has some difficulties the most important of which is connected with the free-floating species. These species can easily be driven among and above the rooted vegetation therefore their presence-absence and abundance–dominance values can be evaluated only taking into account these facts.

The presence of additional species may be the consequence of the mosaic-like habitat structure and of the community complexes that are characteristic features of euhydrophyte communities.

The low transparency of shallow waters, several strata of the vegetation and the seasonal changes in the aspects made the study more difficult. In mosaic-like and overlapping vegetation, correct placing of the quadrate samples and determination of the borderline of the communities were not easy (Szirmai *et al*. 2006).

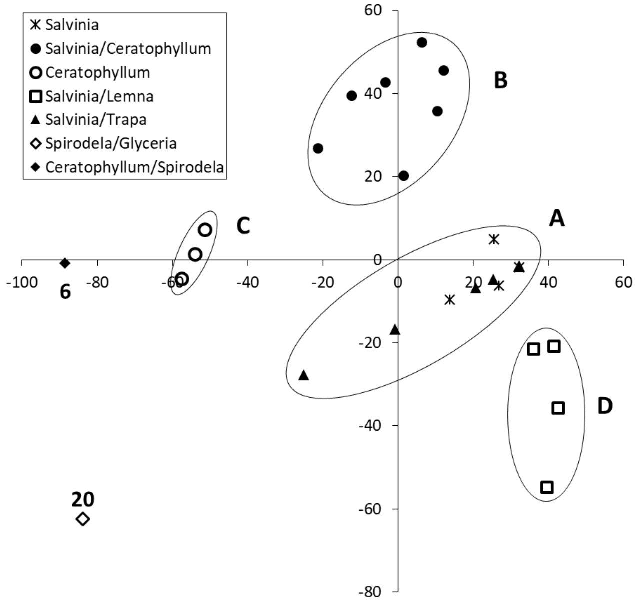

Fig. 1. PCA ordination of the relevés of *Salvinio-Spirodeletum* community (n=26) recorded on percentage scale (centered PCA; for the explanation of legends see text.)

I.2 *Wolffietum arrhizae* (Miyav. and J. Tx. 1960)

Syn.: *Wolffio-Lemnetum gibbae* (Benn. 1943) *wolffietosum arrhizae* (Soó, 1964).

The community was described by Miawaki and Tüxen in 1960 (Miyaw. & Tx., 1960). Earlier it was determined as the subassociation of *Wolffio-Lemnetum gibbae* (Soó, 1964).

Habitat conditions

According to Borhidi, the stands with *Lemna gibba* are characteristic for Middle and Western Europe. This community is azonal floating hydrophyte vegetation with short life span (Borhidi 2003). It is the indicator of eutrophic, HCO_3 rich, alkalic waters. *Wolffia arrhiza* is frequent and forms communities (Bölöni *et al.* 2003, Lakatos 1978). It forms great stands which can be swept by floods according to Bodrogközy, but they can regenerate within a short period (Bodrogközy 1982).

Characterization of the species and the stands along River Tisza and its tributaries

Rootless Water Meal, *Wolffia arrhiza*, is one of our smallest flowering plants. It is a subtropic-mediterranean species. The Hungarian distribution of the species can be connected to the migration of birds. It was first reported from the Soroksár Danube line by Boros, later Almádi reported the species at oxbow lake of Körös at Békésszentandrás (Almádi 1961). In the 1960's the species was observed in many places: S. Tóth observed it in oxbow lake of Tisza near Oszlár and in the surroundings of Tiszalúc, L. Tóth in Lake Velence, Vöröss reported it from Dráva plain at Szapronca, Tihanyi reported it in the Southern part of Somogy at Középrigóc from the water of Nagy-Bók. In the 70's the plant was reported from more localities. Fintha found it in the dead river-bed of Túr stream in the surroundings of Túrricse then in the oxbow lake between Túrriccse and Kölcse, and *Wolffia* performed the highest cover in Malom lake at Csaholc. Tölgyesi wrote about it in the Nagy Sulymos Lake and Kis Sulymos Lake between Lakitelek and Alpár, Legány found it at Tiszadob (at oxbow lake of Szelep), D. Pethe reported it from the watercourse of Dédai forest in the surroundings of Beregedaróc, and from Badalói-szeg oxbow at Tarpa. Fintha found it in the oxbow-lake of Szamos in the surroundings of Fülpösdaróc (Fintha 1979). Lakatos observed the plant near Taktakenéz in an oxbor-lake of Tisza and mentioned an occurrence at Cserehát (Lakatos 1978). *Wolffia* was reported from the Szamos dead channel at Csengersima in 1983 by Fintha, Egey found it in the oxbow-lake of Viss in Bodrogköz (Egey 1987). Recently the species and its association were reported from Kisköre reservoir by Szalma (Szalma 2003).

Characteristic feature of *Wollfia* is that it disappears and later appears again. Lakatos explained this dynamics with the seeds which crop in one year and may germinate in the next favourable year. These dormant seeds ensure the survival of the population during unfavourable conditions and the recolonization (Lakatos 1978).

Wolffia may disappear from many places due to the changing ecological conditions as a consequence of the changing weather. Then the distribution of the species can be observed again in some places (Fintha 1984). The seasonal changes of *Wolffia* together with other hydrophyte species, mainly with *Lemna trisulca* (Almádi 1961) can be well observed. The free-floating species (*Lemna* spp., *Wolffia arrhiza, Spirodela polyrrhiza*) often appear or replace each other only at the end or in the middle of the vegetation period. At the beginning of the vegetation period *Lemna minor* is dominant. *Spirodela polyrrhiza* reaches its maximum in the middle of summer. *Lemna trisulca* becomes dominant by the end of summer, and *Salvinia natans* and *Wolffia arrhiza* by the end of autumn (Szirmai *et al.* 2006). On the basis of the experiences at Taktakenéz, the community consists of several hydrophyte species, the most characteristic species are: *Hydrocharis morsus-ranae, Spirodela polyrrhiza, Wolffia arrhiza, Lemna trisulca* (Lakatos 1961).

On the basis of the relevés along Tisza (9 relevés recorded on percent scale in one stand and 7 relevés recorded on AD scale in 4 stands between 1977-2005; cf. Appendix page 155) the following features can be summarized about the species composition of the community: it is a single layered, rarely double layered community. The floating species (mainly duckweed species) formed the upper layer and the submerged species formed the lower one (*Ceratophyllum demersum, Myriophyllum spicatum*). *Wolffia arrhiza* and *Lemna trisulca* were often codominant in moderately eutrophic waters. *Lemna minor* and *Spirodela polyrrhiza* were additional species.

Wolffia arrhiza was not monodominant differently from the recent literature (Borhidi 2003).

The relevés of Túr-oxbow were species-poor consisting of 3 species, this can be due to the small size of the sample quadrate. In the stands at Malom lake *Salvinia natans, Spirodela polyrrhiza* and *Wolffia arrhiza* were found. In the stands at Túr-oxbow, *Lemna minor* replaced *Salvinia*.

In certain relevés (in the samples of Török-rivulet) a submerged layer was observed which was formed by *Ceratophyllum demersum*. In the submerged layer of Körtvélyes stand, *Myriophyllum spicatum* was present as a constant species, in one of the relevés it was codominant with *Ceratophyllum demersum* while *Potamogeton lucens* was dominant in another relevé. In 60 % of the samples from Török-rivulet, *Wolffia arrhiza* and *Lemna trisulca* were codominant. *Lemna minor* and *Spirodela polyrrhiza* were subdominant in the relevés from Körtvélyes backwater in addition to *Wolffia arrhiza*. In one of the relevés, *Polygonatum amphibium* var. *aquaticum* formed consociation.

No multivariate analysis was performed since the number of the relevés was limited.

Channels are specific from coenological point of view. The bed of the channels is narrow and not too deep (about 1 to 2 m in depth), therefore plants have smaller habitats. Stands have less space, they are more crowded, the individuals of certain species cover each other so in many cases community complexes are formed on and under the water surface (Szirmai *et al.* 2006). The species composition of the stands of channels is different in many cases from the literature description of the community.

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II. BLADDERWORT COLONIES – LEMNO-UTRICULARIETALIA

Orsolya Szirmai, Zoltán Tuba, László Körmöczi

General description

The order *Lemno-Utricularietalia* consists of thermophile communities which are distributed mainly in Middle and Southern Europe. This vegetation type has one or two layers which consist of free-floating species on the surface and insect-trapping species underneath. The determining ecological factor is the organic material and detritus richness of the dystrophic water. Crustacean fauna of the habitat is usually rich in species. Stands frequently appear in shaded waters surrounded by reed vegetation (Borhidi 2003).

II.1. *Lemno-Utricularietum vulgaris* (Soó 1928)

The community was described by Soó in 1928 (Soó 1928). In the first half of the last century it was treated together with *Lemnetum minoris* and was considered as the subassociation of it (Soó 1964).

Habitat conditions

Bladderwort community forms separate zones in the shaded glades of reeds in the secondary lines of rivers, lakes and backwaters. This community occurs mainly in oligo- and distrophic waters of 40-100 cm depth and is sensitive to eutrophication (Borhidi 2003). The composition of the accessory species of the community strongly depends on the fluctuation of water level as was reported from lake Bence (Nagy 1996).

Characterization of stands along River Tisza and its tributaries

Bladderwot community is characterized on the basis of 35 relevés from the Tisza river basin, most of which were recorded on percentage scale (for further details see Appendix page 156).

It is a two layered community which consists mainly of the submerged *Utricularia vulgaris* which can associate with *Lemna minor* in the surface layer and with *Lemna trisulca* in the more shaded places. *Salvinia natans, Lemna trisulca, Hydrocharis morus-ranae* are frequent, they occur in 50-70 % of the stands. In the submerged layer *Ceratophyllum demersum* occurs locally.

The protected *Salvinia natans* occurred in Lake Bence, Török-rivulet and Kengyel-oxbow, and with a minimum cover (+) value in the oxbow of Kistisza-sziget. In the submerged layer of the whole community *Utricularia vulgaris* was dominant and *Ceratophyllum demersum* associated to it in three relevés (11, 13 and 14).

In the Bereg sample, *Salvinia natans, Lemna minor* and *Hydrocharis morus-ranae* were dominant in the free-floating layer. *Hydrocharis morus-ranae* was dominant in the relevé of oxbow lake of Tisza at Boroszlókert. In the oxbow-lake of Kengyel at Bodrogköz, *Lemna trisulca* and *Salvinia natans* dominated the surface layer (except for the relevé 14). The first species was dominant in the half of the relevés while the second one in the other half. In the sample of Török-rivulet, *Lemna trisulca* was present with only a small cover, and *Salvinia natans* was dominant in the surface layer. *Sparganium erectum* and *Sium latifolium* were accessory species in the oxbow lake of Kis Tisza island.

We evaluated only one relevé from Lajos Timár recorded on AD scale because *Utricularia vulgaris* occurred only in this sample (Timár 1954). According to the recent literature, the dominant species of the community is always *Utricularia vulgaris* (Borhidi 2003).

Multivariate statistical analysis

We carried out a centred principal components analysis (PCA) ordination on the relevés (Podani 1993). On the basis of the eigenvalues, 5 components accounted for 90,55 % of the total variance of data. The objects were divided into three large and one smaller groups, and two objects separated from the others. Dominance of *Salvinia natans* and *Lemna trisulca* are the determining factors in the separation of groups. Considering the correlations of the variables with the first two axes, the cover values of *Salvinia natans* grow along *x* axis from the left to the right. There is no large difference in the cover values of *Utricularia vulgaris* (70-100 %) among the relevés.

In the relevés of group A (Fig. 1) the cover value of *Salvinia natans* is low (0-25 %), *Lemna minor* is present in 90 % of the samples, and occassionally it is dominant. In addition, *Hydrocharis morus-ranae* is the most frequent accompanying species and sometimes subdominant in the free-floating layer. *Lemna trisulca* is completely missing from this group.

In the group B, *Salvinia natans* is dominant in the surface layer (its cover value of is 60-95 %), *Lemna trisulca* is sub- or codominant. In relevé 32, *Lemna trisulca* is dominant and *Salvinia natans* is subdominant in the surface layer.

In the relevés of group C, *Hydrocharis morus-ranae* is dominant in the surface layer, creating a consociation, and *Salvinia natans* is missing. In the group D, *Lemna trisulca* is dominant with cover values of 32 to 95 % and *Salvinia natans* becomes a subordinate species.

Relevé 14 is very different from the others; three species are co-dominant (*Utricularia vulgaris*, *Lemna trisulca* and *Ceratophyllum demersum*), they occur in similar proportion, and *Lemna minor* is the only accompanying species.

The sample recorded on AD scale shows a species-poor stand; the surface layer consists of *Lemna minor* and *Salvinia natans*, and the submerged layer is dominated by *Utricularia vulgaris*.

On the ordination plot (Fig. 1) only the relevés of one site (Tisza-oxbow of Boroszlókert, Gulács) form a separate group as a consequence of the dominance of *Hydrocharis morus-ranae* in the surface layer; the samples from the other sites are more or less mixed, geographic differentiation can not be revealed. The groups of relevés were formed by one or several dominant species as was explained above. The ratio of the associated species is influenced by several abiotic and biotic factors, for example by the species composition of the neighbouring communities, the density of water-birds, the rate of eutrophization, the depth of water body, the disturbance of the area etc.

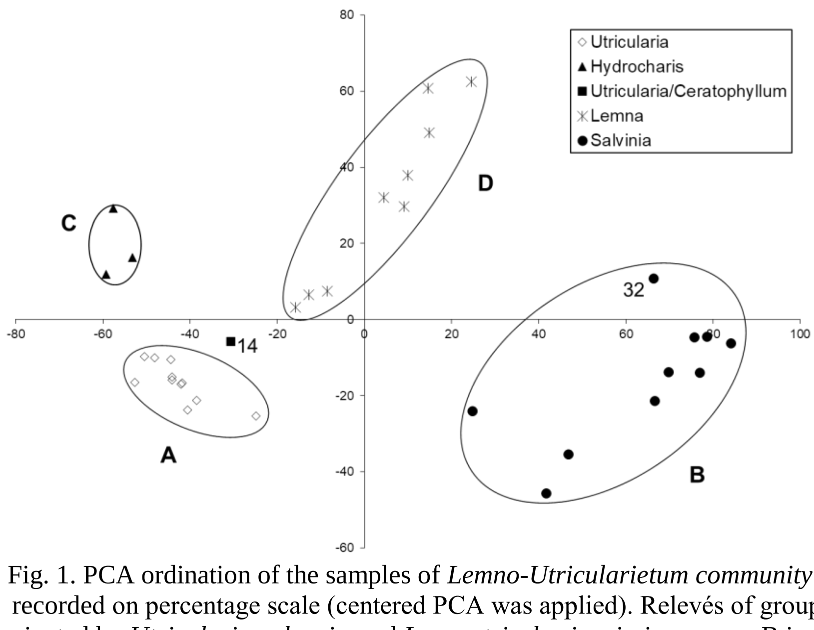

Fig. 1. PCA ordination of the samples of *Lemno-Utricularietum community* (n=34) recorded on percentage scale (centered PCA was applied). Relevés of group A are dominated by *Utricularia vulgaris*, and *Lemna trisulca* is missing; group B is dominated by *Salvinia natans* and group C by *Hydrocharis morsus-ranae*; group D is characterized by the dominance of *Lemna trisulca* and the low cover values of *Salvinia natans*. Int he relevé marked with solide square (No. 14), proportion of *Utricularia vulgais* is much less than the average and *Ceratophyllum demersum* becomes co-dominant.

Acknowledgement

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III. LARGE PONDWEED BEDS – POTAMETALIA

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General description

Potametalia association order consists of the broadleaved rooted pondweeds of still- and slowly floating water bodies with depth of several meters. Several species occurring in this order are purely aquatic plants while other species can be present in terrestrial forms (amphibian plants). Large pondweed beds (*Potamion lucentis*) are the pioneer communities in the eutrophization processes (Borhidi 2003).

III.1 *Potametum lucentis* (Hueck 1931)

Syn.: *Myriophyllo-Potametum potametosum acuminati* Slavnic 1956, *Lemneto-Utricularietum* cons. *P. lucens* Timár 1954, *Myriophyllo-Potametum potametosum lucentis* Soó 1957 (Soó 1964).

The community was described by Hueck in 1931. Earlier it was treated as the subassociation of *Myriophyllo-Potametum* (Borhidi and Sánta 1999).

Habitat conditions

Pondweed bed community is present in 4-7 m deep, moderately eutrophic and mesotrophic, still or slowly moving waters (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

Along river Tisza, 15 relevés were recorded on percentage scale in 4 stands and 10 relevés on AD scale in 4 stands between 1965 and 2000 (cf. Appendix page 158). It can be discussed from the records that all the relevés are dominated by *Potamogeton lucens*. *Ceratophyllum demersum* is also constant, and it dominates the submerged layer. If the surface layer develops it is dominated by *Salvinia natans* and *Hydrocharis morsus-ranae*, and these species may be accompanied by *Lemna minor* and *Spirodela polyrrhiza*.

The studied stands differ from the literature data (Borhidi 2003) since other plants as those with large submerged leaves are also characteristic. In certain relevés the occurrence of swamp and reed bed species like *Sparganium erectum, Bolboschoenus maritimus, Phragmites communis* causes further difference.

From among the protected species, *Salvinia natans* was present in the stands at Zsaró-rivulet, Tisza-oxbow of Hordód, Körös-oxbow of Dan-zug. *Trapa natans* occurred in the stands at Lake Tisza, Körös-oxbow of Dan-zug, Körtvélyes-oxbow, Algyő at Nagyfa.

It is typical for the submerged layer in most relevés that *Ceratophyllum demersum* reached a significant cover value beside the dominant *Potamogeton lucens*. In one of the relevés at Tisza-oxbow of Hordód, *Myriophyllum spicatum* had also a higher cover value. All of the above mentioned species were present in the Körtvélyes stand (Bodrogközy 1982) accompanied by *Potamogeton perfoliatus*. The relevés of Körös-oxbow were exceptional because only *Potamogeton lucens* formed the submerged layer. In the relevés taken by Timár at Algyő Nagyfa, *Potamogeton gramineus* was codominant with *Potamogeton lucens*. In the stands at Tiszafüred, Algyő and Körös-oxbow, species of broad-leaved pondweed carpets, swamps and reed beds may also occur with considerable dominance like *Trapa natans, Sparganium erectum, Polygonum amphibium, Bolboschoenus maritimus, Nuphar lutea, Phragmites australis, Sagittaria sagittifolia*.

Multivariate statistical analysis

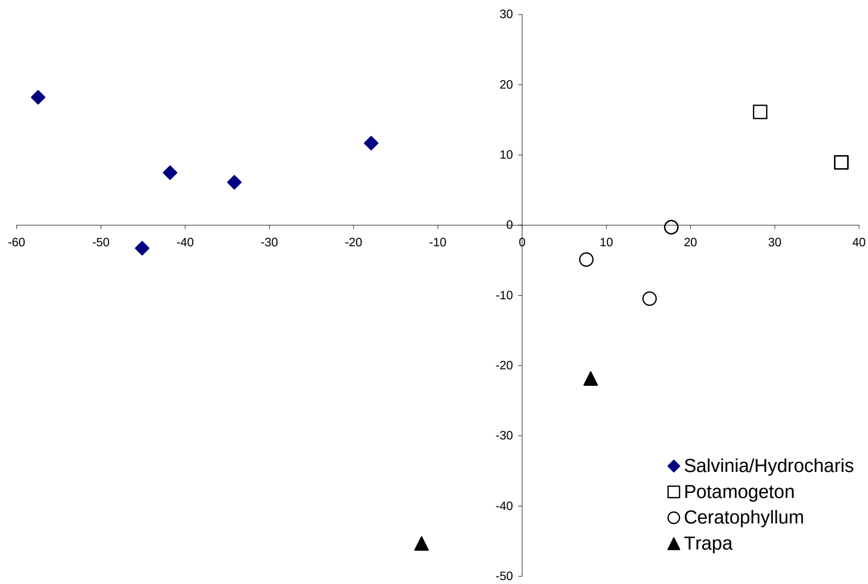

Fig. 1. PCA ordination of the relevés (n=15) of *Potamogetonetum lucentis* community recorded on percentage scale (centered PCA). Relevés marked with diamond are dominated by *Salvinia* and *Hydrocharis*, those marked with open square are dominated by *Potamogeton*. Open circle signs the dominance of *Ceratophyllum*, and triangle signs the dominance of *Trapa*.

Principal component analysis (PCA) was performed on percentage scale data. Due to the low number of species, more than 95 % of the total variance is accounted for by only three components. The scatterplot of the relevés (Fig. 1.) that derived from centred Principal component analysis presents the aggregation according to the species composition and dominance. *Potamogeton lucens, Salvinia natans, Ceratophyllum demersum* and *Hydrocharis morsus-ranae* are the determining species, and are connected to component 1; *Trapa natans* is of secondary importance as it is present only in two relevés. The cover values of *Potamogeton lucens* are high in the right hand objects, and those of *Salvinia natans, Ceratophyllum demersum* and *Hydrocharis morsus-ranae* are higher at the left hand relevés. The relevés characterized by the considerable cover values of *Salvinia* and *Hydrocharis* were sampled in the same stand of Zsaró-rivulet. The reason of separation of relevés marked with triangle was the dominance of *Trapa natans* in the surface layer. The aggregation of the relevés is less connected to the geographic area.

Due to the low number of AD-samples the multivariate analysis was not performed.

III.2 *Myriophyllo-Potametum* Soó (1934)

Syn.: *Potametum myriophylletosum* Soó 1934, *Potametum perfoliati potametosum lucentis* Koch 1926, *Potametum mixtum* Soó, 1930, 1933 (Soó, 1964).

The community was described by Soó in 1934 (Soó 1934)

Habitat conditions

This community occurs normally in the muddy bank zone of shallow large lakes and oxbow lakes. It can be characterized with great photosynthetic activity and biomass production (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

We found very few data from this community recorded along the river Tisza. Two relevés were recorded on percentage scale and 1 relevé on AD scale in 1951 and in 2003 (cf. Appendix page 160). The relevés recorded on percentage scale differ from the published community description (Borhidi 2003), since *Myriophyllum spicatum* did not occur in the quadrates but instead *M. verticillatum* dominated the stand which is usually an accompanying species. The list of the accompanying species is similar to the literature data: *Potamogeton perfoliatu*s generally subdominant, further accompanying species are: *Hydrocharis morsus-ranae, Lemna minor, Lemna trisulca, Salvinia natans, Spirodela polyrhiza,* *Potamogeton natans, Trapa natans*. The last two species were present only in one of the relevés. On the basis of the species composition and considering also the results of Kárpáty V. (Borhidi 2003), the 2 percentage scale relevés can be considered as the facies of *Myriophyllo-Potametum*.

The archive relevé recorded on AD scale includes only two species: *Myriophyllum spicatum* is dominant and *Trapa natans* is subordinate accompanying species. We used only one relevé from those of Timár made in *Myriophylleto-Potametum* (Timár 1954) because *Myriophyllum* species occurred only in this sample. In the other relevés of Timár, *Potamogeton perfoliatus* is the dominant species forming communities, and other pondweed species like *P. pectinatus* or *P. natans* are not present in the relevés of Timár.

The species number of the relevés was very low, and only two protected species were found. *Salvinia natans* was present only in the stand at Tisza-oxbow of Hordód, and *Trapa natans* occured in both stands.

III.3 *Nymphaeetum albo-luteae* (Nowinski 1928)

Syn.: *Myriophylleto-Potametum* W. Koch 1926, Slavnic 1956; *Nuphareto-Castalietum* Soó, 1928, 1933, 1934, 1936, 1938, 1940-41, 1945; Soó-Zólyomi 1951; Timár 1954 (Soó, 1964).

The community was described by Nowinski in 1928 (Nowinski, 1928).

Habitat conditions

Floating broad-leaved carpets are characteristic of large, permanent waterbodies, lakes, and oxbows and sometimes channels and slowly flowing rivers with moderately deep water. The community survives for a long time if the ecological conditions are optimal (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

Along the river Tisza, 50 relevés were recorded on percentage scale and 11 relevés on AD scale between 1947 and 2005. The relevés belonged to 12, and 7 stands, respectively (see Appendix page 161). The separate occurrence of the two dominant species, *Nymphaea alba* and *Nuphar lutea*, supports that the community can be treated as two separate associations but mixed stands can also be observed. Submerged species can accompany the floating species complex thus the community consists of 2 layers in this case. In the *Nuphar* beds (*Myriophyllo verticillati-Nupharetum luteae* W. Koch 1926), *Lemna* species (*L. minor, L. trisulca*) and *Hydrocharis morsus-ranae* can accompany the dominant species in the surface layer while in the submerged layer *Ceratophyllum demersum* is present.

Waterlilly beds (*Ceratophyllo-Nymphaeetum albae* (Kárpáti 1963, Borhidi 2001) differ from the previous community because they are less tolerant to eutrophization (Borhidi 2003). *Lemna* species (*L. minor, L. trisulca*), *Spirodela polyrrhiza* and *Hydrocharis morsus-ranae* can occur in the free-floating layer while the community is characterized with *Ceratophyllum demersum, Myriophyllum spicatum, Utricularia vulgaris* and *U. australis* in the submerged layer.

Some swamp and reed bed species occur in the relevés like *Butomus umbellatus, Sagittaria sagittifolia, Sparganium erectum, Agrostis stolonifera, Glyceria maxima, Typha angustifolia,* and this occurrence is different from the literature data (Borhidi 2003).

From among the protected species, *Hottonia palustris* was found in the Viss-oxbow and Lake Sulymos (Tőserdő). *Nymphaea alba* was recorded in all of the stands except for those at Zsaró-rivulet and Viss-oxbow. *Salvinia natans* was present at Török- and Zsaró-rivulet, Viss-oxbow, Lake Nagy at Bodrogzug, Lake Tisza, Lake Sulymos, Tisza-oxbow of Alpár and Tisza-oxbow of Nagysziget.

The difference among the stands appears in the strata of the community and in the rate of the dominant and accompanying species. *Nymphaea alba* is dominant in the surface layer in 65 % of relevés, and 25 % of the relevés is dominated by *Nuphar lutea*. In the remaining relevés, other species are dominant or codominant (*Hydrocharis morsus-ranae, Stratiotes aloides* and *Glyceria maxima*). In 58 % of the samples a submerged startum is present which consists of free-floating and rooted hydrophyte species.

In most of the relevés recorded on AD scale *Nymphaea alba* is dominant in the surface layer and it is subordinate in some cases. In one of the relevés *Nuphar lutea* is dominant, and two relevés are dominated by *Sagittaria sagittifolia*.

Multivariate statistical analysis

Both percentage and AD-scale data were evaluated with Principal component analysis. In the PCA of percentage data, 4 components were important, they accounted for 91.4 % of the total variance. The ordination scatterplot (Fig. 2) shows four distinct groups of objects that are separated according to the dominant species composition. The distinctive species are *Nymphaea alba, Nuphar lutea* and *Ceratophyllum demersum*. The effects of *Nymphaea* and *Nuphar* are opposite, and they determine the distribution of the objects along the first axis. *Ceratophyllum* is mainly responsible for the distribution along the second axis.

During the ordination of AD scale samples, the original cover values were converted. Instead of + sign 0,1 was used, and in the case of interval values (e.g. 2-3) their means (2,5) were used. In the PCA-ordination of AD-scale data, the first 5 components proved to be important, and accounted for 91.2 % of the total variance of data. The distribution of the points in the scatterplot (Fig. 3) is determined mostly by the AD values of *Nymphaea alba* growing from the left to the right along the first axis.

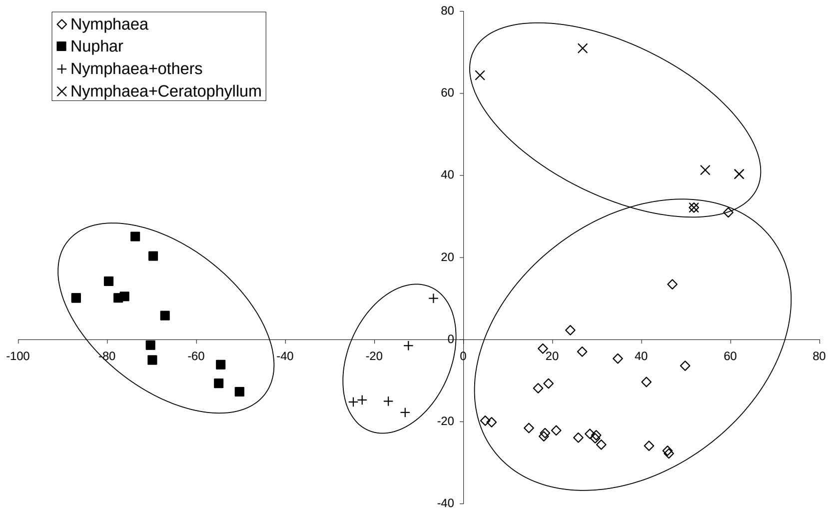

Fig. 2. PCA ordination of the relevés (n=50) of *Nymphaeetum albo-luteae* community recorded on percentage scale (centered PCA). The relevés are separated according to the dominant species composition.

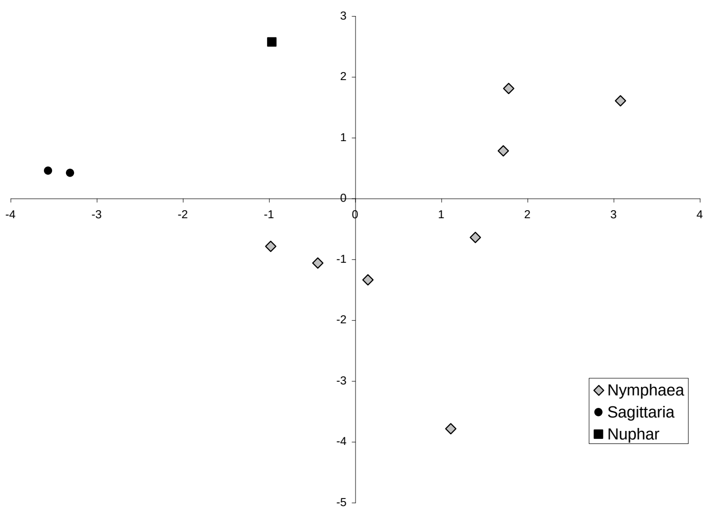

Fig. 3. PCA ordination of the relevés (n=11) of *Nymphaeetum albo-luteae* community recorded on AD scale (centered PCA). The relevés are distinguished again by the dominant species.

The relevés on the left are characterized by smaller AD values of *Nymphaea alba* and are dominated by *Sagittaria sagittifolia* or *Nuphar lutea*. Two relevés are co-dominated by *Salvinia natans* or *Ceratophyllum demersum* but these points do not separate definitely from those dominated only by *Nymphaea*.

The distribution of the relevés in the ordination hyperspace is not connected to the river sections or certain places. The sub-associations or facies may be affected by the local water chemistry.

III.4 *Trapetum natantis* (V. Kárpáti 1963)

Syn.: *Nuphareto-Castalietum* cons. *Trapa* Timár 1954, *Trapa* soc. Soó, 1933, 1934, *Trapo-Nymphoidetum* Ubrizsy 1961 (Soó 1964).

The community was described by V. Kárpáti (1963). Earlier this community was considered as the water chestnut consociation of *Nuphareto-Castalietum* (Timár 1954) or the same community as fringed waterlily carpets (Ubrizsy 1961 in Soó 1964).

Habitat conditions

Water chestnut carpets are the vegetation of slowly moving and still eutrophic waters. This community favours the parts of water bodies which can easily warm up and are moderately alkalic. The stands develop till the depth of 2 m (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

The structure of this community can be evaluated on the basis of 96 relevés from the Tisza valley. Fifty five relevés were recorded on percentage scale (19 stands) and 41 relevés on AD scale (16 stands). The records were done between 1947 and 2005 (Appendix page 164). The stands are mainly species-poor dominated by *Trapa natans*, and also *Lemna* species and *Hydrocharis morsus-ranae* are characteristic. Contrary to the literature data (Borhidi 2003), the community has got two layers in about half of the relevés. The surface layer consists of the above species accompanied often by *Spirodela polyrrhiza* and *Salvinia natans*. Several broad-leaved species occur in the free-floating layer like *Nuphar lutea*, *Nymphea alba, Nymphoides peltata, Potamogeton nodosus* or *P. natans*. *Ceratophyllum demersum* forms the submerged layer in most cases, and sometimes it can be accompanied by *Utricularia vulgaris, U. australis, Myriophyllum spicatum, M. verticillatum, Najas marina, N. minor* and *Potamogeton* species (*P. crispus, P. lucens, P. pectinatus, P. perfoliatus*).

From among the protected species, *Trapa natans* occurred in each stands. *Marsilea quadrifolia* was found only in the Kengyel-oxbow. *Salvinia natans* occurred in the stands of Zsaró-rivulet, Lake Tisza (Tiszavalk, Poroszló, Eger-stream, Csapó, Kozmafok-Sarud, Adádszalók, Kisköre) and Tisza oxbow lakes (Lake Gó, Szóró, Feketeváros, Labodár, Osztora, Mártély and Körtvélyes). *Nymphaea alba* occurred in the stands at Tiszavalk and Poroszló, and *Nymphoides peltata* was found in the stands near Tiszavalk, Kozmafok-Sarud and Kisköre.

The surface layer of the majority of relevés recorded on percentage scale was dominated by *Trapa natans*. Only 3 relelvés were characterized by larger cover values of *Stratiotes aloides* and *Hydrocharis morsus-ranae*. In Kengyel-oxbow and Zsaró-rivulet, certain swamp and reed bed species appeared as accompanying species like *Glyceria maxima, Sagittaria sagittifolia* or *Butomus umbellatus* cover values of which were low (less than 8 %). Most of the relevés had also submerged layer which was formed mainly by *Ceratophyllum demersum* or sometimes by *Lemna trisulca*. In 3 stands (Kengyel, Zsaró-rivulet, Tisza-oxbow of Szóró), there was no submerged layer which was probably the result of the shallow water. The total species number was only 24 and only 5 species performed higher cover values. The frequency of 7 species was considerable. The average number of species per relevé was about 4, and only one species was present in several relevés.

The dominance of the species were much more varied in the relevés made on AD scale. *Trapa natans* was dominant again in every relevés except for two ones, but occurred in each relevé. The other species were less frequent and rarely dominant. *Polygonum amphibium* formed a consociation in certain samples of the stands near Poroszló and Körtvélyes. *Nymphoides peltata* was co- or subdominant in some samples of the Sarud stand. *Hydrocharis morsus-ranae* was subdominant in one of the relevés of Tiszavalk. *Nymphoides peltata* did not occur frequently but should be codominant with *Trapa natans*. In the relevés recorded at Lake Tisza, *Salvinia natans* and *Spirodela polyrrhiza* were frequent species with low cover value as accompanying species. The submerged layer was also diverse: *Ceratophyllum demersum, Urticularia australis* and *Lemna trisulca* were frequent but with low cover values. *Myriophyllum* species were also the members of the submerged layer. *Myriophyllum spicatum* was present only in few relevés but with considerable AD-value in the southern part of Tisza valley (Szolnok-Southern border) while *M. verticillatum* occurred in one stand at Lake Tisza as an accompanying species. The folloving species occurred only in the stands of Lake Tisza: *Najas marina* and *N. minor, Potamogeton pectinatus* and *P. perfoliatus,* while *Potamogeton crispus* and *P. lucens* were recorded from the waters of the Southern part of Tisza (Szolnok-Southern border).

Multivariate statistical analysis

Principal component analysis of percentage data resulted that 3 components are considerable on the basis of eigenvalues, they account for 94.38 % of the total variance of data. The ordination plot (Fig. 4) shows a very characteristic distribution of points representing the relevés. Cover values of *Ceratophyllum demersum* and *Trapa natans* are of primary importance in this respect. The cover value of *C. demersum* is growing from the left to the right along the first axis while that of *T. natans* is growing from the bottom to the top along the second axis thus these two species can be coupled with the first and second components, respectively. The relevés are apparently separated along the first axis by the dominance classes of *C. demersum*, and scattered along the second axis by the dominance values of *T. natans*. Other species play no definite role in this respect.

PCA analysis of AD-scale data resulted 8 components considerable which account for 94.31 % of the total variance. This means that more species are responsible for the point distribution than in the previous analysis. In this analysis, *Trapa natans* plays the most important role and can be coupled with the first component. Its abundance is the highest on the right side of the graph, and one relevé is separated on the left as being practically an open water stand. The distribution of the points along the second axis is influenced by several species with considerable abundance thus groups characterized with the occurrence of *Polygonum amphibium, Nymphoides peltata* and *Ceratophyllum demersum* are distinguished. The overlap among the groups is rather large at the right side that is due to the high abundance of *Trapa natans* (Fig. 5).

No relationship was found between the species composition and geographic position of the stands.

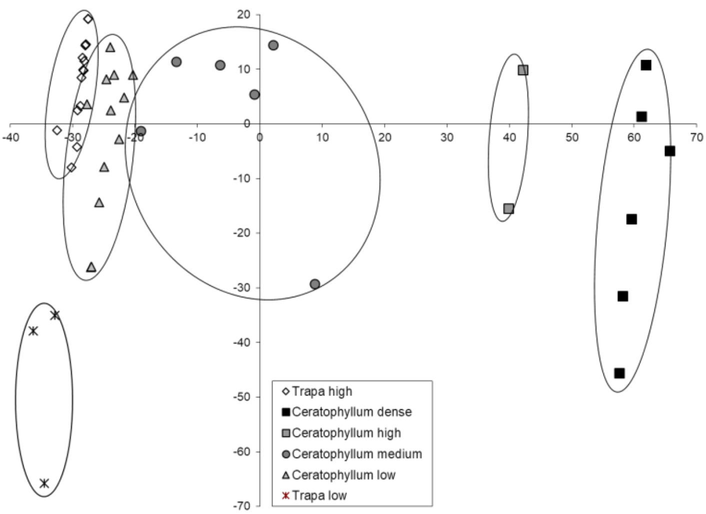

Fig. 4. PCA ordination of the samples (n=55) of *Trapetum natantis* community recorded on percentage scale (centered PCA.) *Trapa natans* is present and in most cases dominant in the relevés; *Ceratophyllum demersum* is not present in the plots marked with „*Trapa* high” and „*Trapa* low”.

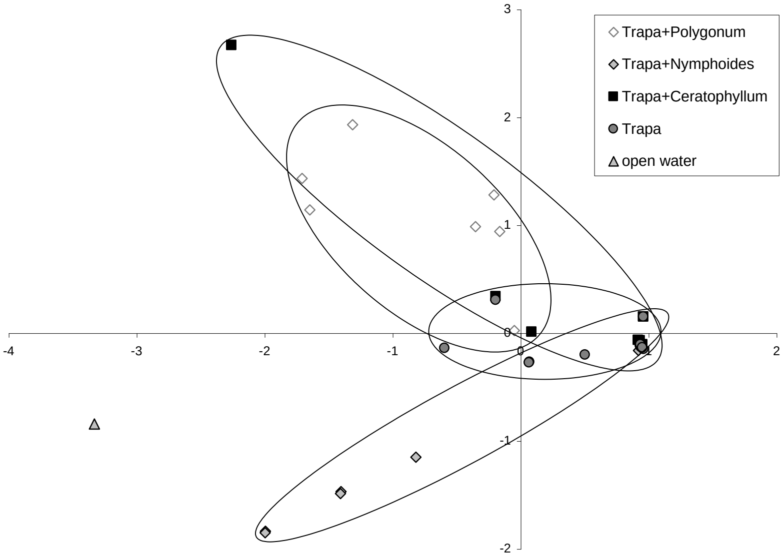

Fig. 5. PCA ordination of the samples (n=41) of *Trapetum natantis* community recorded on AD scale (centered PCA.) The relevés are distinguished according to the second most important species. The groups of relevés of similar character have considerable overlaps.

Acknowledgement

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IV. SMALL GALINGALE SWARDS – NANOCYPERETALIA KLIKA 1935

Balázs András Lukács, Béla Tóthmérész

The association order of small galingale sward vegetation consists of the West-, Central- and South-European mud associations. The main conditions for developing are short vegetation period, permanently humid mud and the absence of any perennial vegetation.

We can find excellent habitats around newly dried shores and shallows of the rivers, on rice fields and such kind of anthropogenic habitats as fisheries dried basin, and wheel-tracks. These habitats are characterised by continuous fluctuation of environmental factors and frequent disturbance which all can hinder the development of perennial vegetation. This kind of fluctuation is, for example, the annual oscillation of the water level that results a nitrogen poor sediment with unfavourable mechanical features. All of these effects determine the composition of the developing vegetation and only annual or ephemeral plants can survive in this habitat.

The research of the *Nanocyperion* associations has been neglected for a long time. The first relevés were made by botanists who carried out floristical researches along larger rivers. The small galingale swards are known from the publications of Timár (1947, 1948, 1950a, 1950b, 1954a, 1957a, 1957b), Ubrizsy (1948), Felföldy (1950), Fintha (1969), Bagi (1985, 1986, 1987a, 1987b, 1988a) and Molnár (2000a). Detailed studies were published by Bagi (1985, 1986, 1987a, 1987b), who dealt with the structure, dynamics, succession and classification of these associations. After the great floods of Tisza River in 1998, Molnár (1999a, 1999b, 2000b, 2000c, 2001) and Farkas (2001) published floristic data and some relevés about *Nanocyperion* communities.

The species composition of the relevés (see Appendix page 167) did not differ from that published in the literature. Categorization of the stands into exact associations was difficult, because the species compositions were similar and the most comprehensive Hungarian literature (Borhidi 2003) did not publish reference relevés. Furthermore, it was difficult because most of the relevés were made to demonstrate the preference of a particular species, and not to document an average and/or typical habitat. Hence, majority of the relevés were dominated by one of the pioneer species, while the other species occurred as subordinate ones. Therefore, it was hard to decide which association, facies or consociation did a given relevé belong to (see Fig. 1).

According to the relevés made on the Tisza valley, 32 % of these habitats was covered by natural pioneer species. From the floristical elements point of view, the widespread eurasian (28.7 %), cosmopolitan (29.4 %) and circumpolar (33.3 %) elements dominate this community (Fig. 2). Because of the heterogeneity of the sediment and the occasional evaporation or carbonate accumulation it may also develop on nitrogen and nutrient rich sediments, dominated by different species. These features suggest that *Nanocyperion* associations have an azonal character. However, the edafic and climate dependences are evident on the level of the stands due to specific ecological demands of the species.

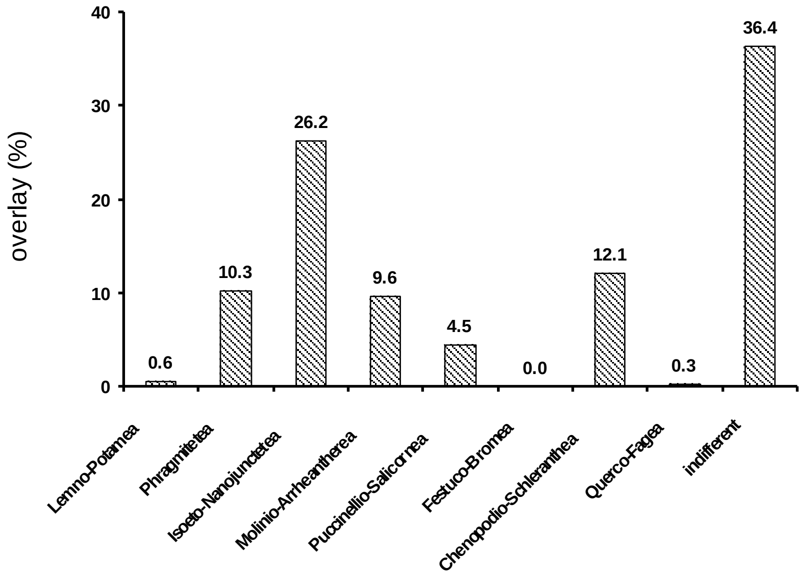

Fig. 1. Distribution of coenosystematic categories in the *Nanocyperion* relevés along River Tisza based on the percentage cover.

With the use of the social behaviour types (Borhidi 1996) we can detect that the native elements are the most frequent; this indicates high naturalness of the relevés. Because *Nanocyperion* communities are pioneer associations the natural pioneer species dominated (32 %) the relevés. In addition, the stress tolerant generalists (16.5 %), disturbance tolerant species (15.8 %) and native weeds (17.8 %) were the most frequent in the plots.

According to Borhidi (2003), *Nanocyperion* stands have low vegetation cover, they are relatively species poor. Relevés made along River Tisza showed the following features: average plant cover was 45 % and species number ranged from 3 to 29. The coverage of the individual species was rather low. Typically the plants formed small tussocks and prostrate shoots.

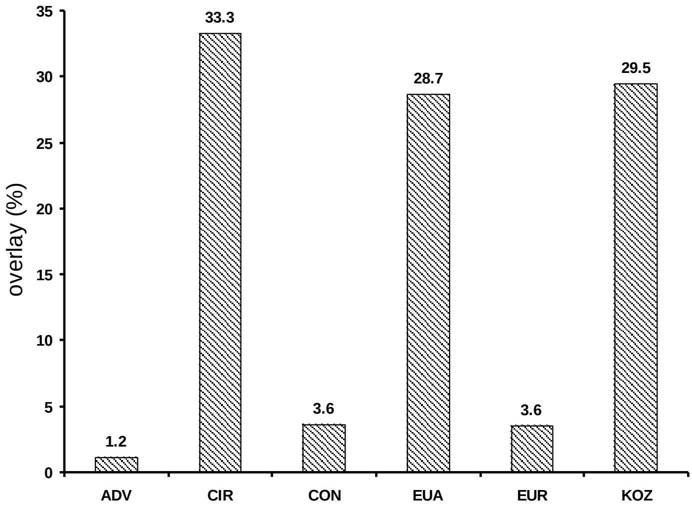

Fig. 2. Distribution of the floristic elements in the *Nanocyperion* relevés along River Tisza based on the percentage cover.

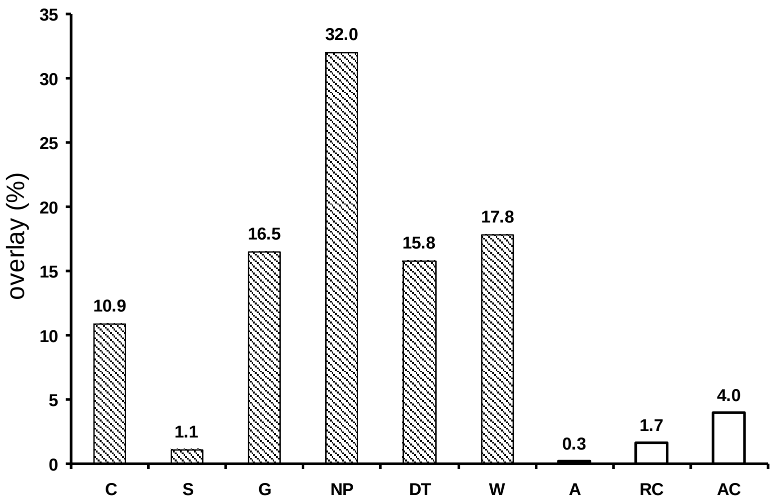

Fig. 3. Distribution of the social behaviour (Borhidi 1995) types in the *Nanocyperion* relevés along River Tisza based on the percentage cover (invasive species with white columns).

Most of the species had specifically low (I-III) constancy value (see Appendix page 167), higher values were very rare. The highest constancy values (IV-III) along the Tisza-River were recorded in the case of the following species: *Agrostis stolonifera, Cyperus fuscus, Echinochloa crus-galli, Persicaria lapathifolia*. Characteristic species were with lower (II) constancy: *Alisma plantago-aquatica, Amaranthus lividus, Atriplex oblongifolia, Bidens cernua, Bidens tripartitus, Carex serotina, Chenopodium album, Chenopodium polyspermum, Chenopodium rubrum, Cyperus michelianus, Eleocharis ovata, Gnaphalium uliginosum, Juncus articulatus, Juncus buffonius, Leersia oryzoides, Lycopus europeaus, Lythrum virgatum, Plantago major, Ranunculus sceleratus, Rorippa sylvestris, Rumex crispus, Rumex stenophyllus, Tanacetum vulgare, Typha latifolia, Xanthium italicum.*

Nanocyperion habitats became very scarce by this time. With the decrease of the former intensive rice-cultivations and with the drainage of the rainwater and inland inundations their habitats were drastically ebbed away, reducing considerably the survival of several rare species. Important data from the relevés along the River Tisza were the occurrence of *Elatine* species (*E. triandra, E. hungarica, E. alsinastrum, E. hydropiper*), *Carex bohemica, Eleocharis carniolica, E. ovata.* These species were extremely rare all across the country; therefore, their frequency in the relevés overestimates their real occurrence frequency.

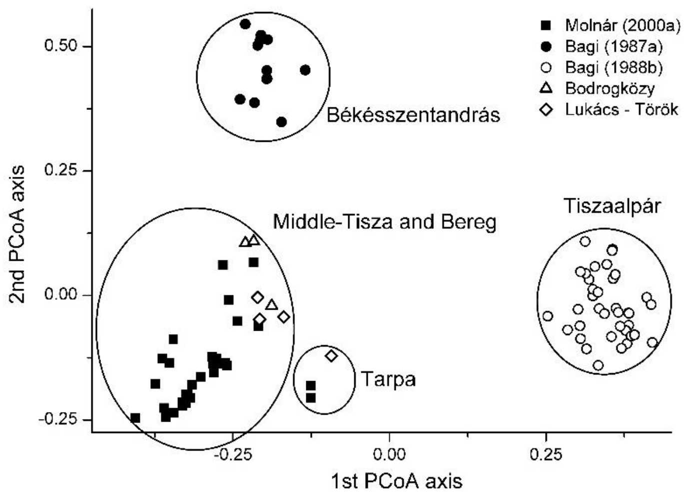

Fig. 4. Ordination of the relevés (PCoA) with Bray-Curtis similarity (n=87) based on the percentage cover. Symbols denote the botanist responsible for the relevés; circles indicate the geographic location of the relevés.

With the ordination of the relevés (Fig. 4) we could distinguish rather separated groups only on the basis of their geographic distribution. This distribution did not coincide with the group of authors responsible for the relevés.

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V. REED BEDS – PHRAGMITETALIA

Orsolya Szirmai, Zoltán Tuba, László Körmöczi

General description

Reed bed communities spread from the area of the Mediterranean Sea to Southern Scandinavia. They occur at the margins and floating rafts of lakes, rivers, and brooks and at fens and eutrophic marshes. One of the characteristic features of the community is that its habitat is flooded at least for a certain part of the vegetation period. This community is a relatively species poor. The stands are usually dense and tall; this physiognomy is influenced by strong competition and clonal growth of the edificator species. The ecological requirements of the community depend on the dominant species (Borhidi 2003).

V.1 *Glycerietum maximae* (Hueck 1931)

The association was described by Hueck in 1931 (Hueck 1931).

Habitat conditions

This community that favours the fluctuating oxigen-rich water appears primarily along the edges of lakes, oxbow lakes, slowly flowing ditches. It is tolerant of flooding and drought but sensitive to trampling. The community can be found on the watercourse zone of eutrophic waters between reed beds and large sedge communities. It replaces reed beds in strongly fluctuating waters (Borhidi 2003). Sometimes it forms stands on moving rafts e.g. in Navat stream. It can be initial state of floating mire succession (Nagy 2000, Szurdoki and Nagy 2002, Nagy *et al.* 2007).

Characterization of stands along River Tisza and its tributaries

On the basis of 34 relevés recorded along river Tisza (for details see Appendix page 171) the following results were obtained on the species composition of the community: in general it consists of a single layer but sometimes is a two- or three-layered community. The uppermost layer is formed by emergent species rooted in mud or sand, floating species with thiny rhizoshpere form the next layer and submerged species form the lowest one.

The uppermost layer is dominated by *Glyceria maxima* accompanied by several swamp species as *Sparganium erectum, Polygonum amphibium, Alisma plantago-aquatica, Carex gracilis, C. riparia* or *C. elata*. Sometimes *Lemna minor,* *L. trisulca* and *Salvinia natans* form free-floating layer. The submerged layer is formed by *Ceratophyllum submersum* and *Utricularia vulgaris*. Contrary to the literature (Borhidi 2003), dominant and characteristic species of other communities like *Trapa natans* may occur in the relevés along Tisza because of the mosaic structure of the vegetation.

Protected *Salvinia natans* can be found in the stands of Lake Bence, Kengyel- and Óbodrog-oxbow-lakes, while *Marsilea quadrifolia* occurs only in the latter site.

Spatial difference can be observed in the number of layers of the stands and in the rate of additional species. Free-floating layer can be found in the stands at Navat stream, Lake Bence, Kengyel- and Óbodrog-oxbows which is dominated by *Salvinia natans, Lemna trisulca* and *L. minor* and accompanied by *Spirodela polyrrhiza, Hyrocharis morsus-ranae*, and only in the last stand *Marsilea quadrifolia.*

The submerged layer is formed by *Ceratophyllum submersum* in one of the relevés recorded at Navat stream, while in those of Kengyel- and Óbodrog-oxbows it consists of *Utricularia vulgaris* which occurs in the latter stand with only 0,1 % cover value. Other additional species are the elements of swamps, reed vegetation and large sedge communities. It is worth to mention that at certain sites of Navat stream *Eriophoro vaginati-Sphagnetum* Soó (1927) 1954 *oxycoccetosum* was the preceding community (Nagy *et al.* 1999).

Multivariate statistical analysis

Relevés recorded on percentage scale were analysed with centred principal component analysis. On the basis of the eigenvalues, 5 components are responsible for 94,49 % of the total variance. On the ordination scatterplot (Fig. 1) one large and two smaller groups can be distinguished that are separated along the first axis by the dominance of *Lemna triscula* and *L. minor*, and along the second axis by *Urticularia vulgaris, Spirodela polyrrhiza* and *Salvinia natans*. *Glyceria maxima* was not determinant as it was present in each relevés with considerable coverage. Most of the relevés of group A are similar in species composition, they have no dense free-floating layer and the accompanying species are mainly swamp and reed vegetation elements. In the free-floating layer of group B, *Lemna triscula* is dominant (80-100 %) forming a facies. Elements of group C, all are the relevés of Kengyel-oxbow, can be distinguished as *utricularietosum vulgaris*-subassociation. The free-floating layer is very dense and consists of *Lemna triscula* and *Salvinia natans*.

The groups on the ordination plot (Fig. 1) do not fit the distinguished Tisza sections. The composition and number of accompanying species show certain differences within the groups, but this phenomenon did not result the separation of units. Free-loating species were found only in two units (Lakes of Bereg, Bodrog-oxbows): *Hydrocharis morsus-ranae, Lemna minor and trisulca, Salvinia natans* and *Spirodela polyrrhiza*. Occurrence of accompanying species can be explained by the species-pool and physiognomy of neighbouring communities.

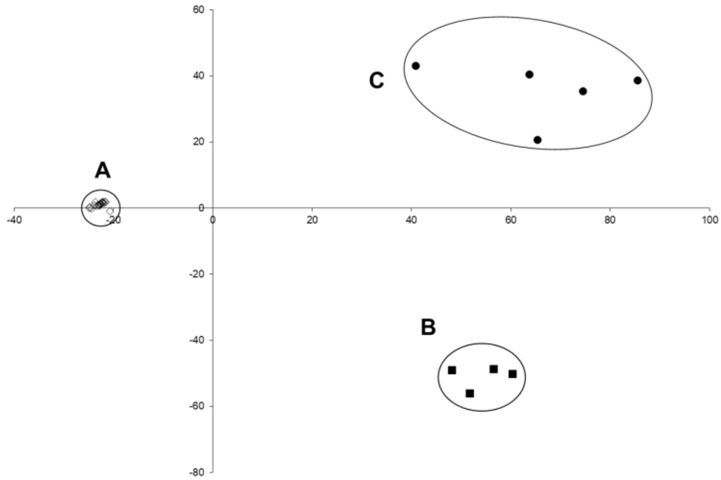

Fig. 1. PCA ordination of the samples (n=33) of *Glycerietum maximae* community recorded on percentage scale (centered PCA; for the explanation of the legends see text).

V.2 *Phragmitetum communis* (Soó 1927 em. Schmale 1939)

Syn.: *Scirpo-Phragmitetum* Koch 1926, *medioeuropaeum* Tx. 1941, *Phragmitetum communis*

The community was described by Soó in 1927 and then Schmale modified the description in 1939 (Borhidi 2003).

Habitat conditions

The stands of reed bed community can be found in the zonation of lakes in mountain region and plains and in the edge of bogs and mires. The surface water cover is generally permanent or may be missing if the thickness of rafts is 2 m or greater.

This community may be present in several types depending on the habitat type (sublitoral sedimentation area) and the type of water bodies (eutrophic, mesotrophic) which is indicated the variable species composition. The vegetation of the stands in oligotrophic habitats is sparse with many species while in eutrophic parts dense, species-poor stands are formed. In the moderately alkaline waters the occurrence of reed is growing against the other elements of reed beds. The terrestrial stands of sediment zone are more species-rich than those standing in water (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

Along river Tisza, 50 relevés have been gathered. Tventy two relevés were recorded on percentage scale from 5 stands and 28 recorded on AD scale from 26 stands; date of sampling: 1944-2005. Reed community can be considered as a multilayer association-complex. The uppermost layer is dominated by *Phragmites australis*; *Schoenoplectus lacustris, Typha angustifolia* and *T. latifolia* can associate to it. Close to the banks, swamp species are also characteristic such as *Calystegia sepium, Lycopus europaeus, Lythrum salicaria, Stachys palustris*. The free-floating *Lemna* species, *Spirodela polyrrhiza* and sometimes *Salvinia natans* form continuous carpets in less dense patches of reed. In some cases the species of the frogbit rafts may occur, for example *Hydrocharis morsus-ranae* or *Stratiotes aloides*. In the submerged layer, *Ceratophyllum demersum* and *Najas marina* can be present.

From among the protected species, *Salvinia natans* occurred in the samples of Kengyel-oxbow and Lake Tisza (Tiszavalk, Sarud, Abádszalók), *Nymphoides peltata* was present only in the stand at Sarud. *Clematis integrifolia* and *Leucanthemella serotina* were present in the stands of Maros valley.

Phragmites australis is dominant in each relevé. *Lemna* species and *Glyceria maxima* are the next most abundant. In one stand, *Festuca peudovina* is co- or subdominant. Further differences can be seen in the strata of the samples.

The historical samples recorded on AD scale do not differ significantly from the recent samples. Subordinate occurrence of certain floodplain-wood species, for example *Salix alba, S. triandra, S. viminalis, Alnus glutinosa* and even invasive elements like *Amorpha fruticosa* indicate minor difference. In certain sites along river Maros, other species may become dominant such as *Lysimachia nummularia, Schoenoplectus lacustris, Typha angustifolia.* Later species may form consociation.

Multivariate statistical analysis

On the basis of the eigenvalues, 4 components proved to be important, they accounted for 95.77 % of the total variance of data. The objects do not show clear cut aggregations in connection with the river sections. The distribution of the objects on the scatterplot (Fig. 2) is determined by the cover values of *Phragmites australis, Glyceria maxima* and *Festuca pseudovina* along the first axis, and of *Lemna minor* and *Lemna trisulca* along the second axis. The dominance of *Phragmites australis* grows from the left to the right along the first axis. Considerable occurrence of *Glyceria maxima* and *Festuca pseudovina* is associated with the lovest cover values of *Phragmites australis.* The two *Lemna species* are connected with the second axis: larger second axis scores are connected with larger cover values of duckweed species. Cover range of *Lemna trisulca* is much wider than that of *L. minor*.

Centred PCA ordination of data (Fig. 3) recorded on AD scale resulted in a considerable number of components responsible for the total variance; ten components accounted for 76.8 %, and 20 components for 95.7 % of the variance. The objects did not show clear aggregation, those belonging to river Tisza and river Maros did not separate, neither the objects from different river sections. The distribution of the points is determined again by the abundance of *Phragmites australis* along the first axis, and by that of *Lemna minor* and *Typha angustifolia* along the second axis.

The stand of Fokköz forest clearing is special, because the cover value of *Phragmites australis* is low but co- or subdominant *Festuca pseudovina* is facies forming. Beside the former taxa the following species are only present in Fokköz stand: *Achillea collina, Artemisia pontica, Centaurea pannonica, Lotus corniculatus, Peucedanum officinale, Stellaria graminea, Veronica spicata* indicating drier habitats. In the relevés of lower Tisza section (Szolnok-southern border), *Elymus repens, Agrostis alba, Calamagrostis epigeios, Lysimachia nummularia, Rubus caesius* have higher cover values that should indicate the degradation of the area. The species composition in the Maros valley is the most diverse, several weed species can be found there like *Aristolochia clematitis, Artemisia vulgaris, Cynodon dactylon, Echinocloa crus-galli*, but protected taxa are also recorded like *Leucanthemella serotina, Clematis integrifolia.*

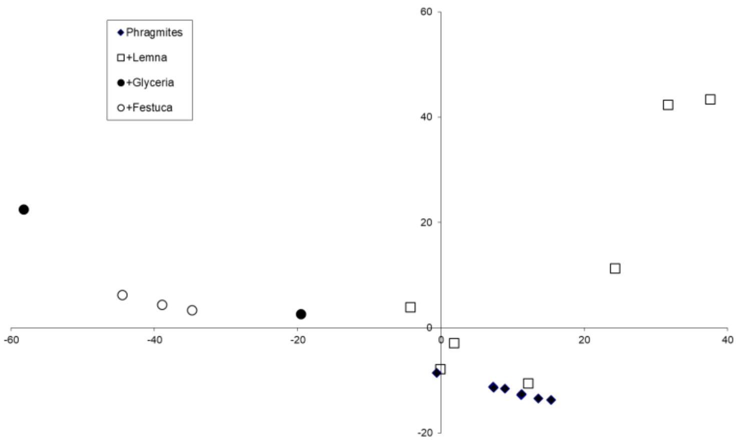

Fig. 2. PCA ordination of the samples (n=22) of *Phragmitetum communis* community recorded on percentage scale (centered PCA). The distribution of the relevés is determined by the increasing abundance of *Phragmites australis* and by the subdominant species.

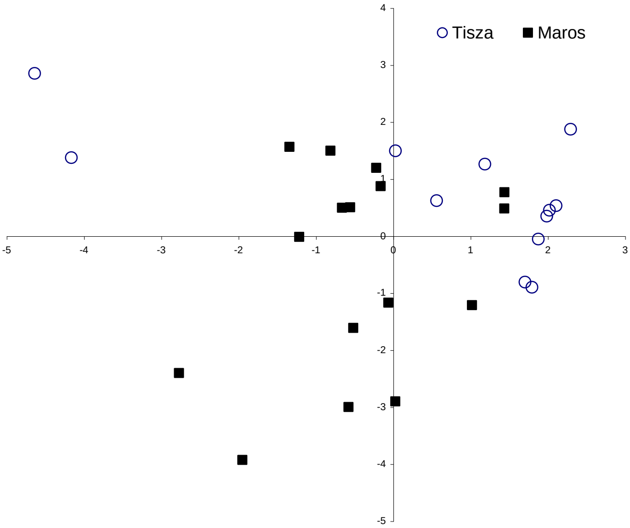

Fig. 3. PCA ordination of the samples (n=28) of *Phragmitetum communis* community recorded on AD scale (centered PCA)

V.3 *Sparganietum erecti* (Roll 1938)

The community was described by Roll in 1938 (Roll, 1938). Soó (1964) did not mention the name of the community, only that of a related one (*Sparganietum minimi hungaricum*) but with doubt. In certain cases it was treated together with *Sparganietum neglecti* Br.-Bl. 1925 em. Philippi 1973 (Rennwald, 2000).

Habitat conditions

Stands of neglected bur-reed communities usually appear on submediterranean plains along lakes, oxbow lakes and slowly flowing waters. This community is typical in oxygen-rich, eutrophic waters where thick sapropel is formed. The stands of this community are fragmented on disturbed bank areas (Borhidi 2003).

Characterization of stands along River Tisza and its tributaries

Twenty seven relevés from 10 stands were recorded on percentage scale and 1 relevé on AD-scale along river Tisza. Data were recorded between 1962 and 2005 (cf. Appendix page 181). It can be concluded from the data that this community can generally be characterised by a single layer, but sometimes it consists of two or three layers. In the uppermost layer emerging plant species are present like *Sparganium erectum, Glyceria maxima, Alisma plantago-aquatica, Sagittaria* *sagittifolia*. The next layer is formed by free-floating species, and under them submerged species occur forming the lowermost layer. The relevés are mainly dominated by *Sparganium erectum*, but floating and rooting hydrophytes also associate with it such as *Lemna minor*, *Spirodela polyrrhiza, Hydrocharis morsus-ranae, Salvinia natans, Nymphaea alba, Nuphar lutea. Glyceria maxima* is subordinate and not very frequent species of this community. Contrary to the literature (Borhidi, 2003), submerged species like *Myriophyllum spicatum, Cerathophyllum demersum* may occur in the community even with considerable coverage.

From among the protected species, *Marsilea quadrifolia* and *Trapa natan*s were present in the stands near Pallagcsa-meadow, Óbodrog- and Kengyel-oxbows. *Salvinia natans* occurred in the stands at Lake Bence, Pallagcsa-meadow, Óbodrog- and Kengyel-oxbows and Tiszaalpár in 1982. *Nymphoides peltata* and *Nymphaea alba* were present in the samples recorded at oxbow lake of Tiszaalpár in 1982 and the latter one occurred in one of the samples in 1962.

The difference among the stands is manifested in the number of vegetation layers and in the rate of dominant and accompanying species. *Sparganium erectum* is dominant in the majority of the relevés. Free-floating species such as *Riccia flutans, Spirodela polyrrhiza, Lemna trisulca, Salvinia natans, Marsilea quadrifolia* form facies in certain relevés.

Free-floating species are present in each stand, and they may be associated by large rooted hydrophytes as *Nuphar lutea* and *Trapa natans*. *Cerathophyllum demersum* frequently forms a submerged layer sometimes accompanied or replaced by *Utricularia vulgaris, Ceratophyllum submersum* or *Myriophyllum spicatum*. *Iris pseudacorus* performs a considerable coverage in the stand of Lake Bence.

Multivariate statistical analysis

Relevés recorded on percentage scale were analysed with centred principal component analysis. On the basis of the eigenvalues, 6 components proved to be considerable, they accounted for 91.8 % of the total variance. Three distinct groups of the objects could be recognized (Fig. 4).

In the distinction of groups the dominance of *Cerathophyllum demersum, Spirodela polyrrhiza* and *Riccia fluitans* plaid essential role, but also *Lemna trisulca* and *Marsilea quadrifolia* were important. The cover values of *Sparganium erectum* grow from the left to the right along the first axis. Most of the objects are distributed in one compact group, and two very distinct groups can be found on the scatterplot (Fig. 4). Relevés of group B are dominated by *Cerathophyllum demersum*, and those of group C by *Spirodela polyrrhiza* and *Riccia fluitans*. Larger cover values of *Lemna trisulca, Salvinia natans* or *Marsilea quadrifolia* in certain relevés did not affect considerably the distribution of the objects in group A.

In the relevé recorded on AD scale and which consists only of 4 species, *Nymphaea alba* is subdominant, and *Typha lathifolia* and *Phragmites australis* occur as accessory species.

No separation of the objects was observed on the basis of the position along the river valley. Though most of the relevés originated from the upper Tisza region and only one relevé from the middle Tiszan region, the regionality seems of secondary importance in the case of this community.

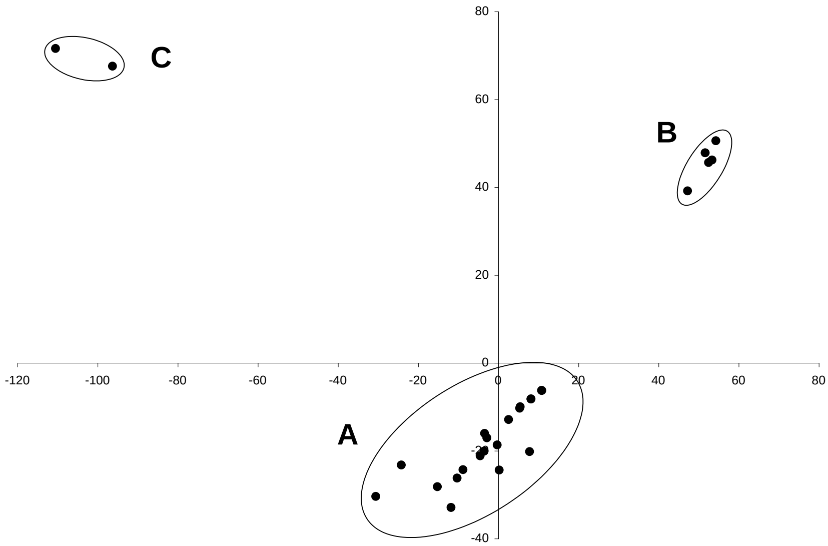

Fig. 4. PCA ordination of the samples (n=27) of *Sparganietum erecti* community recorded on percentage scale (centered PCA; for further explanation see text).

Acknowledgement

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VI. WATER DROPWORT-FLOWERING RUSH COMMUNITIES – OENANTHETALIA AQUATICAE

József Áron Deák

Historical review

The vegetation of medium-height waterside communities has been rather poorly investigated. Several associations and subassociatons of this order are specific for the Pannonian floral province, as their loci classici can be found here, therefore they are of great importance in respect of nature conservation and phytogeography. Many of these cenotaxa are named (e.g. Ubrizsy 1948: *Eleocharicetum palustris*, Máthé and Kovács 1967: *Alismato-Eleocharicetum*) or described (Soó 1928: *Oenanthe aquaticae-Rorippetum amphibiae*, Tímár 1947: *Butomo-Alismatetum lanceolati*) by Hungarian botanists for the first time. Along the river Tisza, these associations were studied firstly by Timár (1950) in the river-section Szolnok-Szeged. Later Bodrogközy (1990) carried out researches on these vegetation-types especially in the Bodrogzug. Recently Deák (2001) made coenological surveys in the Csongrád-Nagyrét nature reserve.

The cenological classification of floodplain swamps dominated by *Bolboschoenus maritimus* is not homogeneous (Bölöni *et al.* 2003), as the stands are classified into the group of „Water-fringing helophyte beds of Flowering rush, Spike-rush, Water-plantain, Fine-leaved water dropwort swamps" (B3) according to the Hungarian habitat classification system. According to the latest results, the *Polygono-Bolboschoenetum* and its subassociations – *typicum, oenanthetosum, Rumex conglomeratus* – described and surveyed by Bodrogközy in 1961 in Tiszafüred (Bodrogközy 1965) can also be classified into this habitat type. In the Vojvodinian Tisza river section, these communities are also named as *Scirpo-Phragmitetum bolboschoenetosum maritim*, where the appearance of *Bolboschoenus maritimus* is considered the consequence of salt-accumulation (Parabucski *et al.* 1989). The monodominant *Sagittaria sagittifolia* marsh is not yet described as an association, but its stands appear sporadically alongside the river Tisza at several places.

From among the associations classified into the Oenanthelia aquaticae order (Borhidi and Sánta 1999) *Eleocharicetum palustris* Ubrizsy 1948, *Alismato-Eleocharicetum* Máthé & Kovács 1967, *Oenantho aquaticae-Rorippetum amphibiae* (Soó 1928) Lohm. 1950, and *Butomo-Alismatetum lanceolati* (Tímár 1947) Hejny 1969 appear alongside the river Tisza. *Butomo-Alismatetum plantaginis-aquaticae* (Slavnic 1948) Hejny 1978 is known only from the region of river Danube whereas *Hippuridetum vulgaris* Pass. 1955 just alongside the rivers Drava and Danube.

The order is characterized by very fast and diverse dynamical processes, thus the abundance ratios given in the literature can often not be observed in the stands. The transitional types are very frequent, their abundance relations can change year by year. *Bolboschoenus maritimus* appears often in great proportion in the *Butomo-Alismatetum lanceolati* association. Other stands show transitions into *Caricetum gracilis*, floodplain high-weed communities, *Phragmitetum communis* or *Typhetum angustifoliae*. If they dry out fast, *Xanthium italicum* can attack them. If the water remains more permanent the coverage of *Alisma lanceolatum* can increase in *Butomo-Alismatetum lanceolati* association.

These communities are typical in the zonation of the backwaters (plesiopotamals) inside the dikes, but they can appear at the oxbow-lakes (paleopotamals) of the saved-side which could be converted arable lands but are covered by inland water during the spring. According to the surface water-coverage and the seasonal changes of the ground-water, certain species gradient may develop that influences the development of the associations, subassociations and their transitions. The members of this species-gradient are ordered as *Oenanthe aquatica – Eleocharis palustris – Alisma lanceolatum – Sagittaria sagittifolia – Butomus umbellatus – Bolboschoenus maritimus – Carex gracilis* – floodplain high-weed species (*Lythrum* spp., *Lysimachia vulgaris*) from the open water-surface to the littoral zone. Because of the annual changes of the water-regime, transitional and incomplete stands can be formed.

VI.1 *Eleocharitetum palustris* (Ubrizsy 1948)

Habitat-characteristics

This community was described from the channels of the rice-fields of Tiszántúl on alkali-sodic soils (Borhidi and Sánta 1999, Bölöni *et al.* 2003), but it can appear in smaller stands alongside the floodplain channels, in navvy-holes, in the littoral zonation of oxbow-lakes inside the dikes due to particular water regime, soil and water chemical conditions.

General features of the species composition

In general the monodominant *Eleocharis palustris* populations constitute the vegetation, but *Typha angustifolia*, *Alisma gramineum*, *Alisma lanceolatum* and *Schoenoplectus supinus* used to occur (Borhidi and Sánta 1999). Some reed-grass species such as *Najas minor* and *Zannichellia palustris* can also appear (Bölöni *et al.* 2003).

Differences of the stands

Alisma gramineum and *Schoenoplectus supinus* are considered as rarer species, their presence increases the nature conservation value of the stands.

Localities

Csongrád, Nagy-Gombás (Csongrád-Nagyrét Nature Reserve); Hódmezővásárhely, Ányási Holt-Tisza (Mártély Landscape Protection Area).

Further comments

It is often difficult to distinguish from the *Alismato-Eleocharitetum* as their features are similar.

VI.2 *Alismato-Eleocharitetum* (Máthé & Kovács 1967)

Habitat-characteristics

The stands of this community develop on flat floodplains inside the dikes, on fresh alluvium which is regularly flooded for a long period each year (Borhidi and Sánta 1999). Flood lasts until the beginning of summer, but after the fast drying-out the area remains wet during the summer and dries out completely at the end of summer. Small stands are widespread.

General features of the species composition

Beside the dominant *Eleocharis palustris, Carex gracilis, Ranunculus repens* and the moss *Drepanocladus aduncus* have greater coverage. Further characteristic species are *Carex vulpina, Gratiola officinalis* and *Lythrum hyssopifolia* (Borhidi and Sánta 1999, Bölöni *et al.* 2003). *Iris pseudacorus, Alisma lanceolatum, Butomus umbellatus* or even *Bolboschoenus maritimus* appear frequently in the South-Tisza Floodplain in this comunity.

Differences of the stands

After the ceasing of the floods, it can transform to a sedge-field (Borhidi and Sánta 1999), but depending on the flood dynamics many kinds of transition can be formed towards the *Butomo-Alismatetum lanceolati*, *Caricetum gracilis* or flood-plain *Bolboschoenus* marshes. The dynamics and dominance relations of this community may alter broadly year by year depending on the floods.

The stands that contain *Gratiola officinalis* and *Lythrum hyssopifolia* are rare therefore they have a major nature conservation values.

Localities

Navvy-holes on the Csongrád-Szeged Tisza-river section, Nagy-Gombás (Csongrád-Nagyrét Nature Reserve); Hódmezővásárhely, Ányási Holt-Tisza (Mártélyi Landscape Protection Area).

Furtehr comments

The coeno-taxonomical classification of the transitional stands is difficult.

VI.3 *Oenantho aquaticae-Rorippetum amphibiae* (Lohmeyer 1950)

Habitat-characteristics

The stands of this association develop on floodplain depressions (oxbow lakes, channels, navvy-holes) inside the dikes which dry out regularly in the summer and are filled with fresh alluvium of silt, sand and clay. The water of this habitat is rich in nutrients. The annual water-level fluctuation is great. This community can only colonize dry habitat patches (Borhidi and Sánta 1999, Bölöni *et al.* 2003).

General features of the species composition

In its typical development, the association has two layers. *Rorippa amphibia* and *Oenanthe aquatica* are often co-dominants, but the spring season used to be dominated by *Rorippa amphibia*, whereas in the late summer aspect *Oenanthe aquatica* is dominant. Frequent accompanying species are *Ranunculus sceleratus*, *Polygonum amphibium* and *Myosotis palustris* (Borhidi and Sánta 1999, Bölöni *et al.* 2003).

Differences of the sites

In case of improper water dynamics this vegetation may transform to its neighbouring habitats and associations: to sweet-grass swamps, sedge-fields (*Caricetum gracilis*), and *Bidention* or other associations classified into the *Oenanthetalia aquaticae* order.

Since this habitat is rather rare its stands have great nature conservation importance.

Localities

Csongrád, Nagy-Gombás (Csongrád-Nagyrét Nature Reserve), navvy-holes of the Csongrád-Nagyrét Nature Reserve, Keselyzugi Holt-Körös (in Szentes opposite to this nature reserve).

Further comments

In case of sudden early summer dry-out or more permanent aridity, the *Rorippa amphibia* dominated spring-ascpect can be transformed with occupation of floodplain ruderal species to a *Bidentalia* community by the autumn of that year.

VI.4 *Butomo-Alismatetum lanceolati* ([Tímár 1947] Hejny 1969)

Habitat-characteristics

The European distribution of this continental association is not known properly. It is typical in the littoral zone of shallow (10-20 cm deep), rapidly warming wetlands (navvy-holes, oxbow-lakes inside the dikes) with seasonal floods. It tolerates the slightly alkali-sodic soils, therefore it can appear in channels and archeopotamals of saline areas.

General features of the species-composition

The dominant species of the association is *Butomus umbellatus*, its most common accompanying species is *Alisma lanceolatum* but *Sparganium erectum* and *Sagittaria sagittifolia* are also frequent. Other species dominant in other associations of this order may also appear (e.g. *Eleocharis palustris*).

Differences of the stands

Those stands that are rich in *Carex gracilis* are transitional towards *Caricetum gracilis* sedge-fields. *Bolboschoenus maritimus* appears very frequently and may become co-dominant. Frequent accompanying species come from floodplain meadows, high-weed communities and sedge-fields (e.g. *Lysimachia vulgaris, Lythrum salicaria, Symphytum officinale, Mentha aquatica*).

The late-drying stands are open and have just a few species (*Sagittaria sagittifolia* should be more common here), in the autumn floodplain ruderal species (e.g. *Polygonum amphibium*) can appear.

It is a rare association, all the stands have very important nature conservation value.

Localities

Once it has covered great areas alongside the river Tisza before the regulation of the river-ways being a very typical association of the floodplains. Many of its earlier sites are extinct. Existing stands:

Szolnok, Scheftschik-rét
Szandaszőlős, Rákóczifalva: oxbow lake inside the dikes
Alpári-rét, Tiszaalpár (Kiskunság National Park)
Háromág, Búzás and Téfölös oxbow lakes of Bokros-puszta
Csongrád, Nagy-Gombás and Szakadás oxbow lakes (Csongrád-Nagyréti Nature Reserve)
Navvy-holes of Csongrád-Nagyrét Nature Reserve
Small patches in the navvy-holes of the Csongrád-Szeged river section
Körtvélyesi and Ányási Holt-Tisza, Hódmezővásárhely (Mártély Landscape Protection Area)
Hódmezővásárhely, Vajhát
Navvy-holes of Tápai-rét

Further comments

The transitions are frequent toward large sedges and *Bolboschoenus* dominated swamps.

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VII. TALL HERB COMMUNITIES – MOLINIETALIA

Orsolya Szirmai, Zoltán Tuba, László Körmöczi

General description

Tall herb communities grow on flooded areas along rivers, lakes and channels. These habitats can be characterized with the flooding in spring and the drought in summer, and the gley horizon in the soil developed as a consequence of the intensive movement of soil water table. The latter may cause also the salinization of the soil.

The overuse of the areas (grazing, mowing) degrades the communities by decreasing of the proportion of natural generalists and specialists and increasing weed species (Borhidi 2003).

VII.1 *Carici vulpinae-Alopecuretum pratensis* (Máthé & Kovács M. 1967 Soó 1971 corr. Borhidi 1996)

Habitat conditions

Although this community is a characteristic mesotrophic wet meadow located on lowlands but it also occurs in the wide valleys of the Hungarian Northern Mountain Range. The habitats are the regularly flooded areas of riverbeds and other mineral- and phosphate-rich permanently or frequently flooded areas. This community can be formed on loamy soil or meadow soil (Borhidi 2003).

Characterisation of the stands along Tisza and its tributaries

Alltogether 189 relevés of sedge community could be found that were taken along the rivers Tisza, Hármas-Körös and Maros. For details see Appendix page 187. Collected data demonstrated that this community has often two layers – the upper layer consists of tall grasses (*Alopecurus pratensis, Arrhenatherum elatius, Carex* sp.) while dicotyledons (e.g. *Lotus corniculatus, Potentilla* spp.) and smaller monocotyledons (e.g. *Festuca pseudovina*) can be found in the lower layer. The community is dominated by *Alopecurus pratensis. Carex vulpina* occurs only in a few relevés recorded on percentage scale with low abundance as an accompanying species and is not listed in the records on several occasions at all. The most frequent accompanying species slightly differ from the literature data (Borhidi 2003): *Ranunculus repens, Iris pseudacorus, Carex melanostachya, Lythrum virgatum, Lythrum salicaria, Lysimachia vulgaris, Potentilla reptans, Ranunculus acris, Carex hirta, Lotus corniculatus, Lychnis flos-cuculi, Galium rubioides*. The distribution of the weed species like *Cirsium arvense, Inula britannica, Lamium purpureum* indicates certain degradation processes. The number of accidental and xerophilous elements (e.g. *Achillea collina, Carex stenophylla, Galium verum*) is rather high compared to that of community description (Borhidi 2003). The presence of the numerous taxa with different ecological requirements should be caused by the strong annual and seasonal fluctuation of the water table. This phenomenon can be justified with the occurrence of xerophilous grassland species mentioned above and swamp elements like *Alisma plantago-aquatica, Symphytum officinale, Juncus compressus, Euphorbia lucida.*

The relevés made along Tisza on percent scale can be characterized with the dominance of *Alopecurus pratensis*. The most frequent additional species are: *Galium verum, Elymus repens, Potentilla reptans, Carex distans, Carex stenophylla, Carex praecox, Agrostis alba, Carex hirta, Poa pratensis, Festuca pratensis, Arrhenatherium elatius, Vicia hirsuta, Carex melanostachya, Phalaris arundinacea, Ranunculus repens, Iris pseudacorus.*

One of the relevés of Lake Nyíres (which is totally degraded) differs from the average in the section of North-Eastern border and Tokaj as *Alopecurus pratensis* is not present in the relevé and is replaced by the dominant *Poa angustifolia* and *Tanacetum vulgare*. The latter species refers to the xerophilous, disturbed feature of the sampling area. During the 20th century, most of the semi-natural meadows of Bereg-mires have been cut off and were put in cultivation (Nagy *et al.* 2003). At the area of Tokaj-Szolnok section in the relevé of Sarud, *Drepanocladus aduncus* covers the entire soil surface (the cover value is 100 %). The cover value of *Alopecurus pratensis* is lower but that of *Eleocharis palustris* and *Lythrum virgatum* is higher than the average. In the relevés of Jászapáti and Jásztelek, *Carex distans* and *Carex praecox* are dominant. In the relevés recorded along the River Maros near Bezdin and Semlac, *Alopecurus pratensis* is not present or has lower cover values and the stands are dominated or co-dominated by *Carex hirta, Festuca pratensis, Agrostis alba* or *Carex vulpina*. In the relevés along river Maros, *Galium verum* is dominant which refers to a drier and more degraded state.

In most of the relevés recorded on AD scale along river Tisza, *Alopecurus pratensis* is dominant or co-dominant, and further frequent species are: *Lysimachia nummularia, Lamium purpureum, Poa angustifolia, Potentilla reptans, Trifolium repens, Ranunculus repens, Galium rubioides, Agrostis stolonifera, Symphytum officinale, Taraxacum officinale, Glycyrrhiza echinata, Lotus corniculatus, Lythrum virgatum.*

The relevé recorded at Kisar is polidominant. It differs from the average of the section of North-Eastern border—Tokaj since *Ajuga reptans, Anthoxanthum odoratum, Leucanthemum vulgare* ssp. *vulgare, Lysimachia nummularia* and *Poa pratensis* are the dominant taxa. *Ranunculus acris* is dominant in the relevé at Vásárosnamény, and in the relevés at Tiszaadony-Tiszakerecsend *Agrostis stolonifera* as well. *Alopecurus pratensis* has rather low cover in the later site. In the section between Tokaj and Szolnok in one relevé near Tokaj, *Agrostis stolonifera* and *Eleocharis palustris* are codominant and *Alopecurus pratensis* is subordinate. In this region some of the relevés are co-dominated by *Agrostis stolonifera, Cichorium intybus, Equisetum arvense, Poa angustifolia, Ranunculus repens, Rorippa sylvestris, Taraxacum officinale. Alopecurus pratensis* is subordinate again. In one of the relevés in the Szolnok-Southern border section, the cover value of *Alopecurus pratensis* is low. In another relevé of the same section at Nagyrév, *Alopecurus pratensis* is replaced by *A. geniculatus* that refers to a permanent water cover.

The protected species of the community in certain localities are the following: *Aster punctatus* – Cserőköz; *Clematis integrifolia* – Tiszafüred, Apátfalva, Gyügérzug and in the stands on the west from it, Makó, Maroslele, Maroslele-pasture, Tápérét; *Gentianella ciliata* – Tiszafüred; *Lathyrus palustris* – Kisar, between Tokaj and Szolnok; *Leucanthemella serotina* – Tiszaalpár, Lake Nyíres, Mártély, Szolnok-southern border; *Leucojum aestivum* - Makó, Maroslele; *Orchis laxiflora* ssp. *palustris* – Tőserdő.

Multivariate statistical analysis

Relevés recorded on percentage scale were analysed with centred principal component analysis. On the basis of the eigenvalues, 10 components accounted for 85.8 % of the total variance of data (due to the large number of species). The separation of the points on the scattergram (Fig.1) is not very clear-cut. Points scattered along the first axis belong mainly to river Tisza and those along the second axis belong mainly to river Maros. On the other hand, the two directions of the range of points should be attributed to the cover values of the two dominant species. The dominance of *Alopecurus pratensis* increases along the first axis from the left to the right, this species associated with the first component. The cover value of *Galium verum* decreases from the top to the bottom along the second axis, and this species can be associated with the second component. In certain relevés the cover of *Alopecurus pratensis* is quite low (0-5 %), it is absent form certain relevés or is present as a subordinate species. The co-dominance of the two species is very rare.

The relevés characterized by the absence or low dominance of *Alopecurus pratensis* are dominated by *Carex hirta, Festuca pratensis, Arrhenatherum elatius, Poa angustifolia* or *Elymus repens*. The relevé with the dominance of *Cirsium arvense* was probably recorded in a degraded patch of the study area and this sample indicates the inhomogeneity of the stand. It is interesting that in one of the separated samples *Drepanocladus aduncus* forms facies.

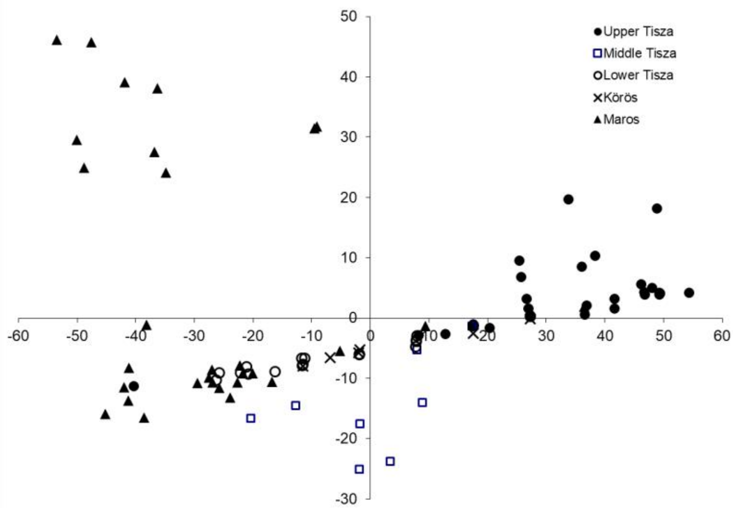

Fig. 1. PCA ordination of the 90 relevés of *Carici vulpinae-Alopecuretum* community recorded on percentage scale (centered PCA). Separation of the points is mainly due to the position along the rivers.

Relevés recorded on AD scale seem much more homogeneous on the basis of the ordination. The original AD values were converted according to van der Maarel (1979) prior to the analysis. The relevés were analysed with centred principal component analysis again. On the basis of the eigenvalues, 15 components accounted for 74,7 % of the total variance; the number of species was large again. It can be summarized that no definite grouping of the objects can be recognized at the scatter diagram therrefore the diagram is not presented.

The above examples refer to the wide tolerance of *Alopecurus pratensis* because the occurrence of this species ranges from xerophilous grasslands to marshmeadows.

Examining the distribution of social behaviour types (SBT; Borhidi 1999) of the species groups on the basis of the data from the last 50 years, the proportion of specialist with low tolerance did not change considerably between the earlier (AD scale data) and later (% scale data) records (Table 1). More specialist species were found in the lower section and less in the upper section of Tisza and no specialist was found along river Maros. The proportion of the competitors grew in the middle and upper sections of Tisza while decreased in the lower section and along Maros.

Table 1. Percentage distribution of social Behavior Types in the relevés along River Tisza and Maros (between1958-2006)

	Upper Tisza/North-Eastern border-Tokaj/		Middle-Tisza /Tokaj-Szolnok/		Lower-Tisza /Szolnok-Southern border/		Maros	
	AD	%	AD	%	AD	%	AD	%
S	4	3	5	3	4	5	4	
C	7	8	9	18	12	7	8	5
G	27	32	31	13	29	28	25	18
NP	5	1	3		3	3	2	2
DT	42	39	34	42	33	38	38	43
W	11	10	15	11	12	14	18	21
I			2	3				
RC	2	6	1	8	4	5	4	7
AC	2	1	1	3	2	1	2	3
n	106	38	88	94	118	155	113	108

S (+6):	Stress tolerant specialists of narrow ecological range
C (+5):	Natural competitors, dominant species, which are able to stabilize the composition and functioning of the community over a longer period and preserve the structure and basic characteristics of the community from strange effects for a longer time
G (+4):	Stress tolerant generalists, species of wide ecological range or tolerance living in natural plant communities, mostly perennials, do not tolerate anthropogenic disturbance
NP (+3):	Natural pioneers, important resilience factors, important means of the rehabilitation processes
DT (+2):	Disturbance tolerants, generally pioneer elements of the secondary successions mostly perennials of roads and banks
W (+1):	Weeds, members of plant communities living on artificial habitats or those heavily disturbed by frequently long lasting anthropogenic influence
I (-1):	Introduced alien species
RC (-2):	Ruderal competitors, dominant or type-forming weeds able to transform the habitat and modify the successional trend
AC (-3):	Aggressive alien species or invadors
n	number of species

Number of generalists decreased everywhere except for Upper Tisza. Number of the natural pioneers did not change considerably at the Lower Tisza and along Maros, it decreased at Upper Tisza and they disappeared from the middle section. The number of natural disturbance-tolerant species increased everywhere, except for Upper-Tisza. The natural weed species were present in a quite great number in the newer relevés except for Middle-Tisza, where invasive species were found. The number of ruderal competitors increased everywhere; it was the most serious in the region of Middle-Tisza. The number of invasive species decreased at Upper and Lower Tisza but increased in the Middle Tisza region and along Maros.

Summarizing the results, we can see that in the recent samples (recorded on % scale) fewer sensitive competitor and generalist species occur while the number of disturbance tolerant, weed species is higher thus a certain kind of degradation can be observed comparing to the earlier samples (made on AD scale).

Further on, it can also be stated about the samples along Tisza and mainly along Maros that the ratio of swamp elements (like *Symphytum officinale, Juncus compressus, Euphorbia lucida*) decreased that refers to the desiccation and degradation of the habitats. As the relevés cover a long period of time the observed differences for example the appearance of xerophilous grassland species may be the consequence of climatic changes.

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VIII. PANNONIC SALINE MEADOWS — SCORZONERO-JUNCETALIA GERARDII

Balázs Deák, Orsolya Valkó, Béla Tóthmérész

***Beckmannion eruciformis* Soó 1933**

Introduction

Alkali grasslands and marshes are typical in continental climate, at sites with at least moderate soil salt content and dynamic changes in water regime (Deák *et al.* 2014a, Eliáš *et al.* 2013, Valkó *et al.* 2014). Alkali landscapes of the Pannonian biogeographical region are considered as the westernmost occurences of the Eurasian steppes (Dengler *et al.* 2014, Wesche *et al.* 2016). With an extension of more than 210,000 hectares they represent the most continuous salt-affected landscape in continental Europe (Deák *et al.* 2014a). These landscapes hold an extremely high habitat diversity with numerous associations which form a complex mosaic structure even at a very fine-scale (Deák *et al.* 2014a,b,c, Eliáš *et al.* 2013, Török *et al.* 2012).

Alkali meadows are typical elements of the alkali landscapes. There are two major types of alkali meadows characterised by marked differences in the soil properties of the habitat (Borhidi *et al.* 2012). On solonetz soil the order of Beckmannion eruciformis Soó 1933, on solonchak soil the order of Scorzonero-Juncion gerardii (Wendelberg. 1943) Vicherek 1973 is typical. In this chapter we discuss the solonetz type, because this type is typical along the river Tisza and its tributary streams. Solonetz meadows are widespread on the alkali soils of the Great Plain (Deák *et al.* 2014a). They can be found in a great extent in Borsod, Heves, Hortobágy, Nagykunság, Jászság and Körös-vidék regions. The order Beckmannion eruciformis Soó 1933 is related to Festuco–Puccinetalia Soó 1968, Bolboschoenetalia maritimi Hejny 1967, Molinietalia Koch 1926 and to the Peucedano officinalis–Asterion sedifolii Borhidi 1996 orders regarding site characteristics and species composition (Borhidi *et al.* 2012, Deák *et al.* 2014b,c, 2015). The three most widespread associations of solonetz meadows are *Agrostio stoloniferae–Alopecuretum pratensis* Soó 1933 corr. Borhidi 2003, *Agrostio stoloniferae–Beckmannietum eruciformis* Rapaics ex Soó 1930 and *Agrostio stoloniferae–Glycerietum pedicellatae* Magyar ex Soó 1933 corr. Borhidi 2003.

The solonetz meadows are tall grass meadows, which are covered by shallow water from early spring even to midsummer. From June or July they get dry and do to the desiccation polygonal splits often appear on the soil surface. For the development of alkali soils, a high groundwater level rich in salts and also a continental climate is needed (Molnár & Borhidi 2003, Tóth 2010). In the dry period, intensive evaporation elevates the salts to the surface through the capillary zone. The solonetz meadows are formed on meadow soils, with moderate salt accumulation in the deeper horizons (usually in B horizon). The humus content of the A horizon is high. That is why the pH of the surface is near to neutral even the soil is alkaline in the deep.

In alkali landscapes, the solonetz meadows are typically located between the salt marshes and alkali steppes (Bodrogközy 1980, Deák *et al.* 2014b). Solonetz meadows form either a narrow transition zone between dry alkali steppes and marshes or they can form large stands of several hectares extension. They usually form a habitat mosaic with loess grasslands, alkali steppes, smaller patches of alkali and non-alkali marshes and with other alkali associations, like *Puccinellietum limosae* Magyar ex Soó 1933, *Plantagini tenuiflorae–Pholiuretum pannonici* Wendelberg 1943, *Camphorosmetum annuae* Rapaics ex Soó 1933.

Besides the prisine alkali meadows, there are several thousand hectares of meadows of secondary origin along the river Tisza. Some of the extended alkali areas in Hungary are ancient formations, which were present before human interventions (Molnár & Borhidi 2003, Sümegi *et al.* 2000, 2013). Most of the secondary alkali meadows developed after the regulation of the Tisza and its tributary streams. This process is well documented by the maps of the 1st (1763-87), 2nd (1819-1869) and 3rd (1869-1887) Military Surveys of Hungary. Due to the altered water balance after the landscape-scale river regulation campaigns, alkali meadows developed at the location of former marshes by secondary salinisation and some meadows that were not alkali in the past also became salt-affected. The species pool of secondary meadows is generally less diverse than that of the ancient alkali meadows (Molnár & Borhidi 2003).

Characteristic species of the solonetz meadows

Solonetz meadows usually have two herb layers. In the upper layer the dominant tall grass species are *Alopecurus pratensis*, *Agrostis stolonifera*, *Beckmannia eruciformis*, *Glyceria fluitans* and *Elymus repens*. In the lower layer typical species are *Cerastium dubium*, *Galium palustre*, *Inula britannica*, *Juncus compressus*, *Juncus gerardi*, *Leonurus marrubiastrum*, *Lotus glaber*, *Lycopus* spp., *Lysimachia nummularia*, *Lythrum virgatum*, *Mentha aquatica*, *Mentha pulegium*, *Oenanthe silaifolia*, *Ranunculus lateriflorus*, *Ranunculus repens*, *Ranunculus sardous*, *Rorippa sylvestris* ssp. *kerneri*, *Rumex stenophyllus* and *Veronica scutellata*. Species typical to salt marshes (*Bolboschoenus maritimus*), non-alkali meadows (*Phalaris arundinacea*) and dry alkali grasslands (*Achillea collina*, *Centaurea pannonica*, *Limonium gmellini* ssp. *hungarica*) also occur in solonetz meadows. There are some species that indicate silt accumulation processes, such as *Alopecurus geniculatus*, *Eleocharis uniglumis*, *Eleocharis palustris*, *Myosurus* *minimus*, *Pholiurus pannonicus* and *Plantago tenuiflora*. These species are common in Puccinellenion limosae Soó 1933 em. Varga & V. Sípos ex Borhidi 2003 hoc loco too. There are some endemic species in solonetz meadows; the most widespread one is the *Cirsium brachycephalum*, which can form stands of even several hectares extension. Other endemic species is *Limonium gmelinii* ssp. *hungaricum*.

Solonetz meadows are sensitive to the water support. After a longer period with precipitation over or under average they can transform into other associations within the class; even they can transform to a dry grassland or marsh. If the water supply is not sufficient, the constant species (*Agrostis stolonifera*) of the association decreases in cover, and a few grass species become dominant. In some cases the cover of dry grassland species (*Festuca pseudovina*, *Poa angustifolia*, *Podospermum canum*, *Trifolium* spp.) and occasionally weedy species (e.g. *Cirsium arvense*, *Cirsium vulgare*, *Myosotis arvensis*) increases due to severe drought. Inadequate water supply or the lack of trampling by grazers leads to the desintegration of the tussock sturcture of the solonetz meadows.

Solonetz meadows are generally inadequate for ploughing, because of the moist soil conditions and the salt accumulation in the deeper horizon. The productivity of the meadows considerably depends on the precipitation of the actual year. If they are not managed, litter can accumulate, which causes decrease in the diversity of annuals and biennials (Kelemen *et al.* 2013). Solonetz meadows, like other natural associations on solonetz soils, are usually not invaded by invasive species, because of the special environmental conditions caused by the high salt content of the soil.

Material and methods

Studied associations and the relevés

We followed Borhidi (2003) for syntaxa and Simon (2000) for taxa. The following associations, affected by Tisza River are discussed in this paper:

Agrostio stoloniferae–Alopecuretum pratensis Soó 1933 corr. Borhidi 2003
Agrostio stoloniferae–Beckmannietum eruciformis Rapaics ex Soó 1930
Agrostio stoloniferae–Glycerietum pedicellatae Magyar ex Soó 1933 corr. Borhidi 2003
Agrostio–Caricetum distantis Rapaics ex Soó 1938
Eleochari–Alopecuretum geniculati (Ujvárosi 1937) Soó 1947
Rorippo kerneri–Ranunculetum lateriflori (Soó 1947) Borhidi 1996

The relevés used in the paper are summarized in Table 1. Most of the relevés were recorded on percentage scale except for old relevés.

Table 1. Summary of relevés used for studying solonetz meadows. Abbreviation of the associations: AgrAlo – *Agrostio stoloniferae–Alopecuretum pratensis*; AgrBeck – *Agrostio stoloniferae–Beckmannietum eruciformis*; AgrGly – *Agrostio stoloniferae–Glycerietum pedicellatae*; AgrCar – *Agrostio–Caricetum distantis*; EleoAlo – *Eleochari–Alopecuretum geniculati*.

Associat-ion	Region	Location	Date of survey	Publisher	No. of relevés	No. of species
AgrAlo	Gyöngyös - Heves vidéke	Sarud (Hídvégpuszta); Tarnaszentmiklós (Garabont); Heves (Doktortanya-dűlő) Pély (Tag-dűlő)	2004, 2005	Schmotzer (unpubl.)	5	44
AgrAlo	Körös-vidék	Vésztő	1998	Penksza (1998)	2	21
AgrAlo	Jászság	Rákóczifalva	2002	Gallé (2002)	5	16
AgrAlo	Nagykunság	Nagyiván	2004	Molnár (NBmR)	20	10
AgrAlo	Nagykunság	Egyek-Pusztakócs	2004, 2007	Deák (unpubl.)	10	26
AgrAlo	Hortobágy	Nyírőlapos	2006	Deák (unpubl.)	10	12
AgrAlo	Hortobágy	Nyírőlapos	2006	Deák (unpubl.)	10	8
AgrAlo	Maros-szög	Deszki-puszta	2006	Aradi (unpubl.)	9	28
AgrAlo	Hortobágy	É-Hortobágy	1963	Bodrogközy (1965)	15	41
AgrAlo	Hortobágy	NA	1934	Soó (1933)	1	45
AgrBeck	Hortobágy	Nyírőlapos	2001	Deák (unpubl.)	6	10
AgrBeck	Nagykunság	Nagyiván	2004	Molnár (NBmR)	20	17
AgrBeck	Nagykunság	Egyek-Pusztakócs	2004, 2007	Deák (unpubl.)	10	33
AgrBeck	Maros-szög	Deszki-puszta	2006	Aradi (unpubl.)	4	18
AgrBeck	Hortobágy	É-Hortobágy	1963	Bodrogközy (1965)	10	25
AgrBeck	Hortobágy	NA	1934	Soó (1933)	1	30
AgrCar	Maros-szög	Deszki-puszta	2006	Aradi (unpubl.)	4	15
AgrGly	Hortobágy	É-Hortobágy	1963	Bodrogközy (1965)	10	30
AgrGly	Hortobágy	NA	1934	Soó (1933)	1	29
AgrGly	Nagykunság	Egyek-Pusztakócs	2007	Deák (unpubl.)	5	10
AgrGly	Hortobágy	Nyírőlapos	2001	Deák (unpubl.)	5	8
EleoAlo	Nagykunság	Egyek-Pusztakócs	2004	Deák (unpubl.)	5	22

Statistical analysis, life forms, and social behaviour types

Our goal was to describe the solonetz meadow associations which have been affected by the Tisza River in present days or in the past. The studied regions were Gyöngyös-Heves-vidéke, Hortobágy, Nagykunság, Jászság, Maros-szög and Körös-vidék. First, we provided a literature review on the solonetz meadows along river Tisza. Second, we characterized the species composition of the solonetz meadows using the relevés available until 2010 (submission date of this chapter) (Table 1). Non-metric multidimensional scaling (NMDS), based on Bray-Curtis dissimilarity was used to explore the differences among associations and regions. For the NMDS we used all of the published relevés except the pooled relevés of Soó (1933). Finally, we compared the three most widespread associations (*Agrostio stoloniferae–Alopecuretum pratensis, Agrostio stoloniferae–Beckmannietum eruciformis* and *Agrostio stoloniferae–Glycerietum pedicellatae*) based on their Relative Ecological Indicator Values (SB, WB), Raunkiaer's life forms, Social Behaviour Types, Phytosociologycal groups and Flora elements of their species pool. The A-D values of the relevés were transformed to percentage cover when it was necessary.

Result and discussion

Literature on the solonetz meadows along the Tisza River

Systematic research on the solonetz meadows was initated by Magyar and Rapaics at the beginning of the 20^{th} century. Rapaics (1916, 1918) described the physiognomy, environmental parameters and species pool of the alkali associations of Hortobágy; among them, he also discussed the solonetz meadows. Later he described the alkali associations of the Middle-Tisza Region, and of Szeged (Rapaics 1927a, 1927b). Magyar (1928) was the first who made the classification of the main solonetz meadow associations. He gave a comprehensive description of the plant associations of the Hortobágy. Soó (1931) evaluated the origin of the flora of Hortobágy. He suggested that Hortobágy was a secondary formation of degraded grasslands, which resulted from human disturbances (regulation of Tisza River, establishing of Árkus-channel, cutting of forests, herding). In a latter article (Soó 1933) he described the associations of the Hortobágy in detail. He categorized the solonetz meadows of the Beckmannion eruciformis association group. Máthé (1941) described the flora elements and the most widespread solonetz meadows of the Hortobágy.

Bodrogközy published several articles about solonetz meadows along the Tisza and its tributary streams. In his paper „Ecology of the Halophilic Vegetation of the Pannonicum" (Bodrogközy 1963) he described vegetation and soil conditions of the Northern-Hortobágy, Árkus-puszta and Máta-puszta. He published coenological data of *Agrostio stoloniferae–Alopecuretum pratensis, Agrostio stoloniferae–Beckmannietum eruciformis, Agrostio stoloniferae–Glycerietum pedicellatae* and described the soil of them. He described several variants of the associations. He studied the productivity of the *Agrostio stoloniferae–Alopecuretum pratensis* associations along the River Maros near Nagylak (Bodrogközy 1972). He also reviewed the vegetation of Körös-region and Maros-basin (Bodrogközy 1980). Jakucs (1976) gave a comprehensive general review of solonetz meadows of Hortobágy. The occurrences of typical plants of Hortobágy were listed in the flora monograph of Szujkó-Lacza (1982). Varga-Sípos *et al.* (1982) described the vegetation, animal assemblages and soil of the solonetz meadows of eastern Hortobágy in their nature protection guide about Nyári-járás. Varga-Sípos (1984) reviewed the papers of Magyar, Soó and Bodrogközy and made a synthetic coenological table of *Agrostio stoloniferae–Alopecuretum pratensis, Agrostio stoloniferae–Beckmannietum eruciformis* and *Agrostio stoloniferae–Glycerietum pedicellatae* associations. There is a similar detailed description in the paper of Varga-Sípos & Varga (1993). Tóth & Kertész (1996) analysed the relationship between vegetation and soil in an *Agrostio stoloniferae–Alopecuretum pratensi*s in Hortobágy. Zalatnai & Körmöczi (2004) studied the fine-scale pattern of the boundary zones in alkaline grassland communities. Molnár & Borhidi (2003) discussed the origin, landscape history and syntaxonomy of the Hungarian alkali vegetation. Eliaš *et al.* (2013) provided a comprehensive classification of the continental alkali vegetation of Europe. Ladányi *et al.* (2016) studied the soil and vegetation changes due to hydrologically driven desalinization process in an alkaline wetland near Szeged. Erdős *et al.* (2011) studied the effect of land use on the vegetation of alkali grasslands. Lukács *et al.* (2017) published a comprehensive summary on new floristic data in the Hortobágy region.

In the recent decades, researchers at the University of Debrecen, Department of Ecology and the MTA-DE Biodiversity and Ecosystem Services Research Group studied the mechanisms shaping the species composition of alkali vegetation of the Hortobágy and the conservation, management of alkali vegetation of these unique habitats. Deák *et al.* (2014a) provided evidence for the relationship between micro-topography and vegetation zonation in alkali habitats using remotely sensed data. They developed a new methodology for large-scale habitat mapping in alkali landscapes based on hyperspectral (Burai *et al.* 2015) and laser-scanned data (Alexander *et al.* 2015, 2016, Zlinszky *et al.* 2015). They evaluated the diversity-productivity relationships (Kelemen *et al.* 2013, 2015) and also the role of soil seed bank in the vegetation dynamics in alkali habitats (Valkó *et al.* 2014). The effects of rainfall fluctuations on the fine-scale vegetation dynamics of alkali grasslands and wetlands is discussed by Lukács *et al.* (2015).

A synthesis on the solonetz meadow vegetation, regarding species composition and conservation challenges was published by Deák *et al.* (2014b). They synthesised the conservation and management prospects of alkali grasslands (Török *et al.* 2012) and alkali marshes (Deák *et al.* 2014c) of Central-Europe. Deák & Tóthmérész (2006, 2007) studied the effect of mowing on *Agrostio stoloniferae–Alopecuretum pratensis* in Hortobágy (Nyírőlapos). They studied effect of reed harvesting on the diversity and productivity of alkali wetlands (Deák *et al.* 2015a) and the role of grazing (Godó *et al.* 2017, Godó 2018, Kovácsné Koncz *et al.* 2018, Török *et al.* 2014, 2016, 2018, Tóth *et al.* 2018) and fire (Valkó *et al.* 2016) in shaping alkali habitats. Spontaneous regeneration of *Agrostio stoloniferae–Alopecuretum pratensis* on soil-filled drainage channels was evaluated by Deák *et al.* (2015b) and Valkó *et al.* (2015, 2017).

General description of the studied associations

VIII.1 *Agrostio stoloniferae–Alopecuretum pratensis* Soó 1933 corr. Borhidi 2003

This widespread association is situated on the least alkali soils (1st class). Stands of *Agrostio stoloniferae–Alopecuretum pratensis* are formed on slightly solonetized meadow soil. A and B horizons are leached, calcium carbonate and soda occurs in deeper horizons. The soil is poor in water-soluble salts (Bodrogközy 1963). This is the driest type of alkali meadows. *Alopecurus pratensis* can tolerate a wide range of soil moisture; thus it is present even under relatively dry soil conditions (Bodrogközy 1965). After the temporal water cover in spring and early summer stands of this association usually dry out and have a polygonally split soil. This association often located between dry steppes and wet alkali meadows like *Agrostio stoloniferae–Beckmannietum eruciformis* or *Agrostio stoloniferae–Glycerietum pedicellatae* (Deák *et al.* 2014a). Depending on the water supply (precipitation, water from snowmelt), this association can have dry grassland or marsh characteristics and it can even turn into these associations. Due to this phenomenon, the *Agrostio stoloniferae–Alopecuretum pratensis* stands are rich in species and are rather variable (Deák *et al.* 2014b).

Its dominant tall grass species are *Alopecurus pratensis*, *Elymus repens* and *Agrostis stolonifera*. The association has an *Elymus repens* facies (Varga 1982), where *Elymus repens* replaces *Alopecurus pratensis* and becomes a dominant or at least subdominant species. In solonetz meadows *Elymus repens* does not behave like a ruderal competitor; it may be regarded as a competitor regarding the Social Behaviour Types (Borhidi 1995). Formation of this *Elymus repens* facies generally occurs due to regional level desiccation or changes in management. We found this facies in the coenological data of the Nagykunság, Hortobágy and in Deszki-puszta. In case of continuous and sufficient water supply and presence of grazing, tussocks formed by *Agrostis stolonifera* can be present. If the habitat gets dry, steppe species establish there, such as *Festuca pseudovina*, *Poa angustifolia*, *Trifolium* spp., *Achillea collina* and *Plantago lanceolata*. In stands where salt accumulation is high

Limonium gmelinii ssp. *hungaricum* may occur, occasionally together with the protected and regionally rare *Prospero paratheticum* (Deák *et al.* 2015c). This process usually takes place on the boundaries of the habitats (Bodrogközy 1965). *Carex praecox* as a subordinate species appear in the relevés of the Middle-Tisza and Maros regions. In every relevés *Juncus* species (*Juncus effusus, J. conglomeratus, J. compressus, J. gerardi*) occur with high frequency and cover. *J. gerardi* is the only species, which is present only in relevés of the Deszki-puszta. Due to heavy grazing and trampling *Trifolium fragiferum* and *Lotus tenuis* might appear.

In the relevés of Soó (1933), there are several species that are not typical to the alkali meadows of the Hortobágy. There are many dry (alkali and loess) grassland species, even ruderal ones (*Achillea collina*, *Centaurea pannonica*, *Festuca pseudovina, Salvia austriaca, Silene viscosa*, *Verbascum phoeniceum*). The presence of *Artemisia pontica*, *Aster sedifolius* ssp. *sedifolius*, *Odontites rubra* and *Peucedanum officinale* is not common in the meadows of the region. The reason for this difference is that Soó made a pooled "typical" relevé from several surveys of the region. That is why the species of other habitats are also included in the list. They may originate from the surveys that were made in the one of the two *Galatello–Quercetum roboris* Zólyomi Tallós 1967 (Ohat, Újszentmargita) forests, and/or other *Peucedano–Asteretum sedifolii* Soó 1947 corr. Borhidi 1996 stands.

Bodrogközy (1965) described four variants of *Agrostio stoloniferae–Alopecuretum pratensis* from the Northern-Hortobágy. These variants can be considered as facies. The four variants are *beckmannietosum*, *juncetosum conglomerati,* normale, normale *trifoliosum fragiferi*. The *beckmannietosum* is considerably salt affected. It is very close to the *Agrostio stoloniferae–Beckmannietum eruciformis* regarding its species composition. The *juncetosum conglomerati* is rarely mentioned as an alkali meadow association. As Bodrogközy described it, it is a wet and less alkali meadow with the dominance of *Juncus conglomeratus,* which is not a typical alkali plant species. In this association several hygrophilous species occur (*Ranunculus* spp.). It often appears in disturbed, grazed areas. The normale *trifoliosum fragiferi* type develops if the meadow dries out and if intensive grazing and trampling occurs. Here the cover of dry steppe species, such as *Leontodon autumnalis*, *Trifolium fragiferum*, *Lotus tenuis*, *Festuca pseudovina* and *Podospermum canum* increases considerably, while the cover of *Agrostis stolonifera* and *Alopecurus pratensis* decreases. This subtype is susceptible to weed encroachment (*Artemisia vulgaris*, *Cirsium arvense*, *Pulicaria vulgaris*). These subtypes show that the *Agrostio stoloniferae–Alopecuretum pratensis* changes dynamically related to the environmental factors. *Agrostio stoloniferae-Alopecuretum pratensis* stands are usually utilized as hay meadow or grazed by cattle.

VIII.2 *Agrostio stoloniferae–Beckmannietum eruciformis* Rapaics ex Soó 1930

Agrostio stoloniferae–Beckmannietum eruciformis is formed on soils with the highest salt content (2nd and 3rd class alkali soils) amongst alkali meadows. The highest salt content is present in stands, which dry out in midsummer. Soil of *Agrostio stoloniferae–Beckmannietum eruciformis* has a loose structure. Thick columnar structure may be found in the B horizon (Bodrogközy 1963). Surface water cover is typical in spring and early summer, but the habitat dries out frequently in midsummer. The dominant grass species are *Alopecurus pratensis*, *Agrostis stolonifera*, and *Beckmannia eruciformis*, which form tussocks in case of proper water supply. Like the *Agrostio stoloniferae–Glycerietum pedicellatae*, it has several hygrophyte species. It has more halophyte species (like *Aster tripolium* ssp. *pannonicum* and *Puccinellia limosa*) than the other meadow associations. In this association due to high salt content and good water balance, species of salt marshes like *Bolboschoenus maritimus* are often found. *Agrostio stoloniferae–Beckmannietum eruciformis* is a more stable association than *Agrostio stoloniferae–Alopecuretum pratensis* as it has more permanent water supply. The high salt content inhibits the establishment of several species, which are present in the *Agrostio stoloniferae–Alopecuretum pratensis* association, but not salt-tolerant enough to survive here. The *Agrostio stoloniferae–Beckmannietum eruciformis* stands are usually not utilized for hay making because their wet soil is not suitable for the machinery, but used as pastures for cattle.

VIII.3 *Agrostio stoloniferae–Glycerietum pedicellatae* Magyar ex Soó 1933 corr. Borhidi 2003

The association occurs on 1st class alkali soils similarly to *Agrostio stoloniferae–Alopecuretum pratensis*, but in lower depressions; that is why it has a more permanent water cover. It is the wettest alkali meadow association. The soil surface dries out only in extreme dry summers (Bodrogközy 1965). Its soil is eluviated, thus its solonetz character is poor. It has little salt content in both horizons. Due to the effect of permanent water cover, columnar structure is generally absent (Bodrogközy 1965). This association often forms a transition zone between the drier alkali meadows and marshes, especially *Schoenoplectetum tabernaemontani* Soó 1947 (Deák *et al.* 2014c, 2015a). The species pool is very similar to the associations mentioned above, but it has a more homogenous species composition, because it is characterised by more balanced water conditions. The dominant grass species are *Glyceria fluitans* and *Agrostis stolonifera.* As subordinate species *Beckmannia eruciformis*, *Eleocharis* spp., *Epilobium tetragonum* and *Lycopus europaeus* are present. Several marsh species occur there, such as *Bolboschoenus maritimus*, *Schoenoplectus lacustris* ssp. *lacustris* and *Schoenoplectus lacustris* ssp. *tabernaemontani*. In this association tussock formation is not typical.

Bodrogközy (1965) differentiated three variants based on their water regime. The wettest subtype is *baldingerosum*; and there is a typicum, and a *beckmanniosum* variant, the latter showing a transition towards the *Agrostio stoloniferae–Beckmannietum eruciformis*. That is why the relevés of Bodrogközy (1965) have a high species number. Soó's relevé has high species number because it is a pooled survey like in case of the *Agrostio stoloniferae–Alopecuretum pratensis*. Stands of this association are often unmanaged; they generally cannot be mown by machine because of the permanently wet soil. If the surroundings of the stand are grazed, cattle may feed here.

VIII.4 *Agrostio–Caricetum distantis* Rapaics ex Soó 1938

Formerly it was treated as a subassociation, and was described as *Agrostidetum stoloniferae* Soó (1940) 1968 in the Red Data Book (Borhidi, 1999). This association is formed on 2nd class alkali soils. Its dominant species are *Agrostis stolonifera* and *Carex distans*. Subordinate species like *Alopecurus geniculatus*, *Aster tripolium* ssp. *pannonicus*, *Beckmannia eruciformis*, *Cirsium brachycephalum* and *Plantago maritima* are present in areas that are affected by silt deposition. *Agrostio–Caricetum distantis* shows a transition to *Puccinellietum limosae*. Tussock forming is typical in this association. Stands of this association are usually mowed or grazed.

VIII.5 *Eleochari–Alopecuretum geniculati* (Ujvárosi 1937) Soó 1947

This association shows relationship with *Plantagini tenuiflorae–Pholiuretum pannonici* but it remains wet until midsummer while *Plantagini tenuiflorae–Pholiuretum pannonici* gets dry earlier.. Silt deposition is typical similarly to *Agrostio–Caricetum distantis*. Some of its species are common with *Plantagini tenuiflorae–Pholiuretum pannonici* and *Agrostio stoloniferae–Alopecuretum pratensis.* Usually the stands of *Eleochari–Alopecuretum geniculati* are species-poor. Constant species are *Alopecurus geniculatus*, *Eleocharis palustris* and *E. uniglumis*.

VIII.6 *Rorippo kerneri–Ranunculetum lateriflori* (Soó 1947) Borhidi 1996

This association generally occurs in the matrix of *Agrostio stoloniferae–Beckmannietum eruciformis*. It is formed on the permanently wet areas, which are rich in silt. It is rich in dicotyledonous species which favour soils affected by silt deposition. Typical species are *Agrostis stolonifera, Eleocharis palustris, Beckmannia eruciformis, Elatine alsinastrum*, *Peplis portula*, *Ranunculus aquatilis*, *R. lateriflorus* and *Rorippa sylvestris* ssp. *kerneri*.

Ordination of the studied associations

The species composition of all studied associations are plotted on Figure 1.

Agrostio stoloniferae–Alopecuretum pratensis

Relevés from Gyöngyös-Heves-vidéke, Nagykunság, Jászság and Maros-szög compose a considerably compact group (Figure 1). The relevés from Gyöngyös-Heves-vidéke does not have a typical species pool, as they contain many species of dry grasslands (Figure 2). Their species number is high (Heves 5 relevés 44 species). Relevés from Körös-vidék shows the same pattern (2 relevés 21 species). Relevés from Nagykunság are more heterogeneous. The reason for this is that the certain relevés were carried out in a vegetation mapping project, thus they are far from each other. One of the relevés was made in an extremely weedy (*Cirsium arvense*) stand, thus it is further away from the other relevés of the association on the scatter plot of the ordination. In spite of being weedy (which usually indicates pure water supply and high level of disturbance), this area is fairly wet which is indicated by the high cover of *Agrostis stolonifera*. Thus, this relevé is located near the group of *Agrostio–Caricetum distantis* (Figure 1). Relevés from Maros-szög overlap with the relevés from Nagykunság. The relevé No.118 is a facies of *Elymus repens*. It does not contain *Alopecurus pratensis,* but many dry grassland species.

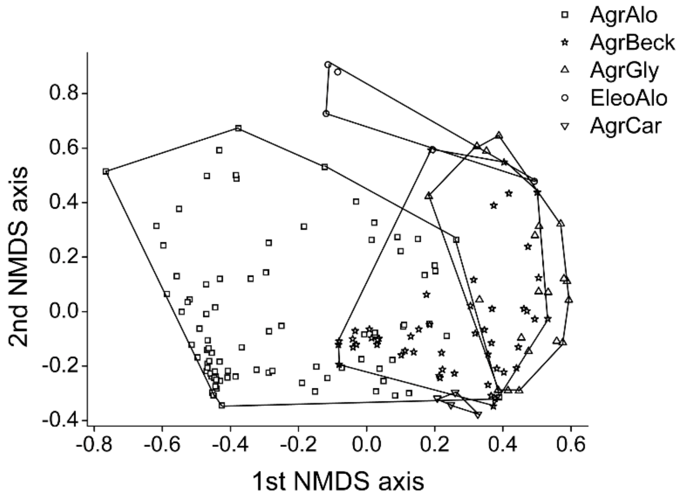

Figure 1. NMDS ordination of the relevés based on the percentage cover scores using Bray-Curtis similarity . Abbreviation of associations: AgrAlo - *Agrostio stoloniferae - Alopecuretum pratensis;* AgrBeck - *Agrostio stoloniferae - Beckmannietum eruciformis;* AgrGly - *Agrostio stoloniferae - Glycerietum pedicellatae;* AgrCar - *Agrostio-Caricetum distantis; EleoAgr - Eleochari - Alopecuretum geniculati*.

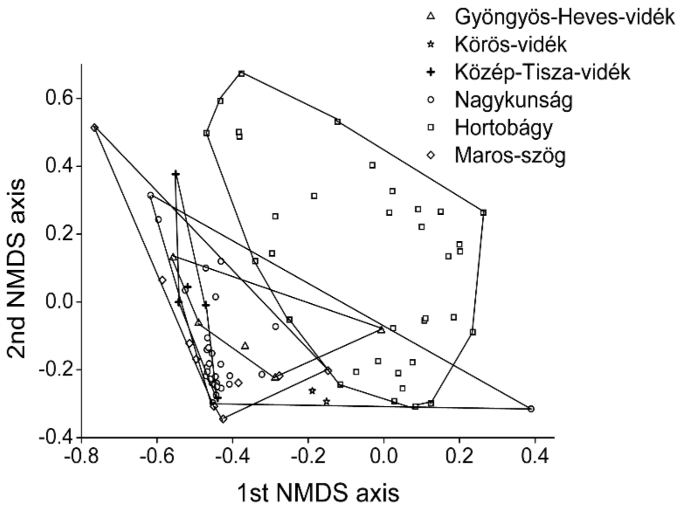

Figure 2. NMDS ordination of the relevés from *Agrostio stoloniferae - Alopecuretum pratensis* stands based on percentage cover scores using Bray-Curtis similarity.

The relevés of Hortobágy are the most heterogeneous. They overlap with all of the groups mentioned before. We have the largest number of relevés from there, which is well-justified by the heterogeneity of associations and habitats. The relevés No.93-102 are placed next to the groups of *Agrostio stoloniferae–Beckmannietum eruciformis* on the ordination (Figure 1). The reason for this is that this stand contains *Beckmannia eruciformis* and *Glyceria fluitans* as subordinate species in a high cover. It is interesting, that even the relevés 83-92 were located only 30-40 meters away from the relevés 93-102. The only difference is that the relevés 93-102 are grazed, the relevés 83-92 are not. This example from Hortobágy (Nyírőlapos) shows that management type can cause considerable differences in the species composition of associations.

The relevés of Bodrogközy overlap with the *Agrostio stoloniferae–Beckmannietum* group (Figure 1). This is due to the fact that his relevés come from four subtypes. Two of these subtypes (*beckmannietosum* and *juncetosum conglomerati*) show a great similarity with the stand of *Agrostio stoloniferae–Beckmannietum eruciformis* in Nagykunság (Kunmadarasi-puszta) in which there were many *Juncus conglomeratus* tussocks. The total species number of the relevés is high (44 species) because the relevés were scattered across four variants of the association. Relevés from Nagykunság (Kunmadarasi-puszta) are considerably more compact (Figure 2). They were recorded in a small homogenously managed area (50×50m).

Agrostio stoloniferae–Beckmannietum eruciformis

We have data from three regions (Nagykunság, Hortobágy, Maros-szög, see Figure 3). The two groups from Hortobágy are not separeted from the relevés of the Maros-szög. Relevés recorded in Nagykunság are very heterogeneous. Stands from Nagykunság (Kunmadarasi-puszta) are similar to the relevés of Bodrogközy's *Agrostio stoloniferae–Alopecuretum pratensis* (Figure 1). The reason for similarity is that the relevés of Bodrogközy from *Agrostio stoloniferae–Alopecuretum pratensis* association contain *Beckmannia eruciformis* with considerable frequency and cover values. The relevés of Bodrogközy are more species rich than any other relevés in the region.

Agrostio stoloniferae–Glycerietum pedicellatae

The group of *Agrostio stoloniferae–Glycerietum pedicellatae* overlaps with the *Agrostio stoloniferae–Beckmannietum eruciformis* (Figure 1). These two associations show considerable similarity as their species composition and attributes of habitat (salt content, water balance) are more similar to each other than to the *Agrostio stoloniferae–Alopecuretum pratensis*.

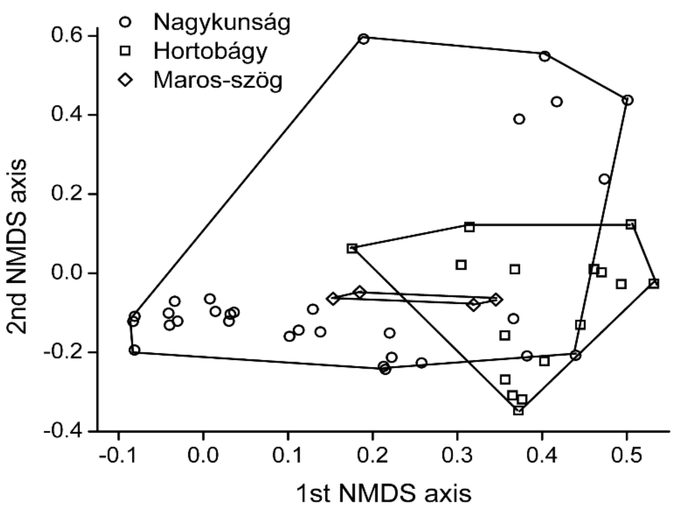

Figure 3. NMDS ordination of the relevés from *Agrostio stoloniferae - Beckmannietum eruciformis* stands based on percentage cover scores using Bray-Curtis similarity.

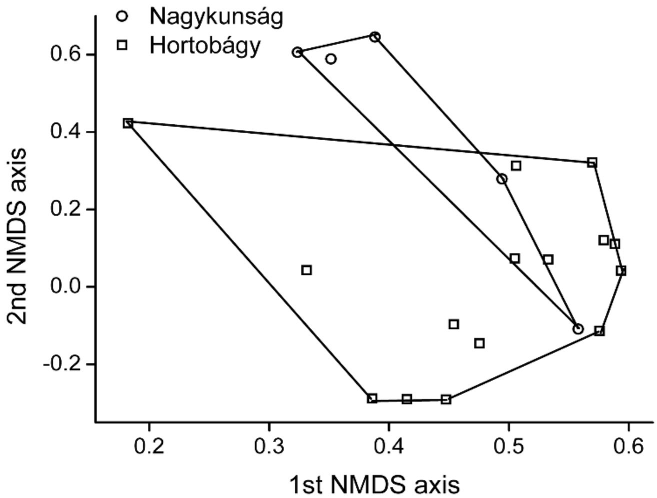

Figure 4. NMDS ordination of the relevés from *Agrostio stoloniferae - Glycerietum pedicellatae* stands based on percentage cover scores using Bray-Curtis similarity.

Groups of Hortobágy and Nagykunság overlap, but not completely (Figure 4). In this case, the subtypes of Bodrogközy (Hortobágy) are very similar to the *Agrostio stoloniferae–Beckmannietum eruciformis* (Figure 1).

Agrostio-Caricetum distantis

Relevés of this association (from Maros-szög) are situated between the *Agrostio stoloniferae–Alopecuretum pratensis* and *Agrostio stoloniferae–Beckmannietum eruciformis* (Figure 1). The *Agrostio–Caricetum distantis* has better water supply and its soil has higher salt content than that of *Agrostio stoloniferae–Alopecuretum pratensis*, but its soil gets dry earlier than that of *Agrostio stoloniferae–Beckmannietum eruciformis*, therefore *Agrostio-Caricetum distantis* stands harbour fewer halophyte species.

Eleochari–Alopecuretum geniculati

Relevés of this association (Nagykunság) are apart from the others (Figure 1). This association is not a typical tall grass alkali meadow.

Vegetation characteristics of the solonetz meadow associations

We studied the characteristics of the three most widespread associations, namely *Agrostio stoloniferae–Alopecuretum pratensis*, *Agrostio stoloniferae–Beckmannietum eruciformis* and *Agrostio stoloniferae–Glycerietum pedicellatae*, from which we had enough relevés for the analyses. Studied characteristics were Relative Ecological Indicator Values (SB, WB), Raunkiaer's life form, Social Behaviour Types, Phytosociologycal groups and Flora elements (Borhidi 1995).

Relative Ecological Indicator Values for Salt content (SB)

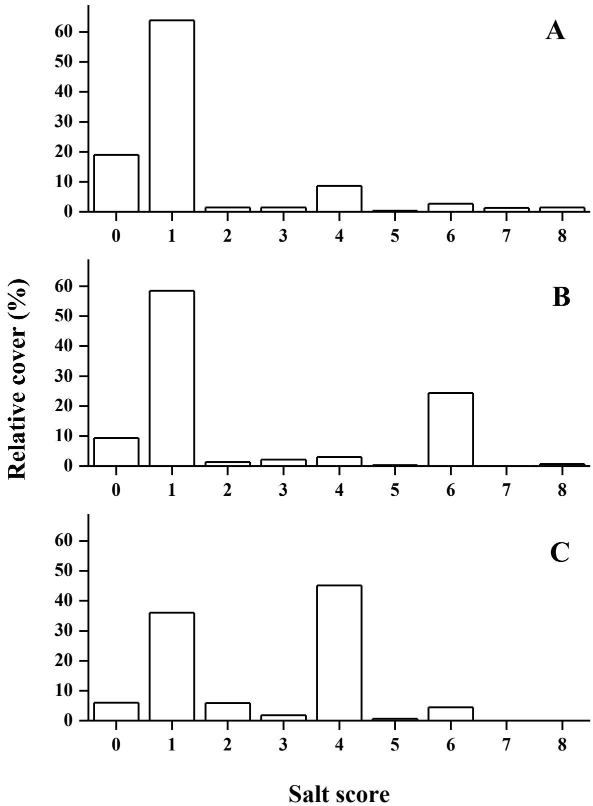

Figure 5. Distribution of Salt scores (SB) in the three studied solonetz meadow associations: A – *Agrostio stoloniferae–Alopecuretum pratensis;* B – *Agrostio stoloniferae–Beckmannietum eruciformis;* C – *Agrostio stoloniferae–Glycerietum pedicellatae*.

In *Agrostio stoloniferae–Alopecuretum pratensis* association the species with 0 and 1 values – which have little tolerance against salt are the dominant (Figure 5). Their ratio is 18.9% and 63.9%, respectively. Beside them, species with the value 4 are present (8.6%) which have a medium salt tolerance. Some of them are dry grassland plants (*Silene viscosa*, *Trifolium* spp.) that are present in drying stands. Some of them are meadow species which can be found in wetter stands, such as *Eleocharis uniglumis*, which is a typical species of *Agrostio stoloniferae–Alopecuretum pratensis* stands. The largest number of salt-tolerant species are present in *Agrostio stoloniferae–Beckmannietum eruciformis* (Figure 5). Here the only species with high salt-tolerance (group 6) is *Beckmannia eruciformis* which is the dominant species of the association. In case of *Agrostio stoloniferae–Glycerietum pedicellatae* species with moderate salt-tolerance (category 4) form the most abundant group (45.2%). The reason for the high ratio of this group is that the dominant plant of the association (*Glyceria fluitans*) belongs here. In this association *Beckmannia eruciformis* with score 6 also occurs.

Relative Ecological Indicator Values for Soil Moisture (WB)

Agrostio stoloniferae–Alopecuretum pratensis is the association located on the driest habitats. Here the group with 6 WB score dominates (47.7%) and also group 4 (13%) and group 7 (15.7%) have considerable proportion (Figure 6). This association occurs typically in wet areas, which can get dried occasionally. Thus, there are several dry grassland species, such as *Achillea collina*, *Centaurea pannonica*, *Cruciata pedemontana*, *Festuca pseudovina*, *Podospermum canum*, *Trifolium* spp. in these meadows. These species are generally typical species of the surrounding dry grasslands (alkali-, loess steppes). Depending on the weather conditions, these associations can transform to each other. A dry grassland species with high frequency is *Elymus repens*. This species is frequently present with high cover in drying stands forming a facies. Usually it appears in those dry stands, which are managed improperly. *Cirsium arvense* is present in dry, heavily disturbed stands. Majority of group 6 is composed by *Alopecurus pratensis*, but the ratio of *Limonium gmelinii* ssp. *hungaricum* is considerable too. High cover of *L. gmelinii* ssp. *hungaricum* is typical in drying meadows with high salt content. Other subordinate species of group 6 are *Rumex* spp. which can form facies of the *Agrostio stoloniferae–Alopecuretum pratensis* association. *Rumex stenophyllus* is typical in undisturbed stands, *R. crispus* is typical in disturbed stands. *Agrostis stolonifera* is the species with the highest cover in group 7. Dominant species of group 8 are *Beckmannia eruciformis* and *Juncus* spp. In lower-lying patches *Eleocharis uniglumis* is frequent, its moisture score is high (9). Other species in the group 9 are: *Lycopus* spp. and *Carex melanostachya* which are species of an alkali sedge association (*Caricetum melanostachyae* Balázs 1943).

In case of *Agrostio stoloniferae–Beckmannietum eruciformis* the histogram shifts towards higher values (Figure 6). This indicates that this association needs wetter habitat than *Agrostio stoloniferae–Alopecuretum pratensis*. The first group with high participation is group 6 (13.5%). Its species are *Alopecurus pratensis* and *Rumex stenophyllus* which are present with a high cover. The largest group is group

7 (44.7%), which is composed by *Agrostis stolonifera*, a constant species of the association and *Mentha* spp. as a subordinate species. Other constant species is *Beckmannia eruciformis*. This species constitutes the majority of group 8 (30.6%). *Lythrum virgatum* and *Glyceria fluitans* are present with high frequency and cover values. In group 9 the endemic *Cirsium brachycephalum* is present. Beside it *Eleocharis uniglumis* and *Veronica scutellata* are present with high values. Group 10 consists of two species with high frequency but low cover values: *Eleocharis palustris* and *Bolboschoenus maritimus*.

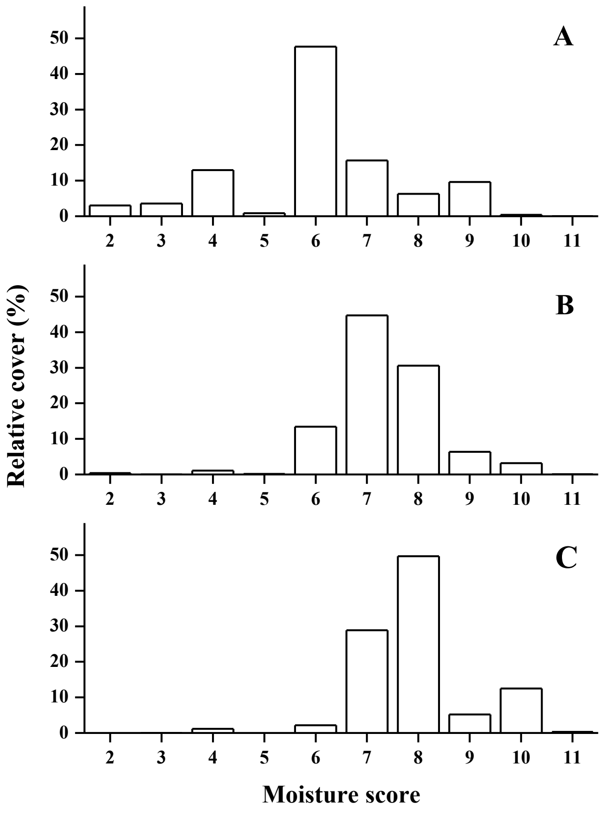

Figure 6. Distribution of Moisture scores in the three studied solonetz meadow associations: A – *Agrostio stoloniferae–Alopecuretum pratensis;* B – *Agrostio stoloniferae–Beckmannietum eruciformis;* C – *Agrostio stoloniferae–Glycerietum pedicellatae*.

Agrostio stoloniferae–Glycerietum pedicellatae occurs in habitats with the best water supply and has a histogram shifted to the highest values (Fig. 6). Group 7 (28.9%) consist almost exclusively of *Agrostis stolonifera*. Two constant species (*Beckmannia eruciformis, Glyceria fluitans*) give the majority of group 8 (49.7%). Group 9 is almost absent. The reason for this is the permanent water cover that is not favourable for *Eleocharis uniglumis*, which was present in the other two associations. *Carex melanostachya* and *Phalaris arundinacea* are present with low cover values thus they contribute to a transition to alkali sedge associations and marshes. The members of group 10 (*Alisma lanceolatum*, *Bolboschoenus maritimus*, *Phragmites australis*, *Schoenoplectus lacustris* and *Typha* spp.) are common species with alkali and non-alkali marshes (Deák *et al.* 2014c).

Raunkiaer's life form categories

Hemicryptophytes (H), geophytes (G) and helo- and hydrophytes (HH) are the most typical life forms in the three associations (Table 2). In *Agrostio stoloniferae–Alopecuretum pratensis,* hemicryptophytes are the dominant group (72.6%) comprised by the dominant graminoid (*Alopecurus pratensis*, *Agrostis stolonifera*, *Juncus conglomeratus*, *J. effusus*) and typical dicotyledonous species (*Galium palustre*, *Lythrum* spp., *Mentha* spp., *Rumex* spp). The most abundant species of the group of geophytes (16.8%) are *Eleocharis* spp. and *Elymus repens* and also the small *Juncus* species (*Juncus compressus, J. gerardii*) belong to this group.

Table 2. Proportions of Raunkiaer's life forms in the three studied solonetz meadow associations. Abbreviation of associations: AgrAlo – *Agrostio stoloniferae–Alopecuretum pratensis;* AgrBeck – *Agrostio stoloniferae–Beckmannietum eruciformis;* AgrGly – *Agrostio stoloniferae–Glycerietum pedicellatae*. Abbreviation of Raunkiaer's life forms: Ch – Chamaephytes; H – Hemicryptophytes; G – Geophytes; HH – Helo- and hydrophytes; Th – Therophytes; TH – Hemitherophytes.

	AgrAlo	**AgrBeck**	**AgrGly**
Ch	0.6	0.1	0.2
H	72.6	90.1	38.9
G	16.8	3.6	4.5
HH	4.8	3.5	54.9
Th	4.4	2.3	1.5
TH	0.8	0.5	0.1

In *Agrostio stoloniferae–Beckmannietum eruciformis* the ratio of geophytes is low (3.6%). The frequent geophyte species are *Eleocharis* spp. *Elymus repens*, which gives the majority of this group in case of *Agrostio stoloniferae–Alopecuretum pratensis*, is not typical in this association because of the high salt content and better water supply. The group of hemicryptophytes (90.1%) is mainly composed by constant grass species, such as *Alopecurus pratensis*, *Agrostis stolonifera*, *Beckmannia eruciformis* and *Glyceria fluitans*. Further species of this group are *Juncus conglomeratus*, *J. effusus*, *Lythrum* spp., *Rumex stenophyllus* and *Veronica scutellata*.

In *Agrostio stoloniferae–Glycerietum pedicellatae* association the group of helophytes and hydrophytes has the highest value (54.9%) indicating the moist habitat conditions of the association. Typical species of this group are the common species with sedge associations and marshes, such as *Alisma lanceolatum*, *Bolboschoenus maritimus*, *Carex melanostachya*, *Lycopus* spp., *Phragmites australis*, *Schoenoplectus tabernaemontani* and *Typha* spp. In the group of hemicryptophytes (38.9%) *Agrostis stolonifera, Beckmannia eruciformis, Glyceria fluitans* and *Rorippa sylvestris* subsp. *kerneri* are present. The group of geophytes (4.5%) is composed only by *Eleocharis* spp.; mainly *Eleocharis palustris* is present.

Social Behaviour Types

Agrostio stoloniferae–Alopecuretum pratensis association is the most heterogeneous regarding social behaviour types (Table 3). The reason for this is partly the many weed species that are present in drying stands. This association is the most unstable because of its place in the zonation (Deák *et al.* 2014a). *Agrostio stoloniferae–Alopecuretum pratensis* can dry out the easiest way that can lead to degradation. Here is the lowest the soil salt content that allows the establishment of a wider range of species. The group of disturbance-tolerants (11.6%) consists of *Juncus* spp. (except *J. gerardi*), *Lycopus* spp., *Mentha* spp.; with lower cover *Pulicaria vulgaris* and *Leontodon autumnalis* also occur. *Elymus repens* is the most frequent species of the group of ruderal competitors (12%). In our opinion, this species is not a ruderal competitor in alkali meadows but a competitor. If we recalculate the data accordingly, the proportion of the competitors is higher as it is shown in Table 3 (59.8%). The dominant grass species of the association and *Eleocharis palustris* also belong to the group of competitors. *Eleocharis uniglumis*, *Lythrum* spp. and *Rumex stenophyllus* belong to the group of generalists (11.6%). Proportion of specialists is low (4.5%). Specialist species typical to meadows (*Rorippa sylvestris* ssp. *kerneri* and *Ranunculus lateriflorus*) and alkali dry grasslands (*Limonium gmelini* ssp. *hungaricum*, *Lotus tenuis*, *Ranunculus pedatus* and *Trifolium* spp.) both occur in this association.

In *Agrostio stoloniferae–Beckmannietum eruciformis* the proportion of species of disturbed, secondary and artificial habitats is low. Disturbance-tolerant species have a small ratio (4.8%), with similar wetland species mentioned at *Agrostio stoloniferae–Alopecuretum pratensis*. The group of competitors (81.7%) is composed by the dominant grass species of the association and *Eleocharis palustris*. The group of geophytes (10.7%) is composed by *Carex* spp., *Eleocharis uniglumis*, *Lythrum* spp., *Rumex stenophyllus* and *Veronica scutellata*. Specialist species (1.1%) include *Aster tripolium* ssp. *pannonicus*, *Cirsium brachycephalum*, *Limonium gmelini* ssp. *hungaricum*, *Lotus tenuis*, *Pholiurus pannonicus*, *Ranunculus lateriflorus* and *Rorippa sylvestris* ssp. *kerneri*.

In *Agrostio stoloniferae–Glycerietum pedicellatae* the proportion and typical species of the groups of disturbance-tolerants (4.7%) and geophytes (5.7%) is very similar to those in *Agrostio stoloniferae–Beckmannietum eruciformis*. The competitors form the largest group (87.1%) including the dominant grass species of the association (*Agrostis stolonifera*, *Beckmannia eruciformis* and *Glyceria fluitans*) and *Eleocharis palustris*, accompanied by *Phalaris arundinacea*, *Phragmites australis*, *Schoenoplectus lacustris* and *Typha* spp. The proportion of specialists is low (1.8%), and most of them are species of wet habitats (*Ranunculus lateriflorus* and *Rorippa sylvestris* ssp. *kerneri*).

Table 3. Proportions of Social Behaviour Types in the three studied solonetz meadow associations. Abbreviation of associations: AgrAlo – *Agrostio stoloniferae–Alopecuretum pratensis;* AgrBeck – *Agrostio stoloniferae–Beckmannietum eruciformis;* AgrGly – *Agrostio stoloniferae–Glycerietum pedicellatae*. Abbreviation of Social Behaviour Types: AC – Adventive competitors; RC – Ruderal competitors; I – Introduced crops; W – Native weed species; DT – Disturbance-tolerant plants of natural habitats; NP – Natural pioneers; G – Generalists; C – Competitors; S – Specialists.

	AgrAlo	**AgrBeck**	**AgrGly**
AC	0	0.1	0
RC	12	0.5	0
I	0.01	0	0
W	0.2	0.8	0
DT	11.6	4.8	4.7
NP	0.3	0.4	0.7
G	11.6	10.7	5.7
C	59.8	81.7	87.1
S	4.5	1.1	1.8

Phytosociological groups

In *Agrostio stoloniferae–Alopecuretum pratensis* association, the Molinio–Arrhenatheretea (48.6%) species dominate (Table 4). These species are meadow species that have low salt tolerance. The majority of this group is composed by *Alopecurus pratensis* and *Juncus conglomeratus*. Festuco–Puccinellietea (8.9%) species typical to alkali includes species of alkali steppes, alkali meadows and other alkali associations (*Puccinellietum limosae, Plantagini tenuiflorae–Pholiuretum pannonici*, *Camphorosmetum annuae*). There are also dry and wet grassland species in this group. Dry grassland species (*Festuca pseudovina, Limonium gmelini* ssp. *hungaricum, Trifolium* spp.) can estabish in *Agrostio stoloniferae–*

Alopecuretum pratensis stands when the habitat is getting dry. Frequent and typical wet grassland species are *Alopecurus geniculatus*, *Beckmannia eruciformis* and *Ranunculus lateriflorus*. Two species is present from the group Phragmitetea: *Carex melanostachya* and *Galium palustre*. *Eleocharis uniglumis* is the only representative of group Scheuchzerio–Caricetea nigrae, but it has high cover (4.5%) and frequency values. There are several species in the indifferent group (33.4%), including *Agrostis stolonifera*, *Carex praecox*, *Elymus repens*, *Inula britannica*, *Lycopus* spp., *Lythrum virgatum*, *Mentha* spp. and *Poa* spp.

Table 4. Proportions of the phytosociologycal groups in the three studied solonetz meadow associations. Abbreviation of associations: AgrAlo – *Agrostio stoloniferae–Alopecuretum pratensis;* AgrBeck – *Agrostio stoloniferae–Beckmannietum eruciformis;* AgrGly – *Agrostio stoloniferae–Glycerietum pedicellatae*.

Phytosociologycal group	AgrAlo	AgrBeck	AgrGly
Agropyretea	0.1	0	0
Agrostietea stoloniferae	0.1	0	0
Artemisietalia	0.1	0.1	0
Bidentetea	0	0.4	0
Bolboschoenetea	0.1	1.4	1.6
Chenopodietea	0.1	0.7	0
Festuco - Brometea	0.1	0	0
Festuco - Puccinellietea	8.9	26.5	8.7
indifferent	33.4	52	34.9
Isoëto - Nanojuncetea	0.1	0.1	0.3
Lemnetea	0.1	0	0.3
Molinio - Arrhenatheretea	48.6	14.8	1.7
Phragmitetea	4.2	1.5	52.4
Plantaginetea	0.1	0.1	0
Ruppietea	0	0.1	0.1
Scheuchzerio - Caricetea nigrae	4.5	2.6	0.1
Secalietea	0.1	0	0
Sedo - Scleranthetea	0.1	0	0
Thero - Salicornieta	0	0.1	0

In *Agrostio stoloniferae–Beckmannietum eruciformis* Festuco–Puccinellietea (26.5%) is the largest group (Table 4). This suggests that this association contains typical alkali species and develops in salt-affected habitats. The most typical species are typical species of wet alkali habitats, such as *Alopecurus geniculatus*, *Beckmannia eruciformis*, *Cirsium brachycephalum* and *Rumex stenophyllus*. *Pholiurus pannonicus* is typical in patches with silt accumulation. Molinio–Arrhenatheretea species are similar to those in *Agrostio stoloniferae–Alopecuretum pratensis* (*Alopecurus pratensis*, *Juncus conglomeratus*) and have a lower proportion (14.8%). The group Scheuchzerio–Caricetea nigrae is represented only by *Eleocharis uniglumis.* The group Phragmitetea is present with a lower value (1.5%) than in *Agrostio stoloniferae–Alopecuretum pratensis*. Typical Phragmitetea species are *Alisma lanceolatum, Glyceria fluitans, Veronica scutellata* and occasionally*Typha angustifolia*. *Bolboschoenus maritimus* is the only representative of the group Bolboschoenetea. Indifferent species form a large group (52%), including *Agrostis stolonifera*, *Eleocharis palustris, Inula britannica*, *Juncus effusus*, *Lycopus europaeus*, *Lysimachia nummularia, Lythrum virgatum* and *Mentha* spp.

The proportion of the phytosociologycal groups shows that *Agrostio stoloniferae–Glycerietum pedicellatae* can be found in habitats with good water supply (Table 4). Accordingly, the group Phragmitetea has the greatest proportion (52.4%). Species that need continuous water supply are more frequent in this association, such as *Alisma lanceolatum*, *Carex melanostachya*, *Glyceria fluitans*, *Lythrum salicaria*, *Phalaroides arundinacea*, *Phragmites communis*, *Schoenoplectus lacustris* and *Typha angustifolia*. The proportion of the species typical to alkali habitats (Festuco–Puccinellietea) is lower (8.7%) than in the other two associations. Species typical to dry steppes are absent, rather typical alkali meadow species are present (*Alopecurus geniculatus*, *Beckmannia eruciformis*, *Ranunculus lateriflorus*, *Rorippa sylvestris* ssp. *kerneri*). Molinio–Arrhenatheretea which is a well-represented group in other two associations is represented here by only a few species with low cover (1.7%). *Alopecurus pratensis* and *Juncus conglomeratus* are present in only a few relevés with small cover. shows the same pattern. From group Bolboschoenetea there is only one species present (*Bolboschoenus maritimus*). The cover of the Scheuchzerio–Caricetea nigrae group is very low (0.1%), as its typical species *Eleocharis uniglumis* cannot tolerate the continuous water cover. The group Isoëto–Nanojuncetea (0.3%). is represented by *Elatine alsinastrum* and *Peplis portula*. The indifferent group contains few species, such as *Agrostis stolonifera*, *Eleocharis palustris* and *Lycopus europaeus.*

Flora elements

The flora elements typical to continental steppes (continental, ponthic-mediterranean, ponthic) are present in *Agrostio stoloniferae–Alopecuretum pratensis* with high scores, as this is the driest solonetz meadow association (Table 5). In the group of continental flora elements (5%) there are alkali steppe species with low cover and frequency (*Achillea collina*, *Festuca pseudovina*, *Hordeum hystrix*, *Plantago tenuiflora*, *Ranunculus pedatus*), and several alkali meadow and sedge species (*Carex melanostachya*, *Lythrum virgatum*, *Ranunculus pedatus*, *Rumex stenophyllus*). The group of ponthic-mediterranean flora elements (1.5%) contains *Podospermum canum*, *Trifolium retusum* and *Trigonella procum-bens*. The group of Pannonian flora elements contains pannonian endemic species that are typical in alkali habitats, such as

Limonium gmelini subsp. *hungaricum* and *Puccinellia limosa*. Proportion of endemic species is the highest in this association (1.2%). *Ajuga genevensis*, *Ranunculus lateriflorus* and *Rorippa austriaca* are in the ponthic group. The only species in the group of atlantic-submediterranean flora elements is *Trifolium striatum*, a typical species of moderately alkali steppes and loess grasslands. The group of European is represented with low species number and cover and includes *Alopecurus geniculatus* and *Juncus conglomeratus*. The group with the highest species number and cover is the groupd of Eurasian flora elements (55.1%) with several generalist wetland plants (*Alopecurus pratensis*, *Carex praecox*, *Eleocharis palustris*, *Inula britannica*, *Juncus compressus*, *Lycopus europaeus*, *Lysimachia nummularia* and *Ranunculus sardous*) and a few dry grassland species (*Gypsophila muralis* and *Trifolium fragiferum*). Typical species from the circumboreal group (20%), such as *Beckmannia eruciformis*, *Eleocharis uniglumis*, *Elymus repens* and *Galium palustre* occur in natural, undisturbed stands in good condition. Cosmopolitan species (11.4%) are *Agrostis stolonifera*, *Bolboschoenus maritimus*, *Juncus effusus*, *Poa trivialis*, *Rumex crispus* and *Typha angustifolia*. There are some other flora element groups present in low proportion, such as submediterrean (0.7%; *Lotus glaber*, *Mentha pulegium*) and balkanian (0.9%; *Trifolium angulatum*, *Bupleurum tenuissimum*).

Table 5. Proportions of the flora elements in the three studied solonetz meadow association. Abbreviation of associations: AgrAlo – *Agrostio stoloniferae–Alopecuretum pratensis;* AgrBeck – *Agrostio stoloniferae–Beckmannietum eruciformis;* AgrGly – *Agrostio stoloniferae–Glycerietum pedicellatae*. Abbreviation of the flora elements: ADV – Adventive; AsM – Atlantic-submediterranean; BAL – Balkanian; CIR – Circumboreal; CON – Continental; COS – Cosmopolitan; EUA – Eurasian; EUR – European; PAN – Pannonian; PoM – Ponthic-mediterranean; PON – Ponthic; PoP – Ponthic-Pannonian; SME – Submediterranean; TUR – Turanian.

Flora element type	**AgrAlo**	**AgrBeck**	**AgrGly**
ADV	0.1	0.1	0
AsM	0.4	0	0
BAL	0.9	0	0
CIR	20	29.2	9.1
CON	5	5.1	1
COS	11.4	46.2	34.9
EUA	55.1	15.3	50.2
EUR	3.2	1.7	3.6
PAN	1.2	0.2	0
PoM	1.5	0.4	0
PON	0.6	0.2	1.2
PoP	0	0.4	0
SME	0.7	1.4	0
TUR	0.1	0	0

In *Agrostio stoloniferae–Beckmannietum eruciformis* association, the cosmopolitan group (46.2%) has the largest proportion (Table 5) including a few species with high cover scores, such as *Agrostis stolonifera*, *Bolboschoenus maritimus* and *Juncus effusus*. The most frequent species of the circumboreal (29.2%) group are *Beckmannia eruciformis, Eleocharis uniglumis* and *Veronica scutellata*. The group of Eurasian flora elements (15.3%) includes common species of wetlands, such as *Alisma lanceolatum*, *Alopecurus pratensis*, *Eleocharis palustris*, *Glyceria fluitans*, *Inula britannica*, *Lycopus europaeus* and *Lysimachia nummularia.* The group of European flora elements is represented with a small percentage cover (1.7%), including *Alopecurus geniculatus*, *Juncus conglomeratus* and *Mentha aquatica*. The continental group has the same proportion as in *Agrostio stoloniferae–Alopecuretum pratensis* (5.1%), but since this association has a wetter habitat, dry grassland species are absent. Typical species with continental distribution are *Lythrum virgatum*, *Plantago tenuifolia* and *Rumex stenophyllus*. *Cirsium brachycephalum* and *Limonium gmelini* subsp. *hungarica* are the only representatives of Pannonian group. There are only a few species in the ponthic group, including *Ranunculus lateriflorus* and *Rorippa austriaca*. In the Submediterranean group there is only one species (*Mentha pulegium*). The ponthic-pannonian group is present only in this association with a single species (*Pholiurus pannonicus*).

The Eurasian group has the largest proportion (50.2%) in *Agrostio stoloniferae–Glycerietum pedicellatae* (Table 5) containing *Alisma lanceolatum*, *Eleocharis palustris* and *Glyceria fluitans*. The cosmopolitan group (34.9%) contains species typical also to marshes, such as *Agrostis stolonifera*, *Bolboschoenus maritimus*, *Phalaris arundinacea*, *Phragmites communis* and *Typha angustifolia*. Typical species of the circumboreal group (9.1%) are *Beckmannia eruciformis, Schoenoplectus lacustris* and *Veronica scutellata*. The European group is represented by *Alopecurus geniculatus* and *Rorippa sylvestris* subsp. *kerneri*. There is only one species in the continental group (*Carex melanostachya*). *Ranunculus lateriflorus* occurs in this association as the member of ponthic group.

Conclusions

Solonetz meadows are typical associations of the alkali grasslands of the Great Hungarian Plain. Water balance and the salt content of the soil are the main environmental factors driving these associations. Solonetz meadows usually form a transition zone between salt marshes and alkali steppes. Six solonetz meadow associations occur on the floodplain of the Tisza river. Three of them (*Agrostio stoloniferae–Alopecuretum pratensis, Agrostio stoloniferae–Beckmannietum eruciformis and Agrostio stoloniferae–Glycerietum pedicellatae*) cover a large area. There are three other, less widespread associations (*Agrostio–Caricetum* *distantis, Eleochari–Alopecuretum geniculati, Rorippo kerneri–Ranunculetum lateriflori*), which are important in maintaining the diversity of the landscape. The three most frequent associations are similar in species pool, structure, and habitat conditions, but there are differences in the ratio of the frequent species controlled by the salt content and the water coverage during the spring and early summer.

Agrostio stoloniferae–Alopecuretum pratensis

This was the most heterogeneous association of the studied solonetz meadows. Salt scores showed that the species with low salt tolerance (0-1) were the most frequent in this association. According to the moisture scores (score 6 dominates) this association is the driest one; therefore, several species typical to surrounding dry grasslands were present here. Competitors and generalists were the most frequent strategies and this association was the most sensitive to the establishment of weed species. Because of the low salt content of the soil the proportion of typical alkali species (Festuco–Puccinellietea) was low. Those species were the most abundant, which were common species of the non-alkali meadows (Molinio–Arrhenatheretea) and those which were habitat generalists. The ratio of continental, ponthic-mediterranean, and ponthic elements was high. The ratio of pannonian endemic species typical in alkali habitats was relatively high. The majority of species belonged to the Eurasian, circumboreal and cosmopolitan groups.

Agrostio stoloniferae-Beckmannietum eruciformis

This association showed more stable meadow and alkali characteristics, than *Agrostio stoloniferae–Alopecuretum pratensis*. *Beckmannia eruciformis* was abundant, indicating the high salt content of the soil. This was a wetter habitat than the *Agrostio stoloniferae–Alopecuretum pratensis,* thus the moisture scores shifted towards the higher scores The most abundant moisture group was 7, and species with low moisture scores were almost absent. There were fewer generalist species there and the most abundant social behaviour type group was the group of competitors. Due to the higher salt content of the soil the species of Festuco–Puccinellietea had the highest proportion in this association. Ratio of the species of non alkali meadows (Molinio–Arrhenatheretea) was considerably lower, but the ratio of indifferent species was the highest in the stands of *Agrostio stoloniferae–Beckmannietum eruciformis*. The majority of the species pool was composed by the Eurasian, circumboreal and cosmopolitan groups as in the *Agrostio stoloniferae–Alopecuretum pratensis* association. The difference was that the ratio of cosmopolitan and continental species was considerably higher, and the Eurasian group was suppressed. There were several endemic Pannonian, Ponthic-Pannonian species with low abundance.

Agrostio stoloniferae–Glycerietum pedicellatae

Agrostio stoloniferae–Glycerietum pedicellatae was the wettest alkali meadow association, it showed common characteristic with sedge meadows and alkali and non-alkali marshes. This association occurred in habitats with moderately deep and permanent water cover; the species preferring wet habitats were typical there having high moisture scores. The good water supply was also indicated by the dominance of helo- and hydrophytes. Spectrum of Social Behaviour Types showed the same pattern as in the case of the *Agrostio stoloniferae–Beckmannietum eruciformis*: group of competitors was the most frequent, generalists and weeds were less frequent. Contrary to the other alkali meadows, the group of Phragmitetea was present with a high ratio. Proportion of species typical to alkali salt-affected habitats (Festuco–Puccinellietea) was the same as in the *Agrostio stoloniferae–Alopecuretum pratensis* association, and the species typical to dry steppes was absent. The ratio of Molinio–Arrhenatheretea species was low. The majority of the species pool was composed by the Eurasian, circumboreal and cosmopolitan groups as in the other alkali meadows. As the habitat had moderate salt content and permanent water cover the ratio of continental and ponthic species was low. There were no endemic species in the relevés ot this association.

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IX. WILLOW SCRUBS AND GALLERIES – SALICETALIA PURPUREAE

Orsolya Makra, László Körmöczi

Salicion triandrae T. Müller & Görs 1958 – Willow scrubs

Coenosystematic state of willow scrubs

At the beginning of the Central-European coenological surveys, all kinds of the willow communities developing on the flood area were classified as *Saliceto-Populetum* (Tx. 1931) included in the alliance *Salicion albae*.

The willow scrubs were not described as separate associations, they were regarded as initial steps of succession and were considered just a facies of the gallery forest (*Populeto-Salicetum Salix triandra* facies, Timár 1950) or – as in Simon's opinion – a stadium of it (*Populeto-Salicetum Salix triandra* stad. Simon 1954). During his research at Szigetköz, Zólyomi mentioned a mixed stadium which was formed with *Salix triandra* and *S. purpurea* (Kárpáti 1958).

In the synopsis of Soó, however, the willow scrubs were included in a distinct alliance (*Salicion triandrae* Müller-Görs 1958), and Soó distinguished two associations – *Salicetum purpureae* and *Salicetum triandrae* (Soó 1964). The weedy types of the willow scrubs were classified into the *Calystegion* alliance (Soó 1960).

In this paper Soó's classification-system – date from 1964 – is presented considering also the recent nomenclature. Kevey revised the association-nomenclature first in 1995 on the basis of his works at Szigetköz (Bartha *et al.* 1995), and changed the names of the two above associations for the very similar *Rumici crispi-Salicetum purpureae* Kevey in Borhidi & Kevey 1996 and *Polygono hydropiperi-Salicetum triandrae* Kevey in Borhidi & Kevey 1996 (Borhidi 2003).

In the followings, we use the latest nomenclature.

Short historical review

Soó was the first who described willow scrub stands along the river Szamos in 1927 (Újvárosi 1940). Later, coenosystematic researches were carried out along the river Danube, and several important results were published by Zólyomi (1937) and Kárpáti (1958). During his researches, Timár published very detailed coenological data from the floodplain forest-associations along the rivers Tisza and Maros (Timár 1950a, 1950b). Simon documented very thoroughly the willow scrub stands along the Upper-Tisza section (Simon 1957). Tóth carried out important vegetation-surveys along the Maros at the 1960s (Tóth 1967). Kevey revised the coenosytematic relations of the willow scrubs, his works focused mainly on the stands along the river Danube (Bartha *et al.* 1995).

IX.1 *Rumici crispi-Salicetum purpureae* Kevey in Borhidi & Kevey 1996

Syn: *Salicetum purpureae* Kárpáti 1958
(not found along the Tisza and its tributaries)

Environmental conditions

The stands of this association develop on shoals of gravel and coarse sand, where the current of the river is very strong. The water regime of these shoals is very extreme: in the case of low water-level they dry up easily, and water-level rises very fast and high at the time of flooding (Bartha *et al.* 1995).

According to the literature, this association is missing from the Hungarian section of Tisza because of the above mentioned habitat demands. It may be present along the upper part of the river, near the riverhead.

IX.2 *Polygono hydropiperi-Salicetum triandrae* Kevey in Borhidi & Kevey 1996

Syn: *Salicetum triandrae* Malcuit 1929, *Salicetum triandrae-purpureae* Soó 1927, *Populeto-Salicetum Salix triandra* facies Timár 1950, *Populeto-Salicetum triandrae* Timár 1950.

Salicetum triandrae association is the willow scrub that is spread along all of the rivers at the Great-Hungarian Plain (Soó 1960).

Environmental conditions

The stands of this association develop along the slow-flowing river sections and backwaters on fine sand and silt. These fine grained sediments have better water retention capacity, thus the water regime of this kind of habitat is more balanced then that of the previous community. Stands could be waterlogged for over 5-7 month a year, therefore the soil formation is rather restricted (Borhidi 1999). This community can be considered local association specific in the Carpathian basin (Borhidi 2003).

Description of the stands along the River Tisza and its tributaries

Soó stated in 1960, that "on the Great-Hungarian-Plain the most exhaustively investigated and best-known forests are the floodplain forests…" (Soó 1960). Unfortunately, our knowledge about the Hungarian willow scrubs did not increase substantially so far, as can be seen from the literature. All of the traceable relevés were taken on Braun-Blanquet scale, and only two of the 90 relevés represented the state of the willow scrubs in turn of the millennium.

The relevés taken along the river Tisza were analysed in three sections – lower, middle, upper – defined by Pécsi (1969). In the case of the tributaries we did not apply any finer distinction.

Lower-Tisza

The analysis of the vegetation of this section was made mainly from the relevés of Timár.

The following species occurred with high constancy and considerable cover (constancy values are in brackets): *Salix triandra* (V), *Bidens tripartitus* (V), *Agrostis stolonifera* (IV), *Echinochloa crus-galli* (IV), *Persicaria lapathifolia* (IV). Altogether 19 species were present with high constancy (V-III). Considering the average cover, most of the species had low AD values (+-1). *Populus nigra* was found in many stands (K=IV) but with very low coverage (+-1). *Populus alba* and *Salix alba* occurred just in few stands but with higher coverage (1-2). The appearance of *Ulmus glabra* was surprising in these stands, probably it was planted. Altogether 122 species were recorded, three of them are remarkable because nowadays are rarely found along the river: *Aster amellus, Gratiola officinalis* and *Tussilago farfara*.

Timár reported that the branches of the willow scrubs were cut down regularly, thus the trees grew close to each other, and the herb layer was rather sparse or nudum. He mentioned that mainly *Elymus repens* and *Agrostis stolonifera* dominated herb layer developed on the open stands (Timár 1950/a, 1950/b). Soó interpreted Timár's stands as a secondary weedy gallery forest after clear-cutting (Soó 1960).

Middle-Tisza

The description of the vegetation of the Middle-Tisza section originates from the examinations of Timár and Újvárosi. Timár investigated the riverbed in the Middle-Tisza region near Tiszaföldvár and Szolnok (Timár 1950/a). Újvárosi worked between Polgár and Tokaj (Újvárosi 1940). Other surveys referring to the willow scrubs have not been carried out till now.

The most abundant and frequent tree-species were in the stands *Populus nigra* (IV) and *Salix triandra* (IV). *Populus alba* also occurred several times (III) but with lower coverage (1-2). *Salix viminalis* dominated just a single stand. Most of the stands were dominated by a single tree species, other trees just mixed sparsely with the dominant species.

Characteristic species of the herb layer were: *Agrostis stolonifera* (IV), *Bidens tripartitus* (IV), *Elymus repens* (III), *Convolvulus arvensis* (III), *Gnaphalium uliginosum* (III), *Rorippa sylvestris* (III).

One hundred and forty-two species were found in the relevés, 17 of them had high constancy values (IV-III), most species occurred sporadically: 124 of the 134 herbaceous species had got +-1 AD range, and only 6 of the subordinate species had higher (III) constancy values. The flora was dominated by ruderal elements and mud vegetation.

Újvárosi published a synthetic coenological table on the basis of 25 relevés from the Polgár-Tokaj section (Újvárosi 1940). In this area, *Salix triandra* had the highest constancy value and average cover in the canopy layer, other species occurred sporadically. This may be resulted because Újvárosi took relevés close to the riverbank. Frequent species of the herb layer were: *Persicaria lapathifolia, Conyza canadensis, Echinochloa crus-galli, Bidens tripartitus, Chenopodium urbicum, Cyperus fuscus, Digitaria sanguinalis, Gnaphalium uliginosum, Plantago major, Potentilla supina, Rorippa sylvestris.*

Total number of the species was 99 on this section.

Upper-Tisza

We analysed the vegetation of the Upper-Tisza section on the basis of Simon's work (Simon 1957).

Only two species were both abundant and frequent – *Salix triandra* (IV), *Populus nigra* (III) – other species occurred with rather low AD values (+-2): *Bidens tripartitus* (IV), *Elymus repens* (IV), *Lycopus europaeus* (IV), *Echinocystis lobata* (III), *Salix alba* (III). Some species, such as *Salix viminalis, Rubus caesius* and *Equisetum arvense*, occurred only in a few stands but with high local coverage. Altogether 65 species were found in the relevés, neither of them was typical mountainous species. Protected species of this section was *Salix elaeagnos*.

Szamos

Data have been published only from three stands, thus this short description may not be considered representative in respect to all this river. Frequent and abundant species were *Salix triandra* (V), *Phragmites australis* (IV), *Rubus caesius* (IV), *Amorpha fruticosa* (IV). Other frequent species were *Bidens tripartitus, Lycopus europaeus, Salix viminalis, Equisetum fluviatile.* Total species-number of the relevés was 33.

Körös

Only few data from two stands were available in the literature. Two recent relevés published by C. Dragulescu consisted of 35 species, and only three of them were present with higher abundance: *Salix triandra*, *S. alba* and *Rubus caesius*.

Maros

Timár and Tóth recorded relevés from 15 stands along this river. On the basis of their works, the most abundant species of the canopy layer was *Salix triandra* (V). In some stands *Populus nigra* (II), *Populus alba* (II) and *Salix alba* occurred with lower coverage. *Amorpha fruticosa* (III) was present in the shrub layer of several stands. Frequent species of the herb layer were *Bidens tripartitus* (V), *Calystegia sepium* (IV), *Erigeron annuus* ssp. *strigosus* (IV), *Lycopus europaeus* (IV), *Rubus caesius* (IV), *Potentilla supina* (IV), *Agrostis stolonifera* (III), *Echinochloa crus-galli* (III), *Persicaria lapathifolia* (III), *Phragmites australis* (III), *Scutellaria galericulata* (III). Altogether 117 species were recorded in the Maros-relevés.

Multivariate analyses

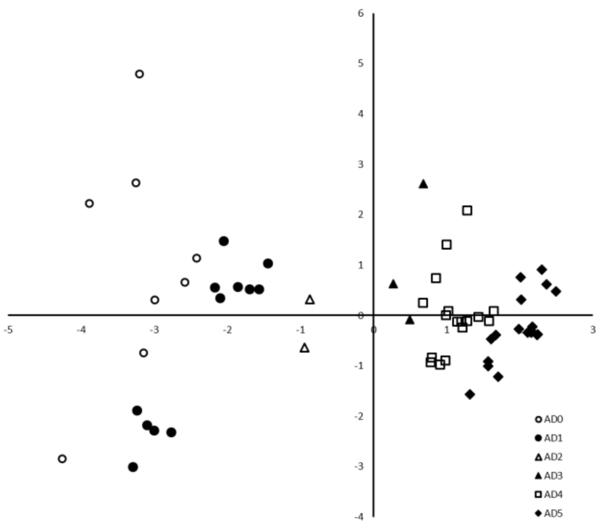

Fig. 1. Scatterplot of the ordination of willow scrub relevés (centered PCA). The distribution of the points is determined by the dominance (AD values) of *Salix triandra* along the first axis.

Sixty relevés were evaluated with Principal Component Analysis (Centered PCA). Number of species was rather high, 235 species were included in the analysis. As a result, 10 variables accounted for 73.99 % of total variance. On the other hand, the points do not show marked aggregations. The distribution of the points is determined mostly by *Salix triandra*. This species dominates 2/3 of the relevés and is absent only from 8 relevés. Thus the distribution of the points along the first axis is connected to the AD-values of *Salix triandra*; AD-values are high in the right-side aggregations and low in the left-side ones. No clear connection was found with the geographic distribution of the stands neither with the presence of other species.

Summarised evaluation

Considering all the river sections and tributaries, the following conclusions were taken:

1. *Salix triandra* was present with high constancy (III-V) and AD values (1-5) in each river sections. In the herb layer *Bidens tripartitus* was the constant element with higher AD values, and *Lycopus europaeus* was found in the majority of the stands, but with low range of AD values (+-1).

A permanent species-composition could not be organized as a consequence of the extreme and quickly changing environmental conditions of this habitat-type. This natural disturbation effect of floods can be tolerated mainly by the natural pioneers (just the elements of *Nanocyperetalia*) and disturbance tolerant plants. Thus the herb layer assembled from these kinds of plant species with changing proportion site by site.

2. Several authors noted that the willow scrubs became weedy due to the regular and intense cutting (Újvárosi 1940, Timár 1950, Soó 1960). These weedy willow scrubs were classified among the *Calystegion* alliance in the early studies.

3. Our field observations suggested that nowadays the willow scrub stripes do not develop very definitely along the riverbanks. This may be explained by the fact that after the river regulation the current of the widely meandering and shoal-building rivers was speeded up due to the cut-off of the river bends. Thus the length of the building banks decreased, and the bank of the deepening riverbed became steeper. The widely extending, continuously moving and changing flat floodplains are rather rare along the river therefore the development of wide willow scrub stands is prevented.

Willow scrubs are endangered by more and more extreme floods because the willow species can not tolerate the long-lasting submerged state of the entire foliage. Willow species are sensitive to the water cover in different degrees: *Salix purpurea* and *S. triandra* tolerate relatively well the inundation unlike *S. fragilis* and *S. viminalis* (Bordács, personal communication).

Salicion albae (Soó 1930 em. Müll. Et Görs 1958) – Gallery forests

IX.3 *Salicetum albae-fragilis* Soó 1957

Considering that the recent nomenclature (Borhidi 2003) of the gallery forests was based on the examination of the Danube stands, we have decided to use the comprehensive name of the willow-poplar gallery forests given by Soó.

Syn: *Salicetum albae-amygdalinae* (Slavnic 1952), *Salicetum mixtum* (Soó 1936), *Saliceto-Populetum albae* Timár (1952, 1953, 1954) *Salicetum albae-fragilis hungaricum* Soó 58.

Short historical review

The researches in connection with the Hungarian floodplain gallery forests started at the 1950s. Kárpáti was the first who described the willow gallery forests in the Szigetköz (Kárpáti 1957). Kevey has carried on with his works and one of his most important results was to clarify the coenosystematic relations of the floodplain forest along the River Danube (Kevey 1993).

Simon worked on the Upper-Tisza section and documented the vegetation with coenological relevés (Simon 1957). Timár revealed the riverside forests of the Lower-Tisza region (Timár 1950). The vegetation studies of Tóth provided important knowledge from the Maros floodplain (Tóth 1967). Soó's scientific achievement should be emphasized with regard to clarifying the European state of the Hungarian stands (Soó 1973).

Changes in the nomenclature of the gallery forests

The alliance *Populion albae* Br-Bl. 1931 ex Tchou 1948 was described in the Mediterranean region. Soó realized that the name *Salicetum albae* described by Issler (1926) refers to the western types of the gallery forests which spread to Eastern-Austria, and it is synonymous with the name *Salicetum albae-fragilis* used by Tüxen 1955. Since the southeast- and east-European stands were significantly different from these gallery forests considering the species composition, Soó classified them in a separate alliance: *Salicion albae* Soó 1930. Soó used the name *Salicetum albae-fragilis hungaricum* already in 1933, and gave this name to the Hungarian gallery forest in 1958. He mentioned the following characteristic species: *Fraxinus angustifolia* ssp. *pannonica, Vitis sylvestris, Glycyrrhiza echinata, Oenanthe banatica, Lycopus exaltatus, Leucanthemella serotina, Leucojum aestivum*. Soó distinguished two regional types within this association: *Salicetum albae-fragilis tibiscense* and *danubiale*. In connection with the stands along the River Tisza, he mentioned some differential species referring to Újvárosi's (1940) study: *Cnidium dubium, Echinocystis lobata* (Soó 1973).

Previously the white poplar forests were thought as a secondary-type of the elm-ash-oak forest after clear-cutting (Kárpáti 1958/b). Nowadays the white poplar forests developed on the low floodplain flats are considered natural stands which indicate the effects of the Sub-Mediterranean climate, and the *Populus alba* becomes more frequent towards the Mediterranean. Therefore we can consider our gallery forests (dominated by *P. nigra* and *Salix alba*) as local associations in the Carpathian basin (Borhidi 2003).

The very first scientific name of the Hungarian gallery forests was *Salicetum albae-fragilis* Issler 26. em. Soó 1957 (Soó 1964). Kevey divided it into two parts on the basis of his works carried out in the Szigetköz: willow gallery forest (*Leucojo aestivo-Salicetum* Kevey 1993) and poplar gallery forest (*Senecio fluviatilis-Populetum* Kevey 1993) (Bartha *et al.* 1995). The Hungarian white poplar gallery forest was not considered the same as the association known as *Populetum albae* Wendelberger-Zelinka 1952 in west-Europe (Bartha *et al.*1995).

Recent studies improved further this system: the poplar gallery forest was divided into black poplar gallery forest (*Carduo crispi-Populetum nigrae* Kevey in Borhidi & Kevey 1996) developing on the medium-high relief of the low floodplain and white poplar gallery forest (*Senecio sarracenici-Populetum albae* Kevey in Borhidi & Kevey 1996) developing on the highest relief of the low floodplain (Borhidi *et al.* 1999). These changes in the nomenclature, however, were based on the examinations of the Danube stands.

Recent results about Populus nigra

European black poplar (*Populus nigra* L.) is a characteristic pioneer species of riparian ecosystems. Its abundance and genetic diversity is threatened due to the loss of its natural habitat – by urbanization, drainage of wetlands for agricultural use, canalization of rivers for flood prevention – and the hybridization with the improved *Populus* clones. *P.×euramericana* was introduced to Northern-Europe in the 19th century (Cottrell *et al.* 2005).

Nowadays, *Populus nigra* is recognized as endangered species all across Europe, and natural populations useable for gene bank-supply disappeared from Western-Europe. The in-situ (preservation of natural stands) and ex-situ (establishing gene banks) conservation strategies applied in Hungary could support the preservation and survival of the local black poplar populations and their genetic resources. A *Populus nigra*-preservation project was elaborated in Gemenc region (Southern-Hungary) and was adopted widely in Europe: the distinction of the hybrid and non-hybrid plants is performed first on morphological level, and then, before the vegetative propagation, it is further refined with molecular (DNA) markers (Bordács *et al.* 2004).

On the basis of the recent examinations, there are essential differences in the genetic structure of the black poplar populations occurring frequently along a certain river system. Genetic diversity does not increase upwards the river, that was assumed earlier from that the gene-flow may proceed opposite with the water flow owing to the opposite wind-flows at the river-valley. The examinations based on the chloroplast DNA (cpDNA) revealed six new haplotypes in the Hungarian samples, which are missing from the West-European populations. This indicates the conservation importance of the gene-pool of the Hungarian black poplar populations (Bordács *et al.* 2004.).

As for the Tisza basin, some black poplar populations were sampled at the surroundings of Zemplénagárd, too. The analysis of these samples and interpretation of the results are in progress (Bordács, personal communication).

The current researches based upon the examination of the chloroplast DNA (cpDNA) variation in black poplar aim the understanding of the location of glacial refugia and the subsequent postglacial routes of the recolonisation of this species. According to molecular analyses based on gene bank collections originating from seven European countries, two gene-centers (a southeastern from Italy to Austria-Hungary and a southwestern at Spain) could be separated. The exact locations of the eastern refugia were also difficult to identify accurately, because there were also several unique haplotypes in the Italian peninsula, eastern Austria and Hungary (Cottrell *et al.* 2004).

The high diversity detected by Bordács in a population growing along the Danube River in Hungary supports this statement, and indicates the necessity of the further investigations toward south and east of Hungary to confirm the existence and location of this putative refugium (Bordács *et al.* 2002).

The phylogenetic analysis showed that three haplotypes (two from Germany and one from Hungary) were very different from the other haplotypes that were detected in the study, and these samples produced the banding pattern typical of the 'Thevestina' clone (Vencsura 1992). Thus these haplotypes might therefore be distinct because they originated from the same area as 'Thevestina', which itself originated from the Central Asian and Black Sea region and has been widely used as ornamental tree. This highlights the need to extend the sampling to regions further east (Cottrell *et al.* 2004).

Environmental conditions

The gallery forests are edafic associations along the rivers, their stands evolve in the low floodplain flats behind the willow scrub zone. Their development is attached to the more or less regular inundations, and their flora is adapted to these extreme natural disturbation effects with a specific reproduction strategy and habitat-demand in evolutionary time. Stands tolerate the permanent water-coverage over three or four month, and develop on crude alluvial soils (muddy sand, fine sand, medium bound soils) (Borhidi *et al.* 1999).

Description of the stands along River Tisza and its tributaries

For the sake of the easier survey we classify and analyse the coenological data along the River Tisza in different sections.

Explanation of the dissections:

1. The River Tisza section from the southern frontier to Szolnok was surveyed very thoroughly. On the basis of our field experiences the natural vegetation survived in this region in low proportion. The flora of the different associations was very poor in species and the vegetation types have become very homogeneous. Because of the lots of relevés collected from this section we divided it into two parts: from the frontier to Csongrád and from Csongrád to Szolnok.

2. The Szolnok-Tokaj section is almost completely overlapped the Middle-Tisza region and this could support the decision to discuss separately this section from the others in spite of the few relevés.

3. Areas lying north of Tokaj represented the Upper-Tisza section.

4. Vegetation of Köröszug and Bodrogzug have special locality, because the areas lie at the junction of two rivers (Tisza and Körös/Bodrog), therefore the relevés taken from these two sections are distinguished from the others.

5. In the case of the tributaries we do not use any finer division.

6. We distinguished the willow dominated vegetation types developed on navvy holes next to the floodplain slopes of the dikes (kubikfüzesek) from the gallery forests of the riverbank. These depressions are under the influence of permanent water coverage for long time of a year therefore their vegetation-types escape from the intensive land use. Till the middle of the last decade, basket-makers cut and collected the osiers of these willow-forms, which made their physiognomy very characteristic. They were called "botolófüzes". This type of management has terminated by nowadays and the less disturbed forest stands serve as refugee-areas for the flora and fauna (Molnár *et al.* 1997).

7. For all river sections, percentage cover (%) and Braun-Blanquet scale (AD) data were handled separately, because the percentage data were usually recorded later than the other type, and on the other hand the numerical analysis of mixed data is very problematic.

The distinguished river sections will be discussed in the following order: first the different Tisza-sections are analysed starting from the southern border towards the Upper-Tisza. The vegetation of Köröszug and Bodrogzug will be treated together with the respective Tisza sections. Tributaries are also discussed from south to north.

The synthetic table contains the average cover and constancy values of the species for each section. Also the overall constancy is given.

To give properly constancy values, it is important to know the number of stands. We determined this number primarily from literature data: all sampling sites given by the authors were considered separate stand, even if only one relevé was taken (e.g. Simon 1967). If the relevés were not grouped in stands by the author but vegetation map with marks of relevés was enclosed, we decided the number of stands and number of relevés belonging to a certain stand (e.g. Deák 2001).

In some cases the stands were delineated on the basis of aerial photos. We ranked the relevés in the same stand if they were taken within a distance of several hundred meters in a narrow belt along the river.

Unpublished data from György Bodrogközy were evaluated on the basis of his field notes; we considered the relevés of a table as members of the same stand.

From the southern frontier to Csongrád

Gallery forests

Recently, the intensive agricultural and silvicultural land uses are characteristic in this river section. The gallery forests can often survive just along the riverbank in a width of one or two rows of trees. The stands are strongly disturbed and quite poor in species. The proportion and number of invasive species are very high. Altogether 79 species were recorded in the relevés of this section. Adventive species were strongly determinant in community-composition.

Species in decreasing order of coverage were the following (constancy values are in brackets): *Fraxinus pennsylvanica* (V), *Salix alba* (V), *Rubus caesius* (V), *Amorpha fruticosa* (V), *Populus nigra* (IV), *Populus alba* (IV), *Acer negundo* (V), *Vitis riparia* (III). This order was established from the greatest average cover values of the species in the vegetation strata. Some species, first of all the adventive, invasive plants like *Acer negundo, Fraxinus angustifolia, Amorpha fruticosa, Vitis riparia*, were present in more than one layer, thus in this case their total average cover values were much higher.

The most dominant species of the herb layer were *Bidens tripartitus* (V), *Urtica dioica* (V), *Aristolochia clematitis* (V), *Glechoma hederacea* (III). Other species occurred with very low constancy and average cover values. Important and valuable species of the relevés were *Salvinia natans, Cucubalus baccifer, Iris pseudacorus*.

AD-scale (Braun-Blanquet scale) data were reported from three stands in the 1960s. The vegetation of these stands had very scarce canopy. Altogether 77 species were present in them, and dominant species were *Rubus caesius* (V), *Elymus repens* (V), *Calystegia sepium* (V), *Salix triandra* (V), *Calamagrostis epigeios* (V). The only valuable plant species was *Leucanthemella serotina*.

Willow stands along the dikes (kubikfüzes)

Characteristic species of these stands were almost the same as those of the sandbank gallery forests: *Salix alba, Fraxinus pennsylvanica, Rubus caesius,* *Amorpha fruticosa, Bidens tripartitus*. Constancy of *Aristolochia clematitis* was high (IV) but its average cover was rather low in contrast to *Symphytum officinale*, which occurred with high coverage in few stands and had low (II) constancy. The following frequent species occurred in many stands with very low average cover: *Echinocystis lobata* (IV), *Lysimachia vulgaris* (III), *Iris pseudacorus* (III), *Lythrum salicaria* (III). The rest of the plant species was sporadic. The stands were very poor in species according to the relevés, only 31 species were recorded.

Köröszug

Gallery forests

This area lies in the junction of the rivers Tisza and Körös. It can be distinguished from the neighbouring areas because it belongs to the Danube-Tisza Interfluve region in evolutionary aspect.

The following species occurred with high constancy and coverage values in the relevés: *Salix alba* (V), *Fraxinus pennsylvanica* (V), *Amorpha fruticosa* (V), *Populus canescens* (IV), *Bidens tripartitus* (IV), *Rubus caesius* (IV). *Acer negundo* (II) was found just in a few stands with relatively high coverage. *Lysimachia vulgaris* (III), *Echinocystis lobata* (III), and *Urtica dioica* (III) existed in several stands but with low coverage. The other species occurred with low constancy and average cover. Altogether 87 species were present. The only valuable plant was *Allium angulosum*.

Willow stands along the dike (kubikfüzes)

Species occurring with high cover had also high constancy values on the basis of the coenological relevés (*Bidens tripartitus, Salix alba, Fraxinus pennsylvanica, Amorpha fruticosa, Symphytum officinale, Rubus caesius*). The flora of this river section was very poor in species (altogether 44 species were recorded). Its protected plant was *Cirsium brachycephalum*.

According to Timár, the vegetation of these pits along the dike should be less grazed, thus they could function as refugee-area maintaining the biodiversity of the local flora and fauna (Timár 1953). Our field experience did not verify this statement; the reason for this could be the impoverishment of the regional species pool.

Csongrád - Szolnok section

Gallery forests

Recently, the most abundant species in this section was *Fraxinus pennsylvanica*. It occurred in each layers with high coverage thus its average cover value was the highest compared to those of the other plant species. In addition, the following species were found with quite high constancy and cover values: *Populus nigra* (V), *Salix alba* (V), *Rubus caesius* (IV), *Acer negundo* (V), *Amorpha fruticosa* (IV), *Populus alba* (III), *Echinocystis lobata* (III). Among the herbaceous plants *Urtica dioica* had the highest coverage, but this value was quite low compared to the upper layers. The relevés consisted only of 33 species. Apparently woody plantations and invasive species were dominant in the stands.

Some of the relevés date from the end of the 1970s (Horváth *et al.* 1978), and others were recorded in this section more than 60 years ago (Timár 1950). Floristic composition of the stands can be regarded more natural on the basis of ancient data, than of the recent ones. Dominant species were *Rubus caesius, Salix alba, Aristolochia clematitis, Populus alba, Populus nigra*. From among the invasive species only *Amorpha fruticosa* could be reckoned among the dominants. Considering the natural association-forming species, *Salix alba* (V), *Populus alba* (III) and *Populus nigra* (III) were found in the majority of the stands. Hybrid poplar plantations are also present in this section, and their proportion is increasing. Valuable species recorded in this community were *Leucojum aestivum, Gratiola officinalis* and *Eryngium planum*. Altogether 109 species were counted in the old relevés. Compared to this number, the low species number of the recent relevés indicated a very fast impoverishment trend of the community.

Szolnok-Tokaj section

Gallery forests

Újvárosi published a synthetic coenological table from the Szolnok-Polgár section on the basis of 20 relevés (Újvárosi 1940). This article was used by Soó to describe the gallery forest along the Tisza (Soó 1973). In addition to these data we found only 3 further relevés made by Bodrogközy, but they were not comparable with those of Újvárosi and were not included in further numerical analyses.

Bodrogközy's data show observations similar to those recorded in the river sections described above. The herb layer was species rich, 56 herbaceous species were recorded. *Urtica dioica* and *Poa trivialis* were the most dominant, other species occurred sporadically. Shrub layer was sparse, it was composed of mainly *Amorpha fruticosa* and *Celtis australis*. *Cornus sanguinea* was present as the only natural gallery forest shrub species. *Salix alba* and *Populus alba* dominated the canopy.

The species-composition of the canopy was very diverse in Újvárosi's relevés. Beside the generally occurring plants – *Populus alba* (III), *P. nigra* (II) – four willow species – *Salix triandra* (V), *S. alba* (III), *S. fragilis* (III), *S. viminalis* (II) – were detected. Újvárosi revealed *Alnus glutinosa* (I) and *Ulmus glabra* (I) in this river section, which are very rare in Hungary. The shrub layer was rich in natural association-forming species (*Ligustrum vulgare, Rhamnus cathartica, Crataegus monogyna, Frangula alnus, Malus sylvestris, Cornus sanguinea*), but these occurred with very low average cover and constancy values. Only two invasive species (*Amorpha fruticosa, Acer negundo*) were found. Frequent and generalist species of the herb layer were: *Poa palustris* (V), *Aristolochia clematitis* (III), *Calystegia sepium* (III), *Cucubalus baccifer* (III), *Lysimachia nummularia* (III), *Stachys palustris* (III), *Cuscuta lupuliformis* (III), others were sparse. According to the relevés, the flora of this section consisted of 99 species. Valuable plants were: *Cnidium dubium, Epipactis purpurata, Iris sibirica, Leucanthemella serotina, Leucojum aestivum*.

Bodrogzug

Gallery forests

The rivers Bodrog and Tisza join at Tokaj forming a common floodplain, this is the reason why this section is distinguished from the others.

The flora of this river section was rather poor, altogether 95 species were found, but this can be explained with the low number of the relevés.

Frequent and abundant species were *Salix alba* (V), *Populus alba* (IV), *Rubus caesius* (IV), *Populus nigra* (III), *Fraxinus pennsylvanica* (III), *Lysimachia nummularia* (V), *Lycopus europaeus* (V). *Ulmus laevis* reached high constancy but very low AD values in the relevés. Some forest species appeared also in the stands: *Geum urbanum, Angelica sylvestris, Galeopsis pubescens, Aegopodium podagraria*.

Tisza section north of Tokaj

Gallery forests

Most of the relevés taken in this region originate from the middle of the last century and were recorded on AD-scale. Only one stand was represented by relevés taken on percentage scale with 51 species, and its abundant plants were *Rubus caesius, Salix alba, Fraxinus angustifolia, Amorpha fruticosa, Glechoma hederacea.*

Simon documented very thoroughly the vegetation of the upper-Tisza section in the 1950s (Simon 1957). We used mainly his data in the evaluation. In addition to this, Dragulescu took relevés in four stands partly in the Ukrainan section of the river in 1995.

On the basis of the above data, predominating species of the stands were *Rubus caesius* (V), *Salix alba* (IV), *Populus nigra* (IV), *Urtica dioica* (V), *Stachys palustris* (III), *Lycopus europaeus* (III), *Agrostis stolonifera* (III). *Amorpha fruticosa* was missing from Dragulescu's data. In general we can say that a few species had high coverage, and several native accompanying species occurred with low abundance as colouring elements. The number of protected plants was significantly higher in this section: *Acer tataricum, Aegopodium podagraria, Anemone ranunculoides, Athyrium filix-femina, Circaea lutetiana, Clematis vitalba, Convallaria majalis, Leucanthemella serotina, Leucojum aestivum, Polygonatum odoratum*.

This section had the highest species diversity, its flora consisted of 213 species that should be caused by several factors. Continuous species immigration from the surrounding mountainous areas can basically result in higher species number in contrast to the stands developed on the Great Hungarian Plain far away from this species pool. On the other hand, most of the relevés were taken at the 1940-50s, when the intensive human influence that affected more the lowland region was not so considerable, yet.

River Maros

We analysed the gallery forests along the river Maros by dividing the relevés into two groups according to their locality. We distinguished the Hungarian section affected by intensive human land use, and the more natural Romanian stands. Tóth took relevés on Braun-Blanquet scale on the Hungarian section in the 1950s, and we evaluated her data separately from the others (Czúcz, Révész, Margóczi, Makra and Penksza) within the Hungarian section because of different data scales and the long temporal distance.

The following species occurred with high constancy values and average cover in all the relevés *Salix alba, Rubus caesius, Urtica dioica, Populus alba*.

Gallery forests at the Hungarian section

In addition to the above mentioned species, further ones were present with high constancy and average cover values in the relevés of the Hungarian section in the 1950s: *Populus nigra* (IV), *Lysimachia nummularia* (III), *Aristolochia clematitis* (IV), *Calystegia sepium* (V), *Agrostis stolonifera* (IV). Several protected species were also recorded: *Cephalanthera damasonium, Epipactis helleborine, Clematis integrifolia, Leucojum aestivum, Vitis sylvestris*. Total number of the occurring species was 181. Climber plants were represented with low constancy and cover values that could refer to the regular land use and more intensive human disturbances (for example: fishing, basket weaving, brushwood gathering).

In the recently taken relevés lots of adventive species were recorded on the Hungarian section, which had high constancy values (*Amorpha fruticosa* (V), *Acer negundo* (III), *Fraxinus pennsylvanica* (III)). These species often dominated in the lower layers as seedlings and saplings, too. The forest plantations (both hybrid poplar and native trees) occupied large areas on the floodplain and their flora considerably differed from the natural community composition. In the plantations the following species proved to be frequent: *Ulmus laevis, Morus alba, Celtis occidentalis, Quercus robur.* Relevés containing *Populus nigra* (III) and *Populus alba* (IV) can not be distinguished unambiguously from each other. One natural association-forming species, *Cornus sanguinea* (IV) was frequent in the stands and just one protected species (*Epipactis helleborine*) occurred. The flora of this type was composed of 78 species.

Gallery forests at the Romanian section

The species number was significantly higher on the Romanian section, altogether 158 species could be listed. Predominant species of the relevés were *Salix fragilis, Populus alba, Ranunculus repens, Helianthus decapetalus, Sambucus nigra, Amorpha fruticosa*. Many species occurred with high constancy but low coverage: *Agrostis stolonifera* (IV), *Urtica dioica* (IV), *Glechoma hederacea* (IV), *Aegopodium podagraria* (III), *Echinocystis lobata* (III), *Humulus lupulus* (III), *Gallium aparine* (III). Several elements of the mountainous flora were present: *Aegopodium podagraria, Angelica sylvestris, Anthriscus caucalis, Circaea lutetiana, Galeopsis speciosa, Heracleum sphondylium, Polygonatum latifolium, Alnus incana*. Some species protected in terms of the Hungarian law were recorded e.g. *Tamus communis, Telekia speciosa, Clematis integrifolia*.

River Körös

Gallery forests

The research intensity of the gallery forests along the river Körös is not satisfactory therefore we found very few data (only from two stands), and the adequate description of this section needs further researches. The following species occurred in both stands: *Echinocystis lobata, Salix alba, Salix fragilis, Artemisia vulgaris, Urtica dioica*, and these were at the same time the most abundant species. Most of the species fell in the range of +-1 AD values. Altogether 50 species were reported. Rare species of this section was *Alnus glutinosa* from the Romanian section of the White-Körös.

River Bodrog

Gallery forests

The relevés came from four different habitats therefore this analysis can not be considered as representative. Altogether 72 species were reported from the relevés.

Characteristic species of this section were *Rubus caesius, Populus alba, Populus nigra, Salix alba, Fraxinus pennsylvanica, Lemna minor, Spirodela polyrhiza*. Usually one tree species (mainly *Populus nigra* or *Salix alba*) was dominant in the canopy, others were present with lower coverage. In some cases, the values of the synthetic table could be misleading because of the few relevés. For example: *Convallaria majalis* occurred with high average cover, but had very high abundance just in a single relevé (85 %) of one stand. Protected/valuable species which appeared in the relevés were not very typical of gallery forests, they indicated other environmental influences (mountainous climate, permanent water cover): *Leucojum aestivum, Convallaria majalis, Iris graminea, Salvinia natans, Pyrus pyraster*.

River Szamos

Gallery forests

We evaluated the gallery forests along river Szamos on the basis of data from eleven stands. Data came from Dragulescu and Simon (Simon 1957). *Salix alba* was found in the highest coverage in certain places mixed with *Salix fragilis* and *Populus nigra*. The following species were dominant: *Rubus caesius* (V), *Populus nigra* (IV), *Salix alba* (V), *Amorpha fruticosa* (III) in most of the relevés. *Populus alba* had no important role, it was recorded only in four stands out of the eleven with +-1 AD values. Further frequent species were *Agrostis stolonifera, Urtica dioica, Helianthus decapetalus, Calystegia sepium, Taraxacum officinale* in the herb layer. *Amorpha fruticosa* was a typical element of the vegetation composition just at the region of Szamosbecs, in other sites it was present with much lower AD and constancy values.

Further 10 cenological relevés were taken by Fintha at Szamosbecs (Fintha 1969), but he used a modified AD scale with unknown scaling therefore his data are not included in this paper.

Multivariate evaluation

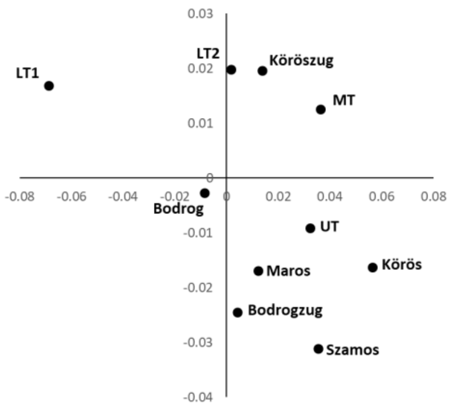

Fig. 2. Scatterplot of the ordination of gallery forest relevés (NMDS, ordinal variable, Gower index). Only centroids of ten groups are marked. LT1: Lower Tisza section 1; LT2: Lower Tisza section 2; MT: Middle Tisza section; UT: Upper Tisza section.

Two hundred and fifty relevés were evaluated with Non-metric Multidimensional Scaling (NMDS, ordinal variable, Gower index). Number of species was rather high, some 400 species were recorded in the relevés but only 223 species occurred with more than 1% frequency. Due to the large number of relevés, we do not indicate all the points in Figure 2 but the centroids of the ten regional groups. The points do not show marked aggregations, the groups broably overlap; only a weak trend can be detected from lower Tisza sections towards the Northern border. Centroids (and also the point clouds) of upper Tisza, Szamos, Bodrog, Körös and Maros are comparatively separated from the others, indicating a certain effect from the Transylvanian floristic region.

Summarised evaluation

Considering all the river sections and tributaries, we can draw the following conclusions:

1. *Salix alba, Populus nigra, Rubus caesius* and *Urtica dioica* can be regarded as constant association-forming elements (occurring with high constancy and average cover). Other frequent species were *Lysimachia nummularia, L. vulgaris, Glechoma hederacea.*

2. *Populus alba* and *Populus nigra* occurred with changing constancy values along the river.

3. The classification of the willow-poplar gallery forests existing along river Tisza is difficult according to the recent nomenclature on the basis of the available relevés. First of all, the samples do not completely fulfil the statistical requirements, thus the proportion of certain association types and the differences among the stands can not be regarded as representative of the whole Tisza section. Lots of background information are missing (for example: exact locality of the stands, relief characteristics, quadrate size, complete coenological data including the whole vegetation period, number of the relevés taken in a single stand etc.).

Recently, majority of the stands is plantation in the whole Tisza valley (mainly in the lower and middle Tisza sections), in contrast to Timár's experiences in the 1950s (Timár 1953). Therefore, the natural and semi-natural vegetation types were forced back into small patches. Considering the relevés of the more natural upper sections we can say, that the three tree species characteristic of the willow-poplar gallery forests (*Salix alba, Populus nigra, Populus alba*) were not segregated exactly on association-level, they occurred together in most of the stands. This mixed species-composition was confirmed by the multivariate analyses, too. The explanation of this phenomenon should be that the natural processes could not play an important role and the segregation of the association-forming species could not be realized effectively at the extremely fragmented and reduced floodplain. The relief differences, which are important in the development of certain association types, are mainly absent from the recent inundation area, too.

4. Constant and dominant species in the shrub layer was *Rubus caesius* in each section. According to literature data, the *Rubus caesius* facies of the gallery forests is one of the most widespread types, and it could turn into a secondary, strongly degraded form, which is very poor in species, due to the permanent and intensive grazing (Kárpáti 1958/a). In his compendium, Soó also distinguished a *Rubus caesius* facies, and qualified it as a secondary type (Soó 1964). Timár mentioned that the gallery forests along the dikes were pastured almost everywhere in the lower Tisza section, and therefore they became weedy, and *Rubus caesius* also dominated these stands (Timár 1953). According to Borhidi and Kevey, the increase of *Rubus caesius* indicates the drying of the area (Borhidi *et al.* 1999).

With the previous statements we wanted to emphasize that the reason why *Rubus caesius* could become one of the most dominant elements in the floodplain forests is the gradual drying up of the area after the water regulation. Grazing has the same effect as the drying due to the strong trampling.

5. The dominance of *Urtica dioica* in the herb layer is indicative of the high nitrogen content of the soil. According to the ecological indicator values by Borhidi, it indicates the hyperfertilized soils (Horváth *et al.* 1995).

6. *Bidens tripartitus* appeared in the stands of the lowland section and along the tributaries with quite high constancy values. We experienced that in the herb layer the real abundance of *Bidens tripartitus* and some other species (mainly the invasive plants as *Amorpha fruticosa, Acer negundo* etc.) could be estimated best

at the end of summer. Earlier the seeds are dormant, therefore it is easy to underestimate the abundance of these species.

7. *Calystegia sepium* performed with high (IV-V) constancy values in the archive relevés, but in the recent vegetation it became insignificant (K=I-II). On the basis of the ecological indicator values, this species indicates nitrogen-rich and water-saturated soil (Horváth *et al.* 1995). Consequently, its decrease along the River Tisza is connected with the drying processes.

8. Comparing the Romanian and the Hungarian sections of the Maros, we found that there was a lot more species with high constancy values at the Romanian section: 19 species occurred with IV-V constancy. Its explanation should be that species can still spread easily among the stands there; the fragmentation of the natural habitats is not so considerable.

9. Several data support the role of the River Tisza and its tributaries in maintaining the species-dispersion (Gallé *et al.* 1995, Gallé 2002, Gallé 2003). This process is traceable by the changing constancy values of the easily spreading invasive species in different river sections and in time.

9.1. *Fraxinus pennsylvanica* was present with low constancy and abundance (K=1, range of the Braun Blanquet scale: +-1) in the archive relevés of the Upper-Tisza, but in the recent relevés it became very dominant element (K=V: southern frontier-Csongrád, Csongrád-Szolnok, Köröszug, K=III: Bodrogzug). Its spreading was forced by the natural disturbances, the intensive human land-use and the increasing proportion of the forest plantations.

9.2. In recent data, *Amorpha fruticosa* occurred with high abundance and constancy (K= IV-V) in most of the stands on the whole Hungarian section of River Tisza, contrasting with the archive records, in which it was found with far lower constancy values (K=I-II).

Amorpha fruticosa was missing from the 1991 relevés of the Romanian section of River Maros, but in other sections it was present with constancy III-IV. *Amorpha fruticosa* was detected with constancy III by Tóth at the Hungarian section in the 1960s.

9.3. The spreading process of *Fraxinus pennsylvanica* was very similar to that of *Amorpha fruticosa. Fraxinus pennsylvanica* was absented in the archive and recent relevés of the Romanian section, but was present with constancy III at the Hungarian section of river Maros.

From the above data, it can be assumed that these species spread from the inundation area of River Tisza towards the Romanian section of River Maros oppositely with the direction of flow. This is due to the fact that *Fraxinus pennsylvanica* was planted mainly along the Tisza basin, and spread spontaneously towards the Maros.

9.4. *Acer negundo* did not appear in as large quantities in the inundation area as *Fraxinus pennsylvanica*. It was found in larger proportion mainly in the lowland section of Tisza. It occurred also along the tributaries with abundance increasing in time.

9.5. According to some field experiences the colonisation of the above mentioned invasive species should depend on the quantity of seeds arriving at a single habitat-patch, and is not influenced by the relief, soil and microclimate conditions of the habitat.

Coenological characteristics of the flora of the willow scrubs and gallery forests

We compared the willow scrub and gallery forest communities on the basis of the coenological affinity of their flora. We used the revised Soó's coenosystematic classification system (Horváth *et al.* 1995), and evaluated the flora of the relevés along the river Tisza and its tributaries (since the sampling methods were not standardized the cover values were not considered, we used only the presence/absence values). It was necessary to set up a new category for the adventive species missing from the system, because they have a strong effect on the floodplain plant communities.

Altogether 252 species were recorded in the relevés of the willow scrubs, including the introduced alien species, too. The analysis was performed from 240 species because the remaining species were not classified in the Soó's system. The relevés of the gallery forests consisted of 433 species, 416 of which were included in the analysis.

Conclusions at division level

The species of the willow scrub communities were classified in 9 categories plus in an adventive category. The gallery forest species belonged to 13+1 (adventive) categories. This difference may be caused by more variable habitat conditions in the gallery forest stands.

Eighty eight per cent of the flora of willow scrubs and 80 % of the gallery forest species were included in the following four categories:

1. Indifferent species

This group is the largest in both community types. It gives 39 % of the willow scrub flora, and 28 % of the gallery forest flora. These species are generalists and have wide tolerance spectrum, thus the regularly developing sediment surfaces may provide an ideal colonization site for them. These conditions are more frequent in the habitats of the willow scrub (shores and sandbanks), therefore this could partly explain the marked differences among the flora of the two associations.

Another explanation should be the different level of organization of the two associations. The more extreme habitat conditions of the willow scrubs could not allow the development of a plant community with highly organized and more or less constant species pool. Alluvial soils developing usually every year could provide excellent colonization sites for any kind of propagules. However, the gallery forests developed on a little higher relief in wider extent, thus the organization of the stands is higher. Later association could filter the species pool.

2. *Chenopodio-Schleranthea*

The division contains the plant associations of the disturbed habitats. This category roughly gives the same proportion of the flora in the case of both associations (willow scrubs: 28 %, gallery forests: 24 %). This indicates that the two habitats do not differ significantly from each other in respect of the disturbation effects.

3. *Cypero-Phragmitea*

Greater difference was detected between the two associations in respect of the *Cypero-Phragmitea* species. The proportion of these species in the willow scrubs – 14 % – gives almost the double to the species of the gallery forests (8 %). This strong difference may be explained by the number of *Nanocyperion* species colonizing in high proportion on the crude alluvial soils along the riverside.

Considering the species number instead of the proportion, the result is different a bit: partly different species (elements of large sedge communities, reed beds and amphibious communities) but broadly in the same number are present in the two community types.

4. *Querco-Fagea*

The species of this division are characteristic of the gallery forests. They give 20,6 % of the total species pool. Regarding the willow scrubs this category shares just 6,6 % in the flora. This shows the close connection of the gallery forests towards the mesophilous oak woods and the hardwood forests.

Floristic characters at lower syntaxonomic levels

The species of *Calystegion sepium* alliance were represented in both community types in a considerable proportion (they gave 3,7 % of the flora of the willow scrubs and 5,3 % of the gallery forest). This means 9 species in the willow scrubs, and 13 species in the gallery forests. All the 9 species of the willow scrubs occurred also in the gallery forest. Certain adventive species associated so strongly to this coenotaxon that they may be considered as members of the group

Calystegion sepium (for example: *Acer negundo, Amorpha fruticosa, Echinocystis lobata*).

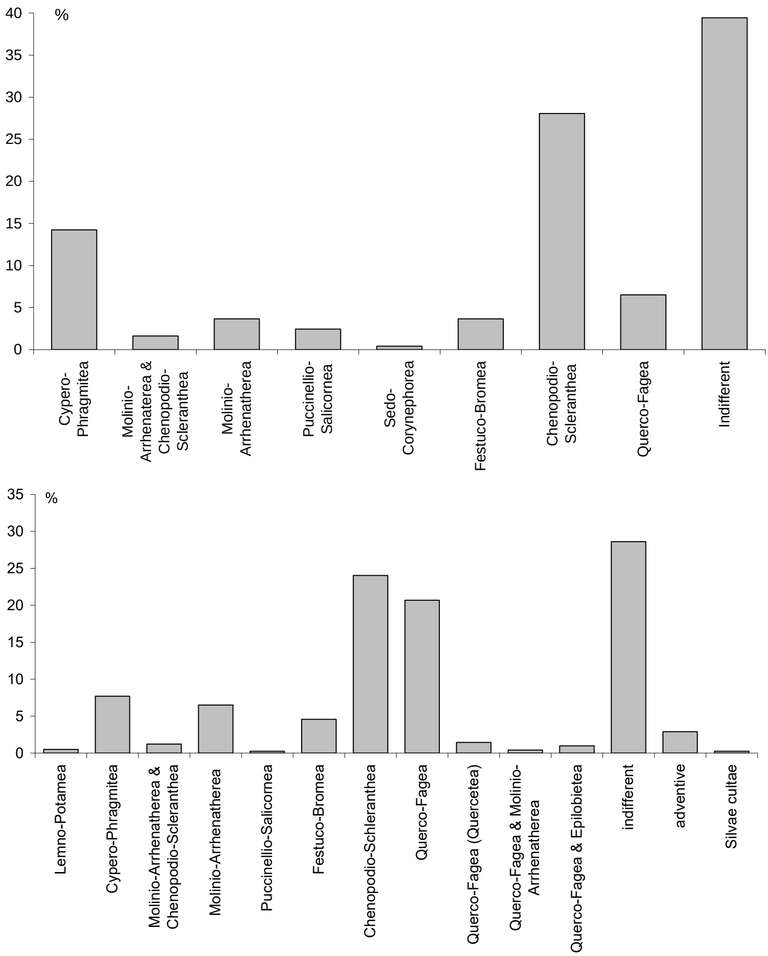

Fig. 3. Percentage distribution of the species belonging to coenosystematic categories at division level. The indifferent and more or less indifferent species are put together.

Salicion triandrae and *Salicion albae* species were present with almost the same weight in the species pool of the willow scrubs. *Salicion triandrae* was represented with the same two species (*Salix triandra, S. viminalis*) in both associations. Six species of *Salicion albae* alliance occurred only in the gallery forests and gave 2,1 % of the flora (*Leucojum aestivum, Rumex obtusifolius, Epipactis purpurata, Carduus crispus, Vitis sylvestris* and *Alnus incana*).

As it was expected, the order *Nanocyperetalia* shared in the flora of the willow scrubs in higher proportion (4,58 %). This may refer to the favourable habitat conditions rather than the biotic connections.

The species of *Molinietalia* order shared in the flora of the gallery forests in 2,6 %. Species of large sedge communities and flood swards could colonize the herb layer since the canopy of this forest was open.

Fagetalia species gave 1,25 % of the flora of the willow scrubs and 4,08 % of the gallery forests (*Alno-Padion* shared in 0,96 %). This indicates again the floristic connection between the gallery forest and mesophylous oak woods and hardwood forests.

As for the composition of the flora of the willow scrubs, 70,4 % of its species were also the components of the gallery forests. Further species are ranked as cultivated plants (2,8 %), amphibious and ruderal species (26,8 %). Thus, no species was found characteristic exclusively for the willow scrubs.

There are several causes of this:

1. Influences of the coenotaxonomic system on the sampling methods: at the beginning, the willow scrubs were not considered a separate association, thus during the sampling of the gallery forests some parts of the willow scrub stands were included in the quadrate, and its species were recorded as the species of the gallery forests.

2. The floristic composition of these two habitat-types is very similar. The flora of the willow scrubs differs from that of the gallery forest mainly in the dominant tree species which determine the physiognomy of the stands, and in the presence of *Nanocyperion* species. The lower shrub- and the herb layers contain almost the same species. This may be explained with the natural disturbations which are the most important processes, thus influencing the species composition. The disturbance tolerant species are present in both associations; certain differences are detected on stand level depending on the successful colonization after the floods. Considering the abundance relation of the species, however, we found greater differences among the two vegetation types.

Adventive species in the floodplain forests

Most of the adventive species have already been classified in certain coenosystematic categories, but considering their very important effect on the floodplain forest communities, we analyzed them in more detail. We used the categories of the invasive neophytes for the separation of the adventive species according to Mihály *et al.* (2004).

Fifteen invasive neophyte species occurred in the willow scrubs (6,25 % of the flora): *Acer negundo, Amaranthus retroflexus, Ambrosia artemisiifolia, Amorpha fruticosa, Conyza canadensis, Echinocystis lobata, Erigeron annuus* ssp. *strigosus,* *Galinsoga parviflora, Oxalis stricta, Robinia pseudo-acacia, Solidago gigantea* ssp. *serotina, Xanthium italicum, Xanthium spinosum, Oenothera biennis, Panicum miliaceum.*

The following invasive neophytes were present in the gallery forests (29 species, 6,9 % of the flora): *Acer negundo, Ailanthus altissima, Ambrosia artemisiifolia, Amorpha fruticosa, Artemisia annua, Bidens frondosa, Celtis occidentalis, Conyza canadensis, Cuscuta campestris, Cyperus difformis, Echinocystis lobata, Erigeron annuus* ssp. *annuus, Erigeron annuus* ssp. *strigosus, Fallopia japonica, Fraxinus pennsylvanica, Galinsoga parviflora, Helianthus decapetalus, Impatiens parviflora, Juncus tenuis, Oenothera biennis, Oxalis stricta, Parthenocyssus inserta, Robinia pseudo-acacia, Rudbeckia laciniata, Solidago canadensis, Solidago gigantea* ssp. *serotina, Vitis riparia, Xanthium italicum, Xanthium spinosum.*

Above species lists suggest that significantly fewer invasive neophytes occurred in the willow scrubs than in the gallery forests, and this contradicts to the opinions (in connection with the indifferent species) that the willow scrubs are more open to the generalist species, and their stands are less organized than those of the gallery forests. The virtual contradiction should be due to the timing of the sampling: the relevés of the willow scrubs were taken in the 1950s when much fever invasive species should have been present in the floodplain of river Tisza. This hypothesis needs further investigations to verify because probably the forest management and land use affected also the colonization and spread of the adventive species.

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X. MEZOPHILOUS DECIDUOUS FORESTS – FAGETALIA SYLVATICAE

Balázs Kevey

Mezophilous deciduous forests are classified into the order *Fagetalia*. Of the forests on the Tisza floodplain, the oak-ash-elm forests (*Fraxino pannonicae-Ulmetum*) and the oak-hornbeam forests (*Circaeo-Carpinetum*) belong to this order. The former association is a representative of the *Alnion incanae*, while the latter represents the *Fagion sylvaticae* alliance.

Alnion incanae Pawłowski in Pawłowski *et al.* 1928

Within the alliance of the hardwood gallery forests, *Alnenion glutinosae-incanae* Oberd. 1953 and *Ulmenion* Oberd. 1953 suballiances are distinguished.

Alnenion glutinosae-incanae Oberd. 1953

Of the hardwood gallery forests, the alder gallery forests occur in habitats that are a little closer to the groundwater than those of the oak-ash-elm forests. On the Hungarian Plain, and therefore along the Tisza river, they are very rare. In this suballiance, only one association, the plain alder gallery forest (*Paridi quadrifoliae-Alnetum*), has been reported from the area.

X.1 *Paridi quadrifoliae-Alnetum* Kevey in Borhidi et Kevey 1996

Syn.: *Fraxineto-Ulmetum alnosum* Soó 1943 p.p.

Habitat characteristics

The alder-domiated forests occurring on the floodplains of the lowland rivers have been considered for long a consociation (Soó 1940, 1943) or subassociation (Jurko 1958) of the oak-ash-elm gallery forests (*Fraxino pannonicae-Ulmetum*). Our research in the Szigetköz (Kevey 1993, Kevey in Borhidi and Kevey 1996) and along the Dráva river (Kevey 2006) has demonstrated that these forest stands should be regarded a distinct association, *Paridi quadrifoliae-Alnetum*. Recently, similar alder gallery forests have been found in other areas of the Hungarian Plain (Hanság, Rábaköz, Marcal-medence, Mezőföld, Harkány-Nagynyárád plain, Nyírség, Bereg-Szatmár plain).

The alder gallery forests of the plains cover the low-lying, local depressions of the higher floodplain. Before the regulation of the rivers, they could have been flooded only during very high flood levels. Today they occur only outside of the dikes. Their habitats differ substantially from those of the alder gallery forests of the mountains and hilly areas, where they occur along more or less rapid streams. The alder gallery forests of the plains typically inhabit areas along very slow streams and still waters. Typical stands are found on somewhat higher reliefs surrounding alder swamps, or on moist, lower reliefs within oak-ash-elm forests. They generally occur on hard, alluvial forest soils. However, the soil of the alder gallery forest right next to swamps may contain a certain amount of decaying peat. Since the habitat of this association is primarily determined by groundwater, the association is edaphic.

Physiognomy

The size of the alder gallery forests of the plains is generally small. Often, they occur in a narrow stripe next to alder and willow swamps. Their presence is nevertheless apparent, and should not be ignored. The alder forests bordering mountain streams are not larger either, and there are as broad as 40-50 m alder gallery forests on the plains.

The canopy of the alder gallery forests studied in the Nyírség covers 65-80 % with height of 25-28 m. The dominant tree is *Alnus glutinosa*, but *Fraxinus angustifolia* ssp. *pannonica* may play a similar role in the structure of the association. The lower canopy layer is 13-18 m high covering 20-40 % of the ground surface. *Alnus glutinosa, Fraxinus angustifolia* ssp. *pannonica* and *Ulmus laevis* occur in it in small groups. The bush layer is more or less well developed. It is composed mostly of *Cornus sanguinea, Corylus avellana* and *Sambucus nigra*, and the saplings of some tree species (*Fraxinus angustifolia* ssp. *pannonica, Ulmus laevis, Ulmus minor*). The cover of the herbaceous layer is 70-95 %, with the following species becoming locally abundant: *Aegopodium podagraria, Allium ursinum, Brachypodium sylvaticum, Circaea lutetiana, Glechoma hederacea, Polygonatum latifolium, Rubus caesius, Stachys sylvatica*. On the Bereg-Szatmár plains, *Galeobdolon luteum* and *Leucojum vernum* may be added to this list.

Early spring aspect of the alder gallery forests is usually well expressed. Characteristic species are *Allium ursinum, Anemone ranunculoides, Ficaria verna* and *Lathraea squamaria*. On the Bereg-Szatmár plain, these species are accompanied by *Anemone nemorosa, Gagea lutea, Galanthus nivalis* and *Leucojum vernum*.

Species composition

The alder gallery forests in the Nyírség are less typical than those found in the Szigetköz and on the Dráva plain. Their species combination is more similar to that of oak-ash-elm forests. Nevertheless, the weighted proportion of species characteristic of swamps (*Alnetea glutinosae* s.l.: 5.7 %) is the highest here indicating the successional past of the association. In the herb layer, some elements of the wet meadows with peaty soil (*Molinio-Juncetea, Molinietalia coeruleae*) may also appear. Characteristic species of the softwood (*Salicetea purpureae* s.l.: 4.6 %) and hardwood gallery forests (*Alnion incanae* s.l.: 11.6 %) as well as the mezophilous deciduous forests (*Fagetalia*: 12.7 %) play a significant role of the species composition.

Characterization of the species composition of the alder gallery forests of the Bereg-Szatmár plain based on a single relevé is not meaningful. There are, however, some unique or rare species, such as *Anemone nemorosa, Gagea spathacea, Leucojum vernum* and *Oenanthe banatica* that have been found in this stand. In the Nyírség, rarities occurring in these forests include *Lilium martagon, Listera ovata* and *Veratrum album*.

Distribution of alder gallery forests on the Tisza plain

The plain alder gallery forests (*Paridi quadrifoliae-Alnetum*) are very rare on the Tisza plain. Some small stands are found at the southeastern part of the Nyírség, such as at Nyírábrány „Mogyorósi-erdő", Terem „Nagyfenék", as well as between Tiborszállás and Mérk „Vadaskerti-erdő" (Kevey 2006). According to Papp L. (*ex verb*.) the alder occurs in Nyírség only as a planted tree, although at the above sites it seems to be native. On the Bereg-Szatmár plain, only a single small fragment of alder gallery forest has been located next to Beregdaróc in „Dédai-erdő" (Kevey 2006).

***Ulmenion* Oberd. 1953**

Relative to alder gallery forests, associations inhabiting areas somewhat higher (i.e., at greater distance) from the groundwater table are classified into the suballiance of *Ulmenion*. As one of the white poplar gallery forests named *Fraxino-Populetum* Jurko 1958 is classified into this suballiance by Jurko (1958), Oberdorfer (1992), and Wallnöfer *et al*. (1993) rather than into the softwood gallery forests, we discuss the white poplar gallery forests of the Hungarian Plain (*Senecioni sarracenici-Populetum albae*) here together with the oak-ash-elm gallery forests (*Fraxino pannonicae-Ulmetum*).

X.2 *Fraxino pannonicae-Ulmetum* Soó in Aszód 1935 corr. Soó 1963

Syn.: *Fraxineto-Ulmetum* Soó 1937; *Ulmeto-Fraxineto-Roboretum* Simon 1950; *Ulmeto-Roboretum* Hargitai 1938–1939; *Querceto-Fraxineto-Ulmetum* Soó 1943, Ujvárosi 1940, Balázs 1943; Ubrizsi 1956, Simon 1957.

Habitat characteristics and zonality

The oak-ash-elm gallery forests are the climax community in the successional series on the floodplains. They are found on the higher floodplain of the Tisza and its tributaries, where flooding occurs at extremely high water levels only. The majority of these forests are protected from floods by dikes, but on the Bereg-Szatmár plain (for example, Gergelyiugornya „Bagiszegi-erdő”) and Bodrogköz (for example, Sátoraljaújhely „Long-erdő”; Vámosújfalu „Papok-erdeje”) there are some forests exposed to flooding even today.

The oak-ash-elm gallery forests (*Fraxino pannonicae-Ulmetum*) succeed the white poplar gallery forests (*Senecioni fluviatilis-Populetum albae*) as a result of sedimentation in the habitat and accumulation of deposits. They may directly border slow streams and brooks on the plain, as at several places in the eastern Nyírség (for example, Bátorliget „Veres-folyás”, „Fényi-erdő”, Terem „Nagyfenék”). They may also occur at a distance from rivers and other water bodies at locations where the groundwater level is high enough (for example, Debrecen „Halápi-erdő”, „Nagy-erdő”; Nyíradony „Gúthi-erdő”). Natural sedimentation of swamps may also lead to the development of these forests (pl. Csaroda „Nyíres-tó”; Vámospércs „Jónás-rész”). Alder gallery forests (*Paridi quadrifoliae-Alnetum*) may also occasionally occur in between the shrinking alder swamps (*Fraxino pannonicae-Alnetum*) and oak-ash-elm gallery forests (*Fraxino pannonicae-Ulmetum*).

These forests represent a transitional stage between the higrophilous and mezophilous deciduous forests. Their soils are typically humus-rich alluvial forest soils showing some signs of transition to brown forest soils. They are less moist compared to the soils of alder gallery forests. The water balance of these soils is influenced by the course of the rivers and streams, and the height of the groundwater table, as well as the physical characteristics of the alluvial deposits (pebble, sand, silt or loess). As the characterisics of the oak-ash-elm gallery forests on the plains are significantly influenced by the groundwater, they are regarded as edaphic associations.

Physiognomy

The height of canopy layer of the oak-ash-elm gallery forests is at about 25-30 m with a cover of 60-85 %. When trees are less dense covering about 30-40 %, the lower canopy layer is well-developed. The dominant trees are *Fraxinus angustifolia* ssp. *pannonica* and *Quercus robur*, although occassionally white poplar (*Populus alba*) may form a consociation. Both elm species, *Ulmus laevis* and *U. minor,* were much more abundant in the past until the elm disease decimated their populations. Today they occur only in small groups or as scattered individual trees.

The lower canopy layer is variable in both percentage cover (10-60 %) and height (8-20 m). The young specimens of *Ulmus laevis, U. minor* and *Fraxinus angustifolia* ssp. *pannonica* are characteristic in this layer, and *Prunus padus* also appears at several locations. Some lianas, such as *Clematis vitalba, Hedera helix* and *Vitis sylvestris* even reach this layer. The shrub layer varies widely in cover and height (5–80 %, 2–5 m, resp.), which may be attributed to forestry practices. It mainly consists of *Cornus sanguinea, Corylus avellana* and *Prunus padus,* but at some places *Sambucus nigra* and the shrub-sized individuals of certain trees (*Acer pseudo-platanus, Fraxinus excelsior*) are abundant. In the lower shrub layer (the layer of saplings) sometimes *Hedera helix* becomes locally abundant. The cover of the herbaceous layer varies between 20 and 100 %. The following species may be locally dominant: *Aegopodium podagraria, Allium ursinum, Anemone nemorosa, Anemone ranunculoides, Convallaria majalis, Corydalis cava, Corydalis solida, Equisetum hyemale, Ficaria verna, Galeobdolon luteum, Galium odoratum, Mercurialis perennis, Polygonatum latifolium, Vinca minor*. The early spring aspect is particularly characteristic with the following species: *Allium ursinum, Anemone nemorosa, Anemone ranunculoides, Corydalis cava, Corydalis solida, Crocus heuffelianus, Ficaria verna, Fritillaria meleagris, Gagea litea, Gagea spathacea, Galanthus nivalis, Isopyrum thalictroides, Leucojum vernum, Scilla kladnii, Scilla vindobonensis.*

Species composition

Compared to alder gallery forests, the proportion of species characteristic of marshes (*Phragmitetea* s.l.) and meadows on peaty soil (*Molinio-Juncetea* s.l.) is smaller in the oak-ash-elm gallery forests. Similar tendencies are apparent in the species characteristic of softwood gallery forests (*Salicetea purpureae* s.l.) and alder swamps (*Alnetea* s.l.). These data suggest that the habitat of the oak-ash-elm gallery forests is less moist, than that of alder gallery forests. Species of the mezophilous deciduous forests (*Querco-Fagetea*, *Fagetalia*) and hardwood gallery forests (*Alnion incanae*) play the greatest role in this association. They are partly demontane elements dispersed here via the rivers, and the rest are remnants of the Bükk I. age (Zólyomi 1936, 1952) with a cooler, more even climate. Interestingly, the species of dry oak forests (*Quercetea pubescentuis-petraeae*) occur in similar proportions, which is likely related to the current habitat conditions of the majority of these forests outside of the dikes.

In the species composition of the oak-ash-elm gallery forests of the various regions, significant differences may be observed in some cases. With respect to the weighted proportion of characteristic species, stands of the Bodrogköz are the most similar to white poplar gallery forests (*Senecioni sarracenici-Populetum albae*), because species characteristic of swamps (*Cypero-Phragmitea* s.l.: 4.0 %) and softwood gallery forests (*Salicetea purpureae* s.l.: 7.1 %) are the most abundant here. Oak-ash-elm gallery forests of the eastern Nyírség and the Bereg-Szatmár plains are the most similar to the oak-hornbeam forests because of the higher proportions of *Fagetalia* species (20.1 %, and 19.0 %, respectively). In the oak-ash-elm gallery forests of the western Nyírség, the proportion of dry oak forest species (*Quercetea pubescentis-petraeae* s.l.) is the highest (17.5 %), and that of the mezophilous deciduous forests (*Fagetalia*) species (7.7 %) is the lowest, rendering them more similar to closed oak forests on sand (*Convallario-Quercetum roboris*). This phenomenon is partly caused by the climatic differences, since the western half of Nyírség is adjacent to the Tisza plain with a more continental, dry climate.

The oak-ash-elm gallery forests harbor a number of characteristic but rare species that differ from region to region. These species mostly play an insignificant role in the association, but can be used to characterize the association, since they are usually relics of earlier times. The majority of the species has not been found to occur along the Danube (indicated by an asterisk): *Carex strigosa* (Bereg-Szatmár plain), *Chrysanthemum serotinum** (Bodrogköz), *Crocus heuffelianus** (Bereg-Szatmár plain), *Fritillaria meleagris** (Bereg-Szatmár plain), *Gagea spathacea** (Bereg-Szatmár plain), *Leucojum vernum** (Bodrogköz, Bereg-Szatmár plain), *Melampyrum nemorosum* ssp. *debreceniense** (Nyírség), *Melica picta** (Nyírség), *Oenanthe banatica** (Bereg-Szatmár plain, eastern edge of Nyírség), *Scilla kladnii** (Bodrogköz, Bereg-Szatmár plain, eastern edge of Nyírség), *Scrophularia scopolii** (Bereg-Szatmár plain, Körös-valley), *Tamus communis** (Körös-valley), *Thalictrum aquilegiifolium** (Körös-valley), *Tilia tomentosa* (Nyírség, Bereg-Szatmár plain).

Distribution of oak-ash-elm gallery forests on the Tisza plain

Relatively large stands of oak-ash-elm gallery forests in natural conditions are found in the vicinity of the Körös rivers: Békéscsaba „Fácános”, „Pósteleki-erdő”; Bélmegyer „Szolga-erdő”; Doboz „Faluhelyi-erdő”, „Gerlamarói-erdő”, „Papholt-erdő”, „Madárfoki-erdő”, „Sebesfoki-erdő”; Gyula „Gelvács”, „Körös-erdő”, „Kutyahelyi-erdő”, „Mályvádi-erdő”, „Sitka”, „Város-erdő”; Sarkad „Remetei-erdő”; Szarvas „Erzsébetliget” etc. (Máthé 1936, Ubrizsy 1956, Kevey 2006). Their area has been steadily decrasing due to the expansion of hybrid poplar plantations.

The greatest number of stands of oak-ash-elm gallery forests with unique species composition occur on the Bereg-Szatmár plains: Beregdaróc „Dédai-erdő”,

„Közös-erdő”; Csengersima „Géci-erdő”; Fehérgyarmat „Birhó-erdő”; Jánkmajtis „Jánki-erdő”; Kérsemlyén „Bakonya-erdő”; Kömörő „Páskom”; Mánd „Mándi-erdő”; Olcsva; Szamosszeg „Grófi-erdő”; Tarpa „Kőris-erdő”, „Nagy-erdő”, „Téb-erdő”; Tiszakerecseny „Lónyai-erdő”; Tiszavid; Vámosatya „Bockereki-erdő”; Turricse „Ricsei-erdő”; Vásárosnamény „Bagiszeg-erdő”, „Szamoszug”, etc. (Hargitai 1943, Simon 1950, 1951, 1957, 1960, Kevey 2006.).

In the Nyírség, this association is much rarer. In the western part, it occurs only as fragments with atypical species composition: Debrecen „Halápi-erdő”, „Monostori-erdő”, „Nagy-erdő”, „Nagycserei-erdő”; Nyírábrány „Kőrises”, „Mogyorósi-erdő”; Nyíracsád „Jónás rész”; Nyíradony „Gúthi-erdő”; Újfehértó „Ángliusi-erdő”. The gallery forests found at the southeastern edge of Nyírség are much more typical: Bátorliget „Fényi-erdő”, „Veres-folyás”; Nyírvasvári „Csirák”; Terem „Nagyfenék”; Tiborszállás „Vadaskerti-erdő” (Soó 1937, 1938a, 1943, Kevey and Papp in Kevey 2006). These stands, however, are located in the sea of black locust plantations as isolated units.

In the Bodrogköz, only very few stands of oak-ash-elm gallery forests have succeeded to survive the last century (Becsked „Becskedi-erdő”; Dombrád; Pácin „Mosonnai-erdő”; Sátoraljaújhely „Long-erdő”; Tiszacsermely; Vámosújfalu „Papok-erdeje”). Along the Tisza and its tributaries below the city of Tokaj, there are fewer and fewer gallery forests whose species composition is less and less typical (Tiszadob „Bárányszeg”, „Fűz”, „Nagysózó”, „Őserdő”, „Szent-erdő”, „Sziget”, „Tölgy-erdő”, „Zátony”; Tiszaladány „Nagytölgyes”; Sajólád „Kemely-erdő”; Lakitelek „Tős-erdő”) (Hargitai 1938–1939, Ujvárosi 1940, 1941, Molnár 1996, Tuba 1994, 1995, Gál *et al.* 2006, 2007, Kevey 2006).

Finally, oak-ash-elm gallery forests also occur beyond the state borders on the Tisza plain. They occur at the boundary of Nyírség and the Szatmár-Bereg plain near Nagykároly and Erdőd (Balázs 1943), as well as along the Maros river (Margóczi ined.). At the lower reaches of the Tisza, Kovács F. (1915) reported a stand with *Allium ursinum* in it (Óbecse „Árpád-liget”), which was exterminated during the regulation of the river.

Fagion sylvaticae Luquet 1926

The mezophilous deciduous forests of the hilly and mountaineous areas of Central-Europe are classified into the alliance of *Fagion sylvaticae*. Some associations of this alliance may be found on the low plains. They are the most diverse in regions with atlantic and subatlantic climate on the continent. Their distribution is limited southward by other alliances (*Aremonio-Fagion, Symphyto cordatae-Fagion, Geranio versicoloris-Fagion*) that are of relic character, species rich and are under submediterranean climatic influence.

***Carpinenion betuli* Issler 1931**

The suballiance of *Carpinenion betuli* includes only those mezophilous forests, in which hornbeam is associated with either *Quercus robur* or *Q. petraea*. The associations belonging to this suballiance occur generally on deep soils, and are zonal or extrazonal. In habitats with more extreme climatic conditions or high groundwater table, they replace beechwoods. On the Hungarian Plains there is only one association known to occur (*Circaeo-Carpinetum*).

X.3 *Circaeo-Carpinetum* Borhidi 2003

Syn.: *Carpinetum* Soó 1937; *Querceto-Carpinetum hungaricum* Soó 1943; Balázs 1943; Simon 1950; *Ulmeto-Querceto-Carpinetum* Hargitai 1943; *Querco robori-Carpinetum* Soó et Pócs in Soó 1957 em. Soó 1980 p.p.

Habitat characteristics and zonality

The oak-hornbeam forests of the Bodrogköz (Hargitai 1938–1939, Tuba 1994, 1995, Gál *et al.* 2006, 2007, Kevey 2006) and the Bereg-Szatmár plains (Hargitai 1943, Simon 1950, 1951, 1957, Kevey 2006) occur in the vicinity of rivers and on the highest areas of the floodplain where the chance of being flooded is almost zero. Nevertheless, it is evident that these habitats must have been created by exceptionally high floods (such as caused by pack ice). This association may develop farther away from the rivers where high groundwater levels provide the necessary moisture and humidity (for example, Beregdaróc „Dédai-erdő"). Along the rivers, the bedrock is composed of juvenile alluvial deposits which may be loose and sandy or hard and silty. The soils on these deposits are mostly humus rich, leached or brown forest soils. The stands of this association are found mostly outside of the dikes, although the oak-hornbeam forests of the Long-erdő in the Bodrogköz are located on the highest reliefs of the floodplain.

Oak-hornbeam forests are also found in the Nyírség on sand (Boros 1932, Soó 1938a, 1943, Kevey 2006). Since their habitats are located higher above the levels of the rivers than those of the aforementioned forests on the floodplains, their stands are not influenced by floods. They are typically in direct contact with hardwood gallery forests (*Fraxino pannonicae-Ulmetum*) on lower reliefs (Tiborszállás „Vadaskerti-erdő"), whereas their stands at the foot of sand dunes gradually change into closed oakwoods (*Convallario-Quercetum roboris*) (for example, Debrecen „Nagy-erdő"). The majority of these stands are located at low lying areas between sand dunes where the mezophilic character of the soil is provided by the special moisture regime of sand (for example, Baktalórántháza „Baktai-erdő"): because of the weak capillary action, only the upper layers of the soil dry out during arid periods. Oak-hornbeam forests may occur along small streams that provide the extra amount of soil moisture supporting their persistence (for example, Bátorliget „Veres-folyás”).

The zonal nature of the *Circaeo-Carpinetum* is difficult to assess. According to the climatic map of Borhidi (1961), its stands are located in the zone of closed deciduous forests (Bodrogköz, Bereg-Szatmár plain, Nyírség) for the most part, with few stands occurring in the forest-steppe zone (area of the Körös rivers). As the herbaceous layer of these forests is moderately affected by the groundwater, they could be regarded as an edaphic vegetation type. Considering that the climatic zone of oak-hornbeam forests is restricted primarily to Western Europe, they could be treated as an extrazonal association. Their occurrence on the Tisza plain is the result of high groundwater and moist soils compensating for the unfavorable macroclimate, rather than local climatic conditions due to northerly exposition.

Physiognomy

The canopy of plain oak-hornbeam forests is well developed and closed with high (60–85 %) cover values. It is also high reaching even 32 m. It is composed mainly of *Quercus robur*, and less frequently of *Carpinus betulus*. On moist sites, *Fraxinus angustifolia* may become locally abundant. Other tree species are also present (*Betula pendula, Cerasus avium, Populus alba, Populus tremula, Tilia cordata, Ulmus laevis, Ulmus minor* etc.) The occurrence of the Balcanian *Tilia tomentosa* in these forests (Nyírség, Bereg-Szatmár plain) is rather unique, just as the presence of small patches of beechwoods in the Bodrogköz (Sátoraljaújhely „Long-erdő”: Hargitai 1938–1939) and the Szatmár plain (Beregdaróc „Dédai-erdő”: Simon 1951). Today, only a few surviving trees or groups of tree represent these woods.

The characteristics of the lower canopy layer vary depending on forestry practices. Its cover ranges from 10 to 70 % with a height of 12-20 m. Most abundant tree here is *Carpinus betulus* although *Acer campestre, Acer tataricum* and *Tilia cordata* may also be frequently encountered. The sporadic occurrence of species, such as *Fraxinus angustifolia, Malus sylvestris, Ulmus laevis, Ulmus minor* and *Vitis sylvestris* lend a gallery forest-like character to these forests.

The height of the shrub layer is mainly determined by the density of the canopy layers. Thus, its cover may vary widely (5–60 %). Its height is also variable (1–5 m), depending on the constituent species. The most abundant species are *Corylus avellana* and *Crataegus monogyna* although *Carpinus betulus* and *Tilia cordata* may also become locally abundant. Among these species other shrubs characteristic of gallery forests (*Frangula alnus, Padus avium, Ribes rubrum, Viburnum opulus, Vitis sylvestris*) may also appear. In the layer of saplings, *Hedera helix* may be frequent.

The herb layer is characterized typically by high cover values (60–100 %), although lower values (5–30 %) may not be infrequent either. The following species may be locally abundant: *Aegopodium podagraria, Allium ursinum, Anemone nemorosa, Anemone ranunculoides, Brachypodium sylvaticum, Circaea lutetiana, Convallaria majalis, Corydalis cava, Dentaria bulbifera, Ficaria verna, Gagea spathacea, Galeobdolon luteum, Galium odoratum, Isopyrum thalictroides, Mercurialis perennis, Polygonatum latifolium, Stellaria holostea, Vinca minor*. As it can be seen in this list the early spring aspect is pronounced with a number of additional species: *Corydalis solida, Gagea lutea, Galanthus nivalis, Leucojum vernum, Scilla kladnii, Scilla vindobonensis*.

Species composition

In the oak-hornbeam forests, the proportion of plants characteristic of marshes (*Phragmitetea* s.l.) and meadows on peaty soil (*Molinio-Juncetea* s.l.) is less than in hardwood gallery forests. Similar tendencies are observed in the groups of species characteristic of alder swamps (*Alnetea* s.l.), softwood gallery forests (*Salicetea purpureae* s.l.) and hardwood gallery forests (*Alnion incanae*). These data indicate that the oak-hornbeam forests inhabit somewhat higher reliefs than the oak-ash-elm gallery forests. In contrast, the proportion of species characteristic of mezophilous deciduous forests (*Querco-Fagetea, Fagetalia*) is the highest in the oak-hornbeam forests. Several of these species are considered as relics of the Subatlantic I. age (Zólyomi 1936, 1952). The proportion of species characteristic of dry oak forests (*Quercetea pubescentis-petraeae* s.l.), however, does not differ significantly from that of oak-ash-elm forests.

In the species composition of the oak-hornbeam forests of the studied regions substantial differences may be observed. For example, elements characteristic of hardwood gallery forests (*Alnion incanae*) reach the highest proportion (11.1 %) in the Bereg-Szatmár plain. The *Fagetalia* species are the most frequent in the Bereg-Szatmár plain (29.9 %) and the Bodrogköz (30.0 %), whereas the least frequent in the area of the Körös rivers. In contrast, the species of the dry oak forests (*Quercetea pubescentis-petraeae* s.l.) are the most abundant in the latter (18.3 %), and least frequent in the Bodrogköz (10.5 %). These data suggest that the oak-hornbeam forests of the Northern Great Plain (Bereg-Szatmár plain, Bodrogköz) – the phytogeographical region of Samicum – are the most typical representatives of this association.

Like the oak-ash-elm gallery forests, the oak-hornbeam forests also harbor species that differ by region, and are remnants of earlier geological ages. A considerable number of them has not been found in the oak-hornbeam forests along the Danube (indicated by an asterisk): *Crocus heuffelianus** (Bereg-Szatmár plain), *Dryopteris expansa** (Bereg-Szatmár plain), *Fagus sylvatica** (Bodrogköz, Bereg-Szatmár plain), *Fritillaria meleagris* (Bereg-Szatmár plain), *Gagea spathacea** (Bereg-Szatmár plain), *Leucojum vernum** (Bodrogköz, Bereg-Szatmár plain), *Luzula pilosa** (Bereg-Szatmár plain), *Melampyrum nemorosum* ssp.

*debreceniense** (Nyírség), *Melica picta** (Nyírség), *Oenanthe banatica** (Bereg-Szatmár plain, eastern edge of Nyírség), *Scilla kladnii** (Bodrogköz, Bereg-Szatmár plain, eastern edge of Nyírség), *Tamus communis** (Nyírség), *Tilia tomentosa* (Nyírség, Bereg-Szatmár plain), *Vitis sylvestris* (Nyírség).

Distribution of oak-hornbeam forests on the Tisza plain

The greatest number and most species rich oak-hornbeam forests are found in the Bereg-Szatmár plain: Beregdaróc „Dédai-erdő", „Közös-erdő", „Tilalmas–Csere-erdő"; Kömörő „Páskom"; Magosliget „Cserköz-erdő"; Tarpa „Darab-erdő"; „Nagy-erdő", „Téb-erdő"; Tiszakerecseny „Lónyai-erdő"; Vámosatya „Bockereki-erdő"; Turricse „Ricsei-erdő"; stb. (Hargitai 1943, Simon 1950, 1951, 1957, Simon and Molnár 1972, Papp and Lesku ined., Kevey 2006.).

Only few stands of oak-hornbeam forests have remained in the Bodrogköz, although within the „Long-erdő" near Sátoraljaújhely, large tracts of this forest type are still present (Soó 1938b, Hargitai 1938–1939, Tuba 1995, Kevey 2006). Small-sized oak-hornbeam forests also occur in „Pap-erdő" near „Long-erdő", and near the „Kastély-erdő" next to Pácin (Tuba ined.).

Oak-hornbeam forests are not frequent in the Nyírség either. The largest and most typical stands are found in the „Baktai-erdő" next to Baktalórántháza (Soó 1937, 1938a, 1943). The oak-hornbeam forests of the „Vadaskerti-erdő" at Mérk, „Ezüsttábla" west of Tiborszállás, and „Fényi-erdő" at Bátorliget are also very impressive. Additional stands of this association are also found at several other locations (Debrecen „Nagy-erdő"; Nyíracsád „Jónás rész"; Bátorliget „Veres-folyás"; Nyírvasvári „Csirák"; Terem „Nagyfenék"), but these stands are fragments only (Kevey and Papp in Kevey 2006).

This association appears in the area of the Körös rivers as fragments only: Békéscsaba „Pósteleki-erdő"; Bélmegyer „Szolga-erdő"; Doboz „Gerlamarói-erdő", „Papholt-erdő", Gyula „Mályvádi-erdő" (Kevey 2003). Unfortunately, these fragments still continue to diminish.

Like oak-ash-elm forests, oak-hornbeam forests are also found on the Tisza and Körös plains beyond the state borders along the Maros and Körös rivers, as well as on the Transsylvanian and Transcarpathian areas of the Bereg-Szatmár plain (Balázs 1943, Simon 1950, 1951, Forgách ex verb.)

References

(For references see the next chapter)

XI. SUBCONTINENTAL SUBMEDITERRANEAN DRY DECIDUOUS FORESTS OF SOUTHEAST EUROPE – QUERCETALIA CERRIS

Balázs Kevey

The xerophilous deciduous forests of the eastern half of Southeast Europe are placed into the order of *Quercetalia cerris*. The recognition of this order is justified, since toward east these xerophilous oak forests form a gradually broadening zone with increasing diversity. This pattern results from climatic influences. To the east, the oceanic climate is diminishing, and the submediterranean climate is associated with more pronounced continentality causing high summer temperatures and long summer droughts. In the west, the xerophilous character of the vegetation is restricted in space due to the strong oceanic climate (Borhidi 2003).

Aceri tatarici-Quercion Zólyomi et Jakucs 1957

The xerothermic forests of the northeastern mountain range of Hungary and the plains under subcontinental climate are classified into the alliance of *Aceri tatarico-Quercion*. The dry forests on the Hungarian Plain once may have been very widespread, but deforestation decimated their stands that became fragmented and isolated from one another.

XI.1 *Convallario-Quercetum roboris* Soó (1937) 1958

Syn.: *Quercetum roboris convallarietosum* (*convallariosum*) 1937, 1943, Aszód 1935; *Convallarieto-Quercetum* Soó 1957; *Convallario-Quercetum tibiscense* Soó 1957; *Quercetum roboris tiliosum argenteae* 1937 p.p.; *Quercetum roboris tibiscense convallariosum* vel *umbrosum* Soó 1937; *Quercetum roboris convallarietosum* Soó 1943, Balázs 1943; *Querceto-Convallarietum tibiscense* Soó et Zólyomi 1951.

Habitat characteristics and zonality

In the Nyírség, the closed oak forests have developed in slight depressions on top of the sand dunes high above the floodplain. Their habitat is only little influenced by groundwater. The bedrock is slightly acidic fluvial sand that was deposited by the Tisza. However, Balázs (1943) also reported this association in the vicinity of Nagykároly and Erdőd on hard alluvial deposits. The stands of this forest occur on humus-rich, clayey brown forest soil, or reddish brown forest soil.

It could be considered a zonal association as the closed forest of Nyírség; however, Jakucs (1981) classified it into the forests primarily influenced by bedrock, and therefore it is regarded an intrazonal association.

Scientists have a different view of the development of the closed oak forests. Hargitai (1940) regarded these oak forests as the climax community of the successional series on sand starting from the moss-lichen stage. At that age, two subassociations of this association were distinguished: *festucetosum sulcatae* and *convallarietosum*. The two subassociations were later put on the rank of association with respective names of *Festuco rupicolae-Quercetum roboris* Soó (1937) 1958, and *Convallario-Quercetum roboris* Soó (1937) 1958. Further developing the idea of Hargitai (1940), Soó (1962) considered the closed oak forest (*Convallario-Quercetum roboris*) as the climax association of the successional series, which develops from the open oak forest (*Festuco rupicolae-Quercetum roboris*) as shown on his figure.

According to Fekete (1992), Soó (1962) with his model has moved away from reality, as the presence of closed forests on sand „may only be understood by the extra availability of edaphic water". Recent studies and observations show that the closed oak forests have probably developed from oak-ash-elm gallery forests as a result of gradual drying of their habitats. Along the rivers, this process may be witnessed spatially in the form of successive occurrence of these associations with a transitional zone between them (Kevey 1993). Horánszky (1998, 2000), however, questions the validity of this model based on the distance from rivers. Oak-ash-elm gallery forests rich in Fagetalia species may have developed far from rivers if the local soil moisture conditions are conducive (see Zólyomi 1934, Járai-Komlódi 1958, 1959). The loss of extra groundwater in these habitats may have led to the development of closed oak forests (*Convallario-Quercetum roboris*) by ecological succession. This model is supported by phytosociological relevés of closed forests on sand and oak-ash-elm gallery forests made by Soó (1937, 1943) in the Nyírség. Also, the two associations are in contact at several locations even today (for example, Debrecen „Halápi-erdő", „Nagy-erdő", „Monostori-erdő", Újfehértó „Ángliusi-erdő"). The occasional occurrence of old specimens of *Ulmus laevis* and *Padus avium* in closed oak forests (*Convallario-Quercetum roboris*) also supports the model. The successional relations of these associations are also accepted by Borhidi (*ex verb*.) and Fekete (1999). Thus, the successional development of the closed forests of the Nyírség on sand may be interpreted with particular reference to their habitat being influenced in the past by rivers or the tributaries of the Tisza. This relationship validates the inclusion of this association into the present study.

Physiognomy

The closed oak forests of Nyírség have been studied by Soó (1937, 1938a, 1943) and Horánszky (1998). The canopy of this association is dense with 65–80 %

cover, and the height may reach 30 meters. The dominant tree is *Quercus robur*, but *Tilia tomentosa* may form a consociation. Other tree species most frequently mixed with them are *Betula pendula* and *Populus tremula*. The trees of the lower canopy layer mainly fill the treefall gaps. Their height varies between 8 and 20 meter, and their cover may approach 40 %.The shrub layer is moderately or well developed, its cover ranges from 40 to 70 %, and its height is 2-4 meters. Common shrub species are *Corylus avellana, Crataegus monogyna* and *Ligustrum vulgare*. Of the xerothermic species *Acer tataricum, Euonymus verrucosa, Prunus spinosa* and *Rhamnus cathartica* occur here. The herbaceous layer is often pronounced (60–95 %), although in some stands it may cover only 10-12 %. The most abundant species are *Convallaria majalis* and *Polygonatum latifolium*. Other species such as *Agropyron caninum, Lithospermum purpureo-coeruleum, Poa nemoralis, Salvia glutinosa* and *Stachys sylvatica* may locally become abundant. At some places *Corydalis cava* forms an early spring aspect.

Species composition

The closed oak forests on the Tisza plain, essentially those of Nyírség are best documented in the works of Soó (1937, 1943). The weighted proportions of the species characteristic of the hardwood gallery forests (*Alnion incanae*: 4.3 %) and mezophilous deciduous forests (*Fagetalia*: 8.7 %) are lower than that of the oak-hornbeam forests (*Circaeo-Carpinetum*), but that of the dry oakwoods (*Quercetea pubescentuis-petraeae* s.l.: 27.9 %) is greater. These data indicate that the closed oak forests are less influenced by groundwater than the oak-hornbeam forests.

There are, however, closed oak forests on sand in the Nyírség that are transitional to oak-hornbeam forests or oak-ash-elm gallery forests. These are mostly dominated by *Salvia glutinosa* and *Stachys sylvatica*, and harbor fewer species characteristic of dry oakwoods (*Quercetea pubescentis-petraeae*: 15.7–16.7 %). The weighted proportions of species of the mezophilous deciduous forests (*Fagetalia* 13.9–15.2 %) and hardwood gallery forests (*Alnion incanae* 7,5–7.7 %) are, in turn, higher. Their successional relationship to oak-ash-elm gallery forests is indicated by the presence of some species characteristic of hardwood gallery forests (*Alnion incanae*): *Carex brizoides, Cephalaria pilosa, Equisetum × moorei, Frangula alnus, Fraxinus angustifolia* ssp. *pannonica, Padus avium, Ribes rubrum, Ulmus laevis, Viburnum opulus*, etc.

Comparison of closed oak forests on sand occurring in the different regions is difficult because typical stands have only been found in Nyírség. Their considerable species are: *Artemisia pontica, Bulbocodium vernum, Campanula rotundifolia, Centaurea triumfettii* ssp. *axillaris, Cephalanthera rubra, Crocus variegatus, Dictamnus albus, Digitalis grandiflora, Equisetum moorei, Gymnocarpium dryopteris, Iris aphylla* ssp. *hungarica, Iris arenaria, Listera ovata, Melampyrum bihariense, Melampyrum nemorosum* ssp. *debreceniense, Muscari botryoides,* *Ophioglossum vulgatum, Platanthera bifolia, Platanthera chlorantha, Primula veris, Pulsatilla pratensis* ssp. *hungarica, Pyrola rotundifolia, Scilla kladnii, Scilla vindobonensis, Thalictrum aquilegiifolium, Tilia tomentosa*. The vegetation samples of Balázs (1943) were collected from the forests of the edge of the Szatmár plain whose soil is not sandy. Consequently, these forests are less typical, although several notable species have been reported here that also occur in the Nyírség: *Digitalis grandiflora, Genista ovata* ssp. *transsylvanica, Gladiolus imbricatus, Listera ovata, Melampyrum bihariense, Melampyrum nemorosum* ssp. *debreceniense, Muscari botryoides, Oenanthe banatica, Platanthera bifolia, Platanthera chlorantha, Primula veris*. The most important of them is *Genista ovata* ssp. *transsylvanica* with Dacic distribution. In the relevés of Margóczi and Makra (ined.) recorded on the Bereg plain, *Listera ovata*, whereas in the material of Tuba (ined.) collected in the Bodrogköz, *Rosa gallica* and *Epipactis helleborine* agg. occurred. In the dry oakwoods of the Sajó river area, the following species were recorded by Ujvárosi (1941): *Dianthus collinus* ssp. *glabriusculus* var. *debreceniensis, Epipactis helleborine* agg., *Neottia nidus-avis, Phlomis tuberosa, Platanthera chlorantha, Thalictrum aquilegiifolium.*

The forest stands of the floodplains occurring in gradually drying habitats exhibit an even closer relationship to oak-ash-elm gallery forests (*Fraxino pannonicae-Ulmetum*). Based on their xerophilous character, these stands are identified with closed oak forests on sand. The weighted proportin of characteristic species differs slightly among regions (Szatmár plain: Balázs 1943, Bereg plain: Margóczi and Makra ined., Bodrogköz: Tuba ined., area of the Sajó river: Ujvárosi 1941). The stands studied in the Bodrogköz (Tuba ined.) are particularly noteworthy, since their species composition is the most similar to that of the oak-ash-elm gallery forests. This is indicated by the relatively high proportions of species characteristic of marshes (*Cypero-Phragmitea* s.l.: 5.5 %), willow gallery forests (*Salicetea purpureae* s.l.: 11.6 %), and hardwood gallery forests (*Alnion incanae*: 9.7 %). These data provide further support to the supposed successional relations of oak-ash-elm gallery forests to dry oakwoods.

Convallario-Quercetum roboris of Nyírség is replaced by the vicariant *Polygonato latifoliae-Quercetum roboris* in the Danube-Tisza Interfluve and South-Mezőföld (Borhidi in Borhidi and Kevey 1996), from which it is distinguished by the presence of the following species: *Digitalis grandiflora**, *Iris aphylla* ssp. *hungarica**, *Melampyrum bihariense**, *Melampyrum nemorosum* ssp. *debreceniense**, *Platanthera chlorantha**, *Pulsatilla pratensis* ssp. *hungarica**, *Scilla kladnii**.

Distribution of closed oak forests on sand on the Tisza plain

The closed oak forests on sand (*Convallario-Quercetum roboris*) once were the dominant forest association in the Nyírség. As a result of deforestation and the spread of black locust plantations, only few typical, natural remnants of this forest type are known today. Soó (1943) observed it at the following locations: Bátorliget „Fényi-erdő"; Debrecen „Nagy-erdő"; Hajdúbagos „Hosszúpályi felé levő erdő"; Mikepércs „Pac-erdő"; Nyírábrány–Szentannapuszta „Bagaméri-erdő"; Nyíregyháza „Városi-erdő"; Nyírtelek–Királytelek „Uradalmi-erdő"; Sáránd „a községtől ÉK-re levő erdő"; Tornyospálca „Pálca-erdő". Horánszky (1998) reported it from the vicinity of Nyíracsád, whereas László Papp and I studied it at the following locations: Debrecen–Haláp „Álló-hegy"; Debrecen–Józsa „Monostori-erdő"; Újfehértó „Ángliusi-erdő". Its stands at Bodrogköz (Tuba ined.) have developed on young alluvial deposits, and therefore more closely resemble the oak-ash-elm gallery forests. Beyond the state borders Balázs (1943) reported closed oak forests close to Nagykároly (Carei) and Erdőd (Arded) in the Szatmár plain on alluvial, hard soil. Similar stands were observed in the vicinity of Békés, Békéscsaba, Doboz, Sarkad, Gyula and Bélmegyer in the area of the Körös rivers. The stands studied by Margóczi and Makra (ined.) at the Bereg plain (Vámosatya „Bockereki-erdő"), Tuba (ined.) at the Bodrogköz, and Ujvárosi (1941) in the area of the Sajó river (Sajólád „Kemely-erdő") are best regarded as closed oak forest-like stands developed from oak-ash-elm gallery forests.

XI.2 *Galatello-Quercetum roboris* Zólyomi et Tallós 1967

Syn.: *Querceto-Festucetum sulcatae pseudovinetosum* Soó 1950; *Quercetum roboris tibiscense festucosum* Máthé 1933 p.p.; *Querceto-Ulmetum* Máthé 1936 p.min.p.; *Quercetum roboris festucetosum pseudovinae* Soó 1934; *Querceto-Festucetum sulcatae pseudovinetosum* Soó 1950; *Pseudovineto-Quercetum roboris* (Máthé 1933) Soó 1958; *Acereto tatarici-Quercetum petraeae-roboris pseudovinetosum* (*tibiscense*) Zólyomi 1957; *Galatello-Quercetum roboris festucetosum sulcatae* Zólyomi et Tallós 1967; *Galatello-Quercetum roboris peucedanetosum officinalis* Tallós et Tóth B. 1968.

Habitat characteristics and zonality

The relic stands of the alkali steppe oakwoods are typically found at the transitional zone between the abandoned floodplain of rivers and the slightly higher reliefs covered with loess. These habitats still have been influenced by groundwater. In terms of their water regime, they are characterized by the extremes. On the one hand, the clearings are often under water in the spring. On the other hand, the water disappears by summer, the soil dries out, and – through the capillary action – the process of salinization begins during the arid period. As a consequence, the soil is poor in nutrients, has been salinized, but the salts accumulate in the deeper layers only. These processes may take place only in areas of continental climate, which characterizes only the forest-steppe zone of the Hungarian Plain.

Thus, the alkali steppe oakwoods are classified into the edaphic, intrazonal forest associations.

In terms of the origin of the alkali oakwoods, Molnár (1989) hypothesizes that these woods have developed from hardwood gallery forests (*Fraxino pannonicae-Ulmetum*). According to his model, the habitat of the hardwood gallery forests along the rivers became gradually drier as the river changed its course and moved away from the forests. Floods reached the forests more and more infrequently while salinization of the soil began. As a consequence, the canopy of these forests opened up, small clearings developed, and the species composition changed, and eventually these forests have developed into alkali oakwoods (*Galatello-Quercetum roboris*). Indirect evidence to this model is that the two forest associations are in direct contact at several locations even today.

Physiognomy

The alkali oakwood (*Galatello-Quercetum roboris*) is a mosaic of clearings with salinized soils and patches of woods – a characteristic of forest steppe vegetation (Molnár *et al.* 2000a). Forestry practices, however, may have altered this original physiognomy by creating even-aged plantations. Today the alkali oakwoods are mostly restricted to the edges of the closed forests and the tiny patches of woods on the clearings (for example, Bélmegyer „Szolga-erdő"). Due to the unfavorable soil conditions, the canopy is very loose (10-40 %), and the trees – mostly *Quercus robur*, but also *Acer campestre*, *Fraxinus angustifolia* ssp. *pannonica*, *Pyrus pyraster* and *Quercus cerris* whose nativity is questioned in this habitat – are low (12–15 m). A lower and also very loose canopy layer may also be observed that consists of low-growth trees. Here *Acer campestre*, *Acer tataricum*, *Pyrus pyraster* and *Ulmus minor* are frequent, whereas *Malus sylvestris* and *Quercus pubescens* are found occasionally. The shrub layer is very dense with 70–90 % cover and 2–4 m height. It primarily consists of *Crataegus monogyna* and *Prunus spinosa*. Other species, such as *Acer tataricum, Ligustrum vulgare* and *Rhamnus catharticus* are also frequent, while species characteristic of the forest-steppes (*Prunus tenella*, *Prunus fruticosa* and *Rosa gallica*) are rare. The shrubs separate the woods from the clearings (*Peucedano–Asteretum sedifolii*) forming a continuous mantle. The spread of the shrubs may also be observed at most locations; that is, the woody vegetation is gradually creeping on the clearings. Among the species, *Quercus robur* is often found indicating the very first step in the successional development of the alkali oakwood (*Galatello-Quercetum roboris*).

The cover of the herb layer varies greatly depending on light availability. Frequent and abundant species, some of them becoming locally dominant, are as follows: *Agropyron caninum, Agropyron repens, Alliaria petiolata, Alopecurus pratensis, Corydalis cava, Dactylis glomerata, Festuca pratensis, Festuca* *rupicola, Festuca valesiaca, Ficaria verna, Lithospermum purpureo-coeruleum, Peucedanum officinale, Poa nemoralis, Poa pratensis, Polygonatum latifolium, Scilla vindobonensis, Viola cyanea*. With the presence of *Corydalis cava, Ficaria verna, Gagea lutea* and *Scilla vindobonensis*, an early spring aspect is also present.

Species composition

In the first half of the 20th century, Máthé (1933, 1936, 1938) and Soó (1938b) studied the phytosociological and habitat characteristics of the alkali oakwoods. However, their publications do not include phytosociological relevés. Later Zólyomi and Tallós (1967) published a synthetic table, then Tallós and Tóth (1968) gave a detalied table of this association. They distinguished two subassociations: the canopy layer of the *festucetosum sulcatae* (= *peucedanetosum officinalis*) is low and open, whereas that of the *polygonatetosum latifoliae* is taller and more closed. The species composition of the former is characteristic of the forest steppes, but that of the latter is more similar to the species composition of the hardwood gallery forests (*Fraxino pannonicae-Ulmetum*). These two subassociations may also be identified in the tables published by Molnár (1989).

The weighted proportions of species characteristic of marshes (*Cypero-Phragmitea* s.l.) and meadows on peaty soil (*Molinio-Juncetea* s.l.) in the alkali steppe oakwoods (*Galatello-Quercetum roboris*) are similar to those in the oak-ash-elm forests (*Fraxino pannonicae-Ulmetum*). On the other hand, the proportion of species characteristic of xerophilous grasslands (*Festuco-Bromea* s.l.: 7.6–10.9 %) is much higher in the alkali steppe oakwoods.

The co-occurrence of higrophilous and xerophilous species may seem contradictory at first. However, the higrophilous species apparently may establish themselves in this habitat because of the frequent water cover in the spring. How can then the xerophilous species successfully survive despite the spring water cover? A partial explanation may be that „the large negative water potential of the alkali soils cause physiological drought" (Kevey 1995). For further support of this idea, physiological and ecological studies are certainly needed. Nevertheless, the occurrence of species characteristic of steppes makes the alkali steppe oakwoods somewhat similar to forest steppe oakwoods on loess (*Aceri tatarico-Quercetum roboris*) (see Molnár 1989). Relative to the oak-ash-elm forests (*Fraxino pannonicae-Ulmetum*), the dry character of their habitat is indicated by the significantly smaller proportion of species characteristic of softwood (*Salicetea purpureae* s.l.: 0.4–2.9 %) and hardwood (*Alnion incanae*: 2.4–3.1 %) gallery forests, and mezophilous forests (*Querco-Fagetea*: 8.2–16.1 %, *Fagetalia*: 0.8–2.6 %). Species characteristic of xerophilous oak forests (*Quercetea pubescentis-petraeae* s.l.: 21.7–37.6 %) are much more frequent, however. The most notable feature of this association is the presence of salt tolerant species (*Puccinellio-Salicornea* s.l.: 4.2–5.4 %): *Artemisia pontica, Artemisia santonicum, Aster* *sedifolius, Festuca pseudovina, Juncus gerardii, Limonium gmelini* ssp. *hungaricum, Melandrium viscosum, Peucedanum officinale, Ranunculus pedatus, Rumex pseudonatronatus*.

The comparison of the species composition of the alkali steppe oakwoods occurring in various regions was not possible due to the availability of only synthetic tables in some instances. The location of the remaining 40 relevés is known, but their grouping is unnecessary, since this association is found only in a few localities on the Tisza plain. Its considerable species are: *Aster linosyris, Aster sedifolius, Artemisia pontica, Artemisia santonicum, Campanula rapunculus, Carduus crispus, Carex melanostachya, Centaurea triumfettii, Cerasus fruticosa, Doronicum hungaricum, Hesperis sylvestris, Iris spuria, Juncus gerardii, Limonium gmelini, Lycopus exaltatus, Melica altissima, Melica transsylvanica, Peucedanum officinale, Phlomis tuberosa, Podospermum canum, Pulmonaria mollis, Rosa gallica, Rumex pseudonatronatus, Saxifraga bulbifera, Scilla vindobonensis, Vicia pisiformis, Viola montana.*

Distribution of alkali steppe oakwoods on the Tisza plain

Alkali steppe oakwoods almost exclusively occur on the Tisza plain, the phytogeographical region of Crisicum. The only exception is the fragment discovered recently near the village of Iván, on the southern part of the Lesser Plain. All other stands occur at the following locations: Alattyán „Berki-erdő”; Békéscsaba „Fácános-erdő”, „Hajlás-erdő”, „Pósteleki-erdő”; Bélmegyer „Fás-erdő”; Berettyóújfalu „Malom-füzes”; Doboz „Madárfoki-erdő”, „Papholt-erdő”; Egyek „Ohati-erdő”; Görbeháza „Bagotai-erdő”, „Fenyves-erdő”; Gyula „Gelvács”, „Kutyahelyi-erdő”, Hencida „Csere-erdő”, „Miklós-erdő”; Hortobágy „Malomházi-erdő”; Jászdózsa „Pap-erdő”; Kerecsend „Kerecsendi-erdő”; Kisújszállás „Nagy-erdő”; Konyár „Határ-erdő”; Körösladány „Ladányi-erdő”; Mezőcsát; Tiszacsege „Berzsenyes morotva”; Tiszadob „Sóskuti-legelő”; Tiszaigar–Tiszaörs „Körtvélyesi-legelő”; Tiszaszentimre „Körtvélyesi-legelő”; Tiszaug „Bokros-puszta”; Újszentmargita „Tilos-erdő” (see Máthé 1933, 1936, 1938, Soó 1938b, Zólyomi and Tallós 1967, Molnár 1989, Horváth *et al.* 1999, Molnár *et al.* 2000b). Many of the above stands are only fragments.

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XII. ALDER SWAMP WOODS - ALNETALIA GLUTINOSAE

Orsolya Szirmai, Zoltán Tuba, László Körmöczi

Alder swamp woods are edaphic communities. Their soil is covered by oxygen-poor slack water in a great part of the vegetation period, mainly in spring and at the beginning of summer. As a consequence of the water table fluctuation, gleying and iron fall-out is frequent in the soil. In the middle of the summer the logged water shrinks, and as a consequence of the ventilation of the upper soil layer ammonia is oxidized to nitrate which favours to the appearance of weed communities.

The canopy layer consists of high trees, *Alnus glutinosa* in swamp areas having extensive buttress roots – so called "foots" – from which more trunks can grow clonally. The shrub layer is poor but the dense herb layer can grow on two substrates: on the widened foot of the trunks rising from water and on the soil among them. On the former, more stable island-like places mainly epiphyte, cortical species live while in the latter habitat several aspects (aquatic palnts, sedge vegetation, ephemeral floodplain weeds) can alternate depending on the water cover (Borhidi 2003).

XII.1 *Fraxino pannonicae–Alnetum* (Soó & Járai-Komlódi 1958)

Syn: *Thelypteridi-Alnetum* 1940, *Fraxineto oxycarpae-Alnetum hungaricum* Soó & Komlódi in Soó 1957 (Borhidi 2003).

The community was described by Klika first in 1940 which was modified by Soó and Komlódi in 1957, then by Soó and Járai-Komlódi in 1958 (Borhidi 2003).

In Hungary, among others Kevey has investigated the coenological characteristics of riverine woodlands (Kevey 1993, 1999 a, 1999 c), riverine ash-alder woodlands and alder swamp (Kevey 1997, 1999 b) forests.

Habitat conditions

This community has a special position, occurring on the southern distribution border of alder swamp woods in the subcontinental-submediterranean middle part of the Great Hungarian Plain. Its soil can dry out frequently therefore it does not contain much turf. In summer, the springs originated from the ground water of sand dunes give the continuous water supply. The stands of alder-ash woods formed mainly on the alluvium of river beds. On the basis of the water supply, proportion of character species and level of disturbance, different alder-ash wood types can be distinguished: 1. watered, 2. sedgy, 3. transient types towards willow galleries or ash-alder woodlands (slow drying out, no weed stands, willow gallery elements appear), 4. dried type (tall herb species are frequent) (Borhidi 2003).

Hungarian coenologists reported *Alnus glutinosa* dominated relevés of this community which cannot be classified either into gallery forests or to *Carici elongatae-Alnetum*. These stands are flooded only periodically and the length of the period is very variable (1-8 months). This period is longer than that in gallery woods (1-4 months) and shorter than the 8-12 months period in *Carici elongatae-Alnetum* stands. Range of the habitat conditions of this association is quite wide and its types can be very different in physiognomy, species composition and ecological requirements (Nagy J. ex verb.) Therefore further examinations are needed to characterize this community.

Characterization of stands along River Tisza and its tributaries

Alltogether 71 historic and recent relevés were found from the region of rivers Tisza and Kraszna made in the period between 1958 and 2001. Evaluation of the data resulted that the species composition of the community in the Tisza basin is similar to that of the literature description of the alliance but stands without trees of widened foot are frequent. In the canopy layer *Alnus glutinosa* and *Fraxinus angustifolia* ssp. *pannonica* are dominant; the latter species may form consociation. In the shrub layer *Alnus glutinosa, Fraxinus angustifolia* ssp. *pannonica, F. pennsylvanica, Frangula alnus, Viburnum opulus, Salix cinerea* are frequent species. Characteristic species of the herb layer are *Carex riparia, C. acutiformis, Thelypteris palustris, Peucedanum palustre, Galium palustre, Stachys palustris, Glyceria maxima, Oenanthe aquatica.*

In the water among the trunks there are free-floating or rooted hydrophytes like *Lemna minor, Hottonia palustris* or swamp species like *Urtica kioviensis*. Unlike the literature data (Borhidi 2003) *Carex elata* is not present in either relevés but *Carex riparia* is dominant in certain relevés (at Márokpapi, Tiborszállás and Dámóc). In the majority of the relevés other swamp species can also be found (with low cover and high frequency) like *Symphytum officinale, Iris pseudacorus, Euphorbia palustre*. From among the protected species, *Dryopteris carthusiana* occurred in the relevé taken at Bockerek forest (Gelénes), *Hottonia palustris* and *Urtica kioviensis* occurred in the Tőserdő (Tiszaalpár) stand.

In the canopy layer of the *Fraxinus angustifolia* ssp. *pannonica* dominated relevés at Dámóc, *Fraxinus pennsylvanica* is subdominant reaching 7-10 % cover values. In the shrub layer *Fraxinus pennsylvanica* is dominant and *Prunus spinosa, Cornus sanguinea* and *Calystegia sepium* also occur. The herb layer is dominated by *Carex riparia, Fraxinus angustifolia* ssp. *pannonica, Glechoma hederacea* and

Fraxinus pennsylvanica and in some stands the patches of certain species like *Symphytum officinale, Stachys palustris, Rubus caesius* make it more diverse.

In the relevé made at Márokpapi, *Alnus glutinosa* was found neither in the canopy layer nor in the shrub layer. In both layers *Fraxinus angustifolia* ssp. *pannonica* was dominant which can form separate consociations (Borhidi 2003). In addition, *Salix alba* and *Fraxinus pennsylvanica* were present, too. The shrub layer consisted also of *Frangula alnus, Quercus robur, Salix cinerea* and *Rubus caesius*. In the herb layer *Carex acutiformis, Carex riparia, Galium palustre* and *Glyceria maxima* were dominant and swamp species like *Oenanthe aquatica, Stachys palustris, Euphorbia palustris, Iris pseudacorus, Lythrum salicaria, Lycopus europaeus* joined them.

In the relevés of Bockerek forest, *Alnus glutinosa* and *Fraxinus excelsior* are found in the canopy layer. In the relatively species poor herb layer *Impatiens noli-tangere* and *Moehringia trinervia* are dominant. *Dryopteris carthusiana* is a frequent characteristic species. *Convallaria majalis* and *Rubus caesius* occur in some relevés. In the relevés of Abádszalók, *Alnus glutinosa* is dominant and composes the canopy layer together with *Populus alba* and *Salix alba*. From among shrub species *Amorpha fruticosa* and *Salix cinerea* are present. The poor herb layer is dominated by *Equisetum arvense, Ranunculus repens* and *Solidago gigantea* with accompanying species like *Calystegia sepium, Lysimachia nummularia, Mentha arvensis* or *Leersia orizoides*.

The estimated cover values for the canopy layer are missing in the quadrates recorded on percent scale near Tőserdő but it can be seen in the description of stands that in the canopy layer only *Alnus glutinosa* is present and occasionally one of the *Fraxinus* species occurs (Bancsó 1987). The shrub layer is almost missing, sometimes young individuals of *Sambucus nigra* and *Fraxinus* species occur. The canopy layers of the three stands are similar. The young *Alnus* individuals are missing because the 4 m high individuals have dried out. The herb layer can be characterized with great variety, high total cover value and diversity. Considering each of the three stands, the dominant species are the following: *Alisma plantago-aquatica, Mentha aquatica, Urtica dioica, Ranunculus repens, Lycopus europeus, Carex pseudocyperus, Solanum dulcamara, Galium palustre, Leersia orisoides, Sium erectum, Sium latifolium, Symphytum officinale.* At the highest relief of the Tőserdő 1 stand a shallow basin has formed which contains water even at the beginning of June thus several species occur frequently that are characteristic for the Tőserdő stands like *Carex pseudocyperus, Mentha aquatica, Solanum dulcamara, Equisetum palustre, Stellaria media, Urtica dioica.*

Characteristic taxa of the lower reliefs are *Lysimachia nummularia, Galium aparine, Geranium robertianum* etc. Between the stands 1 and 2 a transitional zone can be found. It gets a permanent water supply from a spring. The largest patch of *Thelypteris palustris* (with 80% cover values) can be found in this area (Bancsó 1987). This area is adjacent to a typical swamp wood where terrestrial vegetation develops only on the trunks of the alder trees thus the coverage of the soil surface is very low. Stand 2 can be divided into two parts: one part has a species-rich herb layer; the other one is a strongly degraded area, full of weed species. Apart from the dominant species the first part can be characterized by *Bidens tripartita* and *Hottonia palustris*, latter species is characteristic of the areas flooded for a long time. The separation of the second part is the consequence of its discontinuous surface water cover therefore the growth of the vegetation can start in early spring. The gradual desiccation of the soil results in a certain degradation, and as a consequence *Galium aparine, Rubus caesisus, Geum urbanum, Stellaria media, Alliaria petiolata* become dominant.

The stand 3 is covered by water for a rather long term of the vegetation period therefore the vegetation structure differs from that of the other stands. The representative species of the stand is *Urtica kioviensis*. Considering the number of species and the species composition, the stand has moderately degraded. *Mentha aquatica*, *Lycopus europeus* and *Symphytum officinale* are still dominant, but the relatively high ratio of *Rubus caesius, Glechoma hederacea* and *Rumex sanguineus* indicate degradation due to drying. Both the succession and the seasonal changes of the vegetation of higher relief are determined primarily by the water regime (Bancsó 1987).

Two historical relevés are presented from the 1960-ies recorded by Bodrogközy. In one of the relevés the canopy layer is dominated by *Alnus glutinosa*, while *Alnus glutinosa* and *Fraxinus pennsylvanica* occur in the other sample with low AD values (+). The shrub layer is missing in both places. The herb layer is dominated by *Thelypteris palustris; Solanum dulcamara* is subdominant in one of the relevés. Subordinate species are swamp elements like *Carex gracilis, Lycopus europaeus, Lythrum salicaria* and *Symphytum officinale*. In the herb layer of the other relevé *Urtica kioviensis* is dominant, *Galium aparine* and *Polygonum hydropiper* are subdominant. Subordinate species of this relevé differ from those of the other one: *Angelica sylvestris, Iris pseudacorus* and *Thalictrum flavum* occurred. The presence of *Urtica dioica* and *Galium aparine* refers to nitrogen accumulation.

The upper canopy layer of the Tiborszállás stand is composed of *Alnus glutinosa, Salix alba, Salix fragilis* and *Fraxinus angustifolia* ssp. *pannonica* and the last species is dominant, but the lower canopy is dominated by *Alnus glutinosa*. In the shrub layer *Alnus glutinosa* and *Fraxinus angustifolia* ssp. *pannonica* are accompanied by *Frangula alnus*, *Viburnum opulus* and *Rubus caesius*. All the upper layers have low total cover. In the herb layer *Carex* species (*C. acutiformis, C. riparia, C. vesicaria*) and *Glyceria maxima* are dominant and other common swamp species occur as well with low cover.

In the work of Bancsó (1987) the cover values are indicated as fractions (weighted with the number of individuals), these values were rounded off.

Analysis of the relevés of the alder-ash woods suggests that in the North border –Tokaj region of the Tisza Valley – unlike in the other sections – *Fraxinus excelsior* is present as subordinate species both in the shrub layer and in the herb layer. The species richness of the region between Szolnok and the southern border can be explained with the high number of the samples and with the different stands. The stand at Abádszalók (Lake Tisza region) is the most species-poor in respect of protected and characteristic species, this stand may be a planted forest. Summarising the results, it can be seen that the proportion of the subordinate species is very variable among the certain regions. Their presence is influenced by numerous biotic and abiotic factors such as the age and naturalness of the stand, the species composition and propagule supply of the neighbouring communities, and the stage of degradation.

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APPENDIX

I.1 *Salvinio-Spirodeletum*

total number of the stands: 11	Bodrog-oxbow	north-eastern border-Tokaj	Lake Tisza	Tokaj-Szolnok	Berettyó	Körös-oxbow	Szolnok - southern border	
number of the relevés: 2 (AD) + 26 (%) = 28	**average cover (%)**	**average cover (%)**	**average cover (%)**	**(%)**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**K**
Alisma plantago-aquatica		0.14						I
Bolboschoenus maritimus							+	I
Butomus umbellatus		0.29					+	I
Carex gracilis							+	I
Ceratophyllum demersum	14.00	36.74	24.00		12.53	28.33		III
Equisetum hiemale		0.37						I
Glyceria maxima	3.20				11.00			II
Gratiola officinalis		0.07						I
Hydrocharis morsus-ranae		2.65	0.02		0.25		1-3	III
Lemna minor	9.40	2.25	5.00	1	0.28	1.67		IV
Lemna trisulca	48.00		3.00					II
Lysimachia vulgaris							+	I
Oenanthe aquatica		0.01					+	I
Phragmites australis							+	I
Polygonum amphibium var. aquaticum							+-1	I
Polygonum amphibium				3				I
Potamogeton perfoliatus					0.03			I
Salix cinerea					0.25			I
Salvinia natans	73.40	89.39	89.20	85.00	44.80	18.33	2-3	V
Schoenoplectus lacustris					0.03		1	II
Sium latifolium							+	I
Solanum dulcamara					0.30			I
Sparganium erectum	26.20							I
Spirodela polyrhiza	10.00	8.45	0.02	1.00	24.53	2.33	2	IV
Stratiotes aloides		1.61			0.50			II
Trapa natans			3.80	10.00	12.50	16.67	+	III
Typha angustifolia					0.30			I
Typha latifolia					0.25		+	II
Utricularia vulgaris	13.20							I

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Bodrog-oxbow			
Kengyel-oxbow, Bodroghalász	4 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Viss-oxbow, Viss	1(%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Tisza from the north-eastern border to Tokaj			
Lake Bence	1 (%)	June 1990	János Nagy (in Nagy, 2002)
Zsaró-rivulet, Tokaj	1(%)	July 2003	Zoltán Tuba (in Szirmai et al., 2006)
Zsaró-rivulet, Tokaj	6(%)	August 2006	Zoltán Tuba et al. (in Szirmai et al., 2006)
Lake Tisza			
Tisza-oxbox of Hordód, Poroszló	2(%)	June 2003	Balázs András Lukács
Kisköre	3(%)	August 2003	János Nagy (unpublished)
Tisza from Tokaj to Szolnok			
Tisza-oxbow of Szóró, Besenyszög	1(%)	September 2001	Elemér Szalma (Szalma, 2003)
Berettyó river			
Berettyó (between Karcag and Püspökladány)	4(%)	September 2004	János Nagy (unpublished)
Körös river			
Körös-oxbow of Dan-zug, Gyomaendrőd	3(%)	August 1998	Károly Penksza et al. (in Penksza et al. 1999)
Tisza from Szolnok to the southern border			
Körtvélyes-oxbow, Mártély	2(AD)	1982	György Bodrogközy (Bodrogközy, 1982)

I.2 *Wolffietum arrhizae*

total number of the stands: 5	Túr-oxbow	north-eastern border-Tokaj	Szolnok-southern border	
number of the relevés: 7 (AD) + 9 (%) = 16	range of the AD values	average cover (%)	range of the AD values	K
Alisma plantago-aquatica			+	I
Ceratophyllum demersum		20.00	2	II
Glyceria maxima		0.56	+	II
Hydrocharis morsus-ranae		6.33		I
Lemna minor	0-2	6.33	2	IV
Lemna trisulca		62.33		I
Myosotis palustris		0.001		I
Myriophyllum spicatum			+-2	I
Nuphar lutea		5.46		I
Polygonum amphibium var. aquaticum			+-3	I
Potamogeton lucens			+-3	I
Salvinia natans	0-3	0.56		III
Spirodela polyrhiza	1-3	3.23	2	V
Stratiotes aloides		6.90		I
Typha angustifolia		1.11		I
Wolffia arrhiza	2-5	87.67	2-3	V

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Túr-oxbow			
Malom-lake, Csaholc	2 (AD)	September 1977	István Fintha (Fintha, 1979)
Túr-oxbow 1 near by Borzsa-bridge, toward Ricse	1 (AD)	September 1977	István Fintha (Fintha, 1979)
Túr-oxbow 2 near by Borzsa-bridge, toward Ricse	1 (AD)	September 197	István Fintha (Fintha, 1979)
Tisza from the north-eastern border toTokaj			István Fintha (Fintha, 1979)
Török-rivulet, Viss	9 (%)	October 2005	Zoltán Tuba et al.(in Szirmai et al., 2006)
Tisza from Szolnok to the southern border			
Körtvélyes-oxbow, Mártély	3 (AD)	1982	György Bodrogközy (Bodrogközy, 1982)

II.1. *Lemno-Utricularietum*

total number of the stands: 6	Lakes of Bereg	north-eastern border-Tokaj	Bodrog-oxbow	Szolnok-southern border	
number of the relevés: 1 (AD) + 34 (%) = 35	**average cover (%)**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**K**
Alisma plantago-aquatica		0.25			I
Bidens cernua		0.25			I
Carex gracilis		1.75			I
Ceratophyllum demersum		6.25	1.40		II
Cicuta virosa	1.00				I
Glyceria maxima	1.50		4.56	+	IV
Hydrocharis morsus-ranae	11.10	61.25	6.08		IV
Lemna minor	15.70	2.53	5.79	1	V
Lemna trisulca		4.00	63.35		III
Nymphaea alba		0.75			I
Polygonum lapathifolium		0.50			I
Salix cinerea	0.05				I
Salvinia natans	4.10	1.25	43.80	+	IV
Sium latifolium				1	I
Sparganium erectum			4.92	1	II
Spirodela polyrhiza		1.25	0.40		II
Stratiotes aloides	14.60				I
Typha latifolia			13.60		I
Utricularia vulgaris	79.00	78.75	92.10	5	V

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Lakes of Bereg			
Bence-lake, Csaroda	6 (%)	July 2000	János Nagy (Nagy, 2002)
Zsid-lake, Csaroda	4 (%)	July 2000	János Nagy (Nagy, 2002)
Tisza from north-eastern border to Tokaj			
Tisza-oxbow of Boroszlókert, Gulács	3 (%)	July 2003	András Balázs Lukács (unpublished)
Török-rivulet, Viss-szivattyútelep	1 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)

Bodrog			
Kengyel-oxbow, Bodroghalász	20 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Tisza from Szolnok to the southern border			
Tisza-oxbow of Kistisza-sziget, Csongrád	1 (AD)	August 1953	Lajos Tímár (Tímár, 1954)

III.1 *Potametum lucentis*

total number of the stands: 8	**North-eastern border-Tokaj**	**Lake Tisza**	**Lake Tisza**	**Kőrös**	**Szolnok-southern border**	
number of the relevés: 10 (AD) + 15 (%) = 25	**average cover (%)**	**average cover (%)**	**range of the AD values**	**average cover (%)**	**range of the AD values**	**K**
Alisma plantago-aquatica					+	I
Bolboschoenus maritimus			1-2		1	II
Ceratophyllum demersum	23.5	10.67	1-2		1	IV
Glyceria maxima					+	I
Eleocharis palustris					+	II
Hydrocharis morsus-ranae	20		1-2	7.50	+-1	III
Lemna minor	2.2	0.10	+-2	1.50		III
Lemna trisulca		0.10				I
Lysimachia vulgaris					+	I
Myriophyllum spicatum		3.33	+-2		2	II
Nuphar lutea			+-1			I
Phragmites australis			+-2			I
Polygonum amphibium				5.00	+-1	II
Polygonum amphibium var. aquaticum					+	I
Potamogeton gramineus					3	I
Potamogeton lucens	71.5	83.33	4-5	45.00	3-4	V
Potamogeton perfoliatus		1.67			1	II
Rorippa amphibia					+	I
Sagittaria sagittifolia			+		1	II
Salvinia natans	45	5.00		7.50		II
Schoenoplectus lacustris				2.50		I
Sparganium erectum				5.00		I
Spirodela polyrhiza	0.32	0.07		2.50	+	III
Stratiotes aloides	1					I
Trapa natans			1-2	15.00	1-2	III

locality of the stands/group	number of the relevés and the sampling methods	date of survey	informants
Tisza from the north-eastern border to Tokaj			
Tisza-oxbow of Rózsás-dűlő, Mezőladány	5 (%)	July 2003	András Balázs Lukács (unpublished)
Zsaró-rivulet	5 (%)	October 2005	Zoltán Tuba et al.(in Szirmai, 2006)
Lake Tisza			
Tisza- oxbow of Hordód, Poroszló	3 (%)	July 2003	András Balázs Lukács (unpublished)
Tiszafüred	6 (AD)	1965	György Bodrogközy (Bodrogközy, 1965)
Körös			
Körös-oxbow of Dan-zug,	2 (%)	August 1998	Károly Penksza et al. (Penksza et al. 1999)
Tisza from Szolnok to the southern border			
Körtvélyes-oxbow, Mártély	2 (AD)	1982	György Bodrogközy (Bodrogközy, 1982)
Algyő, Nagyfa	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)
Algyő, under the Sport Airpot	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)

III.2 *Myriophyllo-Potametum*

total number of the stands: 2	Lake Tisza	Szolnok-southern border
number of the relevés: 1 (AD) + 2 (%) =3	**average cover (%)**	**AD values**
Hydrocharis morsus-ranae	10.00	
Lemna minor	1.05	
Lemna trisulca	0.55	
Myriophillum spicatum		5
Myriophyllum verticillatum	50.00	
Potamogeton natans	3.50	
Potamogeton perfoliatus	30.00	
Salvinia natans	17.50	
Spirodela polyrhiza	12.50	
Trapa natans	2.50	+

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Lake Tisza			
Tisza-oxbow of Hordód, Poroszló	2 (%)	July 2003	András Balázs Lukács (unpublished)
Tisza from Szolnok to the southern border			
Tisza-oxbow of Atka, Sövényháza	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)

III.3 *Nymphaeetum albo-luteae*

total number of the stands: 19	north-eastern border - Tokaj	Bodrog-oxbow	Lake Tisza	Lake Tisza	Szolnok-Tokaj	Szolnok-Tokaj	Szolnok-southern border	Szolnok-southern border	navvy-hole (Szolnok-southern border)	
number of the relevés: 11(AD) + 50(%) = 61	**average cover (%)**	**average cover (%)**	**average cover (%)**	**AD**	**range of the AD values**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**range of the AD values**	**K**
Agrostis stolonifera	0.00									I
Alisma plantago-aquatica	0.09									I
Bidens tripartitus					1-+					I
Butomus umbellatus	0.00				2					I
Carex gracilis								+	+	I
Ceratophyllum demersum	17.96	4.08	45.00	3		22.50	11.43	2		III
Cirsium arvense					+					I
Echinochloa crus-galli					+					I
Equisetum telmateia		0.01								I
Euphorbia palustris										I
Glyceria maxima	0.00	0.08					4.29			II
Eleocharis acicularis					+					I
Eleocharis palustris					1			1	1	I
Hottonia palustris	0.17						1.57			I
Hydrocharis morsus-ranae	4.68					1.50	4.57			II
Lemna minor	0.26		0.05	2			0.43			III
Lemna trisulca	3.22	0.54	0.08			2.50	8.57			III
Mentha arvensis					1					I
Myriophyllium spicatum			6.67				1.43			I
Nuphar lutea	11.36	46.54					1.86	1-4		II
Nymphaea alba	58.86	17.92	92.50	3	5-1	67.50	41.43	1-5	1-3	V
Nymphoides peltata					1-+					I
Oenanthe aquatica	0.22						2.14	1		I
Plantago major cf. intermedia					+					I
Polygonum amphibium					+-1	2.50	0.43	+-2	1	III
Polygonum lapathifolium	0.05									I
Potamogeton crispus						0.50		+		I
Potamogeton gramineus					+				+	I

Potamogeton lucens	3.18				3					I
Potamogeton filiformis							1.43			I
Ricciocarpus natans							0.14			I
Rorippa amphibia	1.37				1		1.71		+-1	II
Sagittaria sagittifolia					3			+	+-3	II
Salix alba					1				+-1	I
Salvinia natans	1.22	1.47		2			1.86	+-4		III
Schoenoplectus lacustris		0.08					0.14		+	I
Sium latifolium									+	I
Sparganium erectum	0.05				+		0.71		2	II
Spirodela polyrhiza	0.11		0.03	1		1.50	1.00	2		III
Stratiotes aloides	2.05	15.35					12.14			II
Trapa natans	2.95		3.33			1.50	0.43	1		II
Typha angustifolia	2.50							1		I
Typha latifolia								1		I
Urtica kioviensis							0.43			I
Utricularia australis							0.14			I
Utricularia vulgaris	1.36						1.43			II
Wolffia arrhiza							0.29			I

locality of the stands	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Tisza from the north-eastern border to Tokaj			
Tisza-oxbow of Boroszló-kert, Gulács	7 (%)	June 2004	András Balázs Lukács (unpublished)
Tisza-oxbow of Rózsásdűlő	6 (%)	July 2003	András Balázs Lukács (unpublished)
Török-rivulet pumping-station, Viss	7 (%)	October 2005	Zoltán Tuba et al.(in Szirmai, 2006)
Zsaró-rivulet, Tokaj	2 (%)	July 2003	Zoltán Tuba (in Szirmai et al., 2006)
Bodrog			
Viss-oxbow, Viss	5 (%)	October 2005	Zoltán Tuba et al.(in Szirmai, 2006)
Lake Nagy, Bodrogzug	8 (%)	June 2004	Zoltán Tuba (in Szirmai et al., 2006)
Lake Tisza			
Tisza-oxbow of Hordód, Poroszló	6 (%)	July 2003	András Balázs Lukács (unpublished)
Lake Tisza, Abádszalók	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba, 1989)
Tisza from Szolnok to Tokaj			
temporary Lake Alcsi, Szolnok	1 (AD)	August 1947	Lajos Tímár (Tímár, 1954)
Alcsi, Szolnok	1 (AD)	July 1952	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Csatló, Kőtelek	2 (%)	September 2001	Elemér Szalma (Szalma, 2003)

Tisza from Szolnok to the southern border			
Lake Sulymos, Tőserdő	1 (%)	May 1983	Elemér Szalma (Szalma, 2003)
Lake Sulymos, Tőserdő	1 (%)	June 1987	Elemér Szalma (Szalma, 2003)
Lake Sulymos, Tőserdő	1 (%)	June 1998	Elemér Szalma (Szalma, 2003)
Tisza-oxbow of Alpár, Tiszaalpár	4 (%)	August 1998	Elemér Szalma (Szalma, 2003)
Lake Sulymos, Kecskemét	1 (AD)	September 1952	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Nagysziget, Tiszaug	3 (AD)	August 1952	Lajos Tímár (Tímár, 1954)
Tisza-oxbow at Station, Tiszaug	1 (AD)	August 1953	Lajos Tímár (Tímár, 1954)
Navvy-hole, Tápé	3 (AD)	August 1951	Lajos Tímár (Tímár, 1954)

III.4 *Trapetum natantis*

total number of the stands: 35	**north-eastern border-Tokaj**	**Bodrog**	**Lake Tisza**	**Lake Tisza**	**Tokaj - Szolnok**	**Szolnok - southern border**	**Szolnok - southern border**	
number of the relevés: 41 (AD) + 55 (%) = 96	**average cover (%)**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**K**
Alisma plantago-aquatica							+	I
Butomus umbellatus	0.01	0.01					+-1	I
Ceratophyllum demersum	49.09	17.78	47.06	+-1	2.25	7.29	1-3	IV
Eleocharis palustris							+	I
Glyceria maxima		1.17					+	I
Hydrocharis morsus-ranae	1.36	0.01	1.36	2		2.50		II
Lemna minor	0.01	0.00	3.62	+-2	3.00	1.21	1-2	III
Lemna trisulca	0.01		7.84	+-1		0.07	+	II
Lythrum salicaria							+-1	I
Marsilea quadrifolia		0.56						I
Myriophyllum spicatum						0.07	1-2	I
Myriophyllum verticillatum				+				I
Najas marina			1.76	+-1		0.14		II
Najas minor				1				I
Nuphar lutea	0.09	0.33		1				I
Nymphaea alba			0.24	1				I
Nymphoides peltata				+-3				I
Phragmites australis			0.18					I
Polygonum amphibium				2			+-3	I
Potamogeton lucens						0.36	3	I
Potamogeton crispus						0.07	1	I
Potamogeton graminea				+				I
Potamogeton nodosus				+-2				I
Potamogeton pectinatus				+				I
Potamogeton perfoliatus				+-3				I
Potamogeton natans			0.12					I
Riccia fluitans				+				I
Sagittaria sagittifolia		0.01					+-1	I

Salix alba							+	I
Salvinia natans	0.91		5.42	+-3	5.00	7.86		III
Schoenoplectus lacustris		0.01						I
Sparganium erectum		0.56						I
Spirodela polyrhiza	0.02	0.01	0.09	+-3		0.71		III
Stratiotes aloides	0.91	8.33						I
Trapa natans	90.91	73.67	89.24	+-5	90.00	78.50	3-5	V
Utricularia vulgaris			0.24					I
Utricularia australis				+-1		0.36		II
Zygnemales sp.				1				I

locality of the stands/group	number of the relevés and the sampling methods	date of survey	informants
Tisza from the north-eastern border to Tokaj			
Tisza-oxbow of Boroszló-kert, Gulács	5 (%)	June 2004	András Balázs Lukács (unpublished)
Tisza-oxbow of Rózsásdűlő	5 (%)	July 2003	András Balázs Lukács (unpublished)
Zsaró-rivulet, Tokaj	1 (%)	July 2003	Zoltán Tuba et al. (Szirmai, 2006)
Bodrog			
Kengyel-oxbow	3 (%)	July 2003	Zoltán Tuba (in Szirmai, 2006)
Viss-oxbow	6 (%)	October 2005	Zoltán Tuba et al.(in Szirmai, 2006)
Lake Tisza			
Tisza-oxbow of Hordód, Poroszló	5 (%)	June 2004	András Balázs Lukács (unpublished)
Basin of Poroszló	2 (%)	August 2004	András Schmotzer, József Sulyok
Brook of Eger (Basin of Poroszló)	2 (%)	August 2004	András Schmotzer, József Sulyok
Tisza-oxbow of Csapó (Basin of Poroszló)	1 (%)	August 2004	András Schmotzer, József Sulyok
Lake Tisza, Kisköre	7 (%)	August 2003	János Nagy (unpublished)
Tiszavalk	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Basin of Valk	3 (AD)	July 1996	Elemér Szalma (Szalma, 2003)
Poroszló	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Kozmafok, Basin of Sarud	4 (AD)	July 1996	Elemér Szalma (Szalma, 2003)
Basin of Sarud	11 (AD)	July 1996	Elemér Szalma (Szalma, 2003)
Sarud	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Abádszalók	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Kisköre	7 (AD)	July 1996	Elemér Szalma (Szalma, 2003)
Tisza from Tokaj to Szolnok			
Lake Gó, Tiszaroff	2 (%)	September 2001	Elemér Szalma (Szalma, 2003)

Tisza-oxbow of Szóró, Besenyszög	2 (%)	September 2001	Elemér Szalma (Szalma, 2003)
Tisza from Szolnok to the southern border			
Tisza-oxbow of Feketeváros, Szolnok	2 (%)	August 2001	Elemér Szalma (Szalma, 2003)
Tisza-oxbow of Labodár, Csanytelek	2 (%)	July 1996	Elemér Szalma (Szalma, 2003)
Tisza-oxbow of Labodár, Csanytelek	2 (%)	August 2001	Elemér Szalma (Szalma, 2003)
Osztorai-oxbow, Szegvár	2 (%)	July 1996	Elemér Szalma (Szalma, 2003)
Osztorai-oxbow, Szegvár	2 (%)	August 2001	Elemér Szalma (Szalma, 2003)
Tisza-oxbow of Mártély	2 (%)	August 2001	Elemér Szalma (Szalma, 2003)
Tisza-oxbow of Körtvélyes	2 (%)	August 2001	Elemér Szalma (Szalma, 2003)
Tisza-oxbow, at railway, Szolnok	1 (AD)	July 1947	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Körtvélyes, Hódmezővásáhely	3 (AD)	September 1951	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Körtvélyes	2 (AD)	1981	György Bodrogközy (Bodrogközy, 1981)
Tisza-oxbow of Hódmezővásáhely	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Atka, Sövényháza	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Sasér, Sövényháza	2 (AD)	August 1951	Lajos Tímár (Tímár, 1954)
Tisza-oxbow of Nagyfa, Algyő	1 (AD)	August 1951	Lajos Tímár (Tímár, 1954)
Kistisza-channel, Algyő	1 (AD)	July 1951	Lajos Tímár (Tímár, 1954)

IV Nanocyperetalia

total number of the stands: 26	Tisza recent		Tisza archive			
number of the relevés: 2(AD) + 86 (%) = 88	Average cover (%)	K	Average cover (%)	K	Range of AD scale	K
Elymus repens	1.63	I	1.0	II	-	-
Agrostis stolonifera	7.41	III	1.5	IV	+	III
Alisma gramineum	5.40	I	-	-	-	-
Alisma lanceolata	1.20	I	0.1	I	-	-
Alisma plantago-aquatica	2.90	II	-	-	2	III
Alopecurus aequalis	4.34	I	-	-	-	-
Amaranthus lividus	2.03	II	-	-	-	-
Amaranthus retroflexus	0.86	I	-	-	-	-
Atriplex hastata	0.10	I	-	-	-	-
Atriplex oblongifolia	1.10	II	-	-	-	-
Batrachium aquatile	1.07	I	-	-	-	-
Bidens cernua	11.38	II	-	-	+	III
Bidens tripartitus	1.26	II	0.4	V	1	III
Bolboschoenus maritimus	1.12	I	-	-	-	-
Butomus umbellatus	0.10	I	-	-	-	-
Carex bohemica	10.53	I	-	-	-	-
Carex serotina	10.97	II	-	-	-	-
Chenopodium album	2.16	II	0.1	IV	-	-
Chenopodium ficifolium	1.00	I	-	-	-	-
Chenopodium glaucum	0.10	I	-	-	-	-
Chenopodium polyspermum	0.55	II	-	-	-	-
Chenopodium rubrum	2.94	II	-	-	1	III
Cirsium arvense	1.46	I	-	-	1	III
Convolvulus arvensis	-	-	-	-	1	III
Cyperus difformis	3.72	I	-	-	-	-
Cyperus fuscus	6.91	III	-	-	1	III
Cyperus glomeratus	0.10	I	-	-	-	-
Cyperus michelianus	13.39	II	-	-	+-1	V
Echinochloa crus-galli	3.56	III	0.55	IV	+	V
Elatine alsinastrum	1.51	I	-	-	-	-
Elatine hungarica	7.51	I	-	-	-	-

Elatine triandra	5.83	I	-	-	-	-
Eleocharis acicularis	32.33	I	90.0	III	-	-
Eleocharis ovata	9.17	II	-	-	-	-
Eleocharis palustris	0.83	I	3.0	III	-	-
Glyceria fluitans	3.92	I	-	-	-	-
Glyceria maxima	1.82	I	-	-	-	-
Glycyrrhiza echinata	-	-	-	-	+	III
Gnaphalium uliginosum	5.60	II	-	-	+-4	V
Heleochloa alopecuroides	20.32	I	50.0	IV	2-3	V
Juncus articulatus	10.33	II	-	-	-	-
Juncus buffonius	3.97	II	-	-	-	-
Juncus compressus	0.30	I	0.1	III	-	-
Juncus effusus	0.55	I	-	-	-	-
Leersia oryzoides	4.98	II	-	-	-	-
Lemna minor	3.06	I	-	-	-	-
Limosella aquatica	2.18	I	-	-	-	-
Lindernia procumbens	5.79	I	-	-	-	-
Lycopus europeaus	1.95	II	-	-	-	-
Lythrum hyssopifolia	5.31	I	-	-	-	-
Lythrum salicaria	4.10	I	-	-	-	-
Lythrum virgatum	1.06	II	0.1	IV	-	-
Malva neglecta	0.81	I	-	-	-	-
Tripleurospermum inodorum	0.23	I	0.1	III	-	-
Mentha aquatica	0.58	I	-	-	-	-
Myriophyllum spicatum	-	-	-	-	1	III
Nymphoides peltata	-	-	-	-	+	III
Oenanthe aquatica	5.30	I	-	-	-	-
Peplis portula	2.81	I	-	-	-	-
Plantago major	3.57	II	3.0	III	2	III
Poa trivialis	11.61	I	-	-	-	-
Persicaria amphibium	7.00	I	-	-	1	III
Persicaria aviculare	1.14	I	10.0	III	2	-
Persicaria hydropiper	1.30	I	-	-	-	-
Persicaria lapathifolium	2.61	III	-	-	+	III
Portulaca oleracea	1.53	I	-	-	-	-
Potentilla supina	1.54	I	-	-	1	III
Ranunculus sardous	5.25	I	-	-	+	III

Ranunculus sceleratus	15.47	II	-	-	-	-
Rorippa austriaca	0.10	I	0.1	III	+	III
Rorippa sylvestris	7.08	II	5.0	III	-	III
Rubus caesius	-	-	-	-	+	III
Rumex crispus	1.44	II	-	-	-	-
Rumex hydrolapathum	0.28	I	-	-	-	-
Rumex stenophyllus	4.93	II	-	-	-	-
Salix triandra	1.66	I	-	-	-	-
Schoenoplectus supinus	6.14	I	-	-	-	-
Solanum dulchamara	1.06	I	-	-	-	-
Solanum nigrum	0.25	I	-	-	-	-
Sonchus arvensis	0.10	I	-	-	-	-
Sonchus asper	0.10	I	-	-	-	-
Sparganium erectum	9.02	I	-	-	-	-
Stachys palustris	0.10	I	0.1	III	-	-
Symphytum officinale	8.00	I	-	-	+	III
Tanacetum vulgare	2.13	II	-	-	-	-
Typha angustifolia	2.10	I	-	-	-	-
Typha latifolia	2.74	II	-	-	-	-
Urtica dioica	5.24	I	-	-	-	-
Veronica anagallis-aquatica	1.60	I	-	-	-	-
Veronica beccabunga	1.10	I	-	-	-	-
Veronica sp.	2.90	I	-	-	-	-
Xanthium italicum	1.85	II	3.0	IV	-	-
Xanthium strumarium	-	-	-	-	+	III

locality of the stands	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Upper-Tisza			
Between Csaroda and Gelénes	1 (%)	27 September 1998	Attila Molnár V., Norbert Pfeiffer
Beregsurány: to Beregdaróc	1 (%)	22 June 1999	Attila Molnár V., Norbert Pfeiffer
Beregsurány: to Tarpa.	1 (%)	22 June 1999	Attila Molnár V., Norbert Pfeiffer
East from Tarpa, cc. 500 m	2 (%)	22 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszatelek: to Újdombrád	1 (%)	6 July 1999	Attila Molnár V., Norbert Pfeiffer
Dombrád: to Újdombrád	2 (%)	6 July 1999	Attila Molnár V., Norbert Pfeiffer
Dombrád: to Tiszakanyár	1 (%)	15 August 1999	Attila Molnár V., Norbert Pfeiffer
Kisar-Panyola: Kerice-háti-morotva	3 (%)	19 June 2004	András Lukács Balázs, Péter Török

Tarpa: Ducskósi-morotva	1 (%)	22 July 2004	András Lukács Balázs, Péter Török
Middle-Tisza			
Tiszanána: Galambos	4 (%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszanána: West to Dinnye-hát	3 (%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszagyenda	1(%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszagyenda	1(%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszafüred: Hagymás-lapos	2(%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszagyenda.	3 (%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Tiszaderzs.	2 (%)	17 June 1999	Attila Molnár V., Norbert Pfeiffer
Szajol: Alamánd	2 (%)	14 August 1999	Attila Molnár V., Norbert Pfeiffer
Kisköre: Rák-hát	1 (%)	17 September 1999	Attila Molnár V., Norbert Pfeiffer
Tiszpüspöki: Felső-földek	3 (%)	17 September 1999	Attila Molnár V., Norbert Pfeiffer
Abádszalók, nearby a backwater (*Polygono-Eleocharitetum ovatae*)	1 (%)	June 1964	György Bodrogközy (Bodrogközy, 1965)
Kisköre (*Dichostylido-Heleochloetum alopecuroidis*)	1 (%)	July 1981	György Bodrogközy
Lower-Tisza			
Körtvélyes (*Dichostylido-Heleochloetum alopecuroidis*)	1 (%)	September 1974	György Bodrogközy (Bodrogközy, 1982)
Tiszaalpár	1 (AD)	October 1962	György Bodrogközy
Tiszaug, Along Tisza-River	1 (AD)	June 1958	György Bodrogközy
Tiszaalpár (*Eleocharito-Caricetum bohemicae* Klika em. Pietsch).	34 (%)	1985	István Bagi (Bagi, 1988)
River Körös			
Békésszentandrás: floodplain of Körös-River.	12 (%)	1982	István Bagi (Bagi, 1985)

V.1 *Glycerietum maximae*

total number of the stands: 11	north-eastern border-Tokaj	north-eastern border- Tokaj	Lake of Bereg	Bodrog	Szolnok - southern border	
number of the relevés: 1 (AD) +33 (%)= 34	**range of the AD values**	**average cover (%)**	**average cover (%)**	**average cover (%)**	**average cover (%)**	**K**
Agrostis stolonifera	1			7.43		I
Alisma lanceolatum	1				0.22	I
Alisma plantago-aquatica		3.79		0.43		II
Alopecurus pratensis		0.04		0.59		I
Althaea officinalis				0.01		I
Ambrosia artemisiifolia		0.0015				I
Ballota nigra			0.17			I
Bidens cernua		2.5				I
Bidens tripartita				0.01		I
Butomus umbellatus				0.29	0.22	II
Calamagrostis epigeios		0.15	0.15			I
Calystegia sepium		0.25		0.16		I
Carex acutiformis		3.125			5.00	I
Carex elata	+	2.375	1.63		11.00	II
Carex elongata			2.38			I
Carex gracilis		0.0015				I
Carex hirta		1.625				I
Carex riparia				1.44		I
Carex vulpina	+					
Ceratophyllum submersum			2.31			I
Chenopodium album			0.05			I
Cirsium arvense		0.44		0.16		I
Conyza canadensis			0.08			I
Drepanocladus aduncus	+					
Elatine alsinastrum	+					
Eleocharis palustris					3.40	I
Eleocharis acicularis	+					
Eleocharis carniolica	+					

Equisetum palustre		0.25				I
Euphorbia lucida					0.22	I
Galium palustre	+	0.265	0.19			I
Glyceria maxima	3	75	83.46	81.00	60.60	V
Gratiola officinalis	+					
Hydrocharis morsus-ranae			1.23	0.57		II
Inula britannica	1					
Iris pseudacorus	+	1	0.42	0.43	1.50	II
Juncus atratus	2					
Juncus effusus		0.125				I
Juncus tenuis		0.015				I
Lactuca serriola			0.08			I
Lemna minor			8.55	6.86		III
Lemna trisulca			27.31	38.57		II
Lycopus europaeus	+	0.875	0.01	0.43		II
Lysimachia nummularia	+			0.01		I
Lysimachia vulgaris		0.575	0.82	0.43	0.10	II
Lythrum salicaria	+	0.515		0.57		I
Lythrum virgatum					0.42	I
Marsilea quadrifolia				0.07		I
Matricaria maritima		0.0015				I
Oenanthe aquatica		0.015				I
Peplis portula	+					
Phalaris arudinacea					1.80	I
Plantago major		0.125			0.20	I
Poa palustris		0.015				I
Polygonum amphibium		0.265			0.02	I
Polygonum lapathifolium		0.165		0.71		I
Potentilla anserina				0.14		I
Ranunculus flammula	2					
Ranunculus repens	+	0.915	0.02			I
Ranunculus sceleratus		0.05				I
Rorippa amphibia		1.5				I
Rumex crispus	+	0.025			0.12	II
Sagittaria sagittifolia		0.25				I
Salix fragilis			0.77			I
Salix cinerea			1.85			I

Salvinia natans			0.23	12.01		II
Schoenoplectus lacustris			0.00		3.20	II
Scutellaria galericulata	+		0.54			I
Sium latifolium	1					
Sonchus palustris		0.0015				I
Sparganium erectum		4.5		0.14		II
Spirodela polyrhiza			3.09			I
Stachys palustris	+	0.1		0.29		II
Stellaria palustris	+					
Stratiotes aloides			0.08			I
Symphytum officinale		1.275	0.24		0.90	II
Tanacetum vulgare			0.46			I
Taraxacum officinale			0.00			I
Trifolium repens		0.015				I
Typha latifolia				0.43		I
Urtica dioica		0.025				I
Utricularia vulgaris	+			54.30		I
Veronica scutellata	+					
Vicia angustifolia				0.01		I

locality of the stands	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Tisza from the north-eastern border to Tokaj			
Tisza-oxbow, Boroszló-kert, Gulács	4 (%)	July 2004	András Balázs Lukács (unpublished)
Gelénes	1 (AD)	1951	Tibor Simon (Simon, 1951)
Pallagcsa-meadow	4 (%)	June 2005	Zoltán Tuba et al. (in Szirmai et al, 2006)
Lake of Bereg			
Navat-streamlet	7 (%)	July 2003	János Nagy, Dániel Cserhalmi (unpublished)
Lake Bence,Csaroda	4 (%)	August 1994	János Nagy (Nagy, 2002)
Lake Bence,Csaroda	1 (%)	July 2000	János Nagy (Nagy, 2002)
Lake Bence,Csaroda	1 (%)	August 2004	János Nagy (unpublished)
Bodrog			
Kengyel-oxbow	5 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al, 2006)
Óbodrog-oxbow	2 (%)	June 2005	Zoltán Tuba et al. (in Szirmai et al, 2006)
Tisza from Szolnok to the southern border			
Nagy-meadow, Tiszajenő	3 (%)	2004	Mária Szitár (Szitár, 2005)
Nagy-meadow, Tiszajenő	2 (%)	2005	Mária Szitár (Szitár, 2005)

V.2 *Phragmitetum communis*

total number of the stands: 31	Lake of Bereg	Bodrog	Lake Tisza	Lake Tisza	Szolnok - southern border	Szolnok - southern border	Maros	
number of the relevés: 28(AD) + 22 (%) = 50	**average cover (%)**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**average cover (%)**	**range of the AD values**	**range of the AD values**	**K**
Acer negundo						+		I
Achillea collina					6.67			I
Achillea millefolium							+-1	I
Agropyron repens						+-4	+	II
Agrostis alba						1-3	1-2	I
Alisma lanceolatum							+-2	I
Alnus glutinosa				1			+-1	I
Althaea officinalis						+	+-1	II
Amorpha fruticosa				1-2		+-1		II
Aristolochia clematitis						+	+-1	II
Artemisia pontica					0.33			I
Artemisia vulgaris						+	+-2	I
Atriplex nitens							+	I
Atriplex prostrata						+		I
Baldingera arundenacea						+-2	+-1	II
Bidens cernua	0.29							I
Bidens tripartita				+-1		+		I
Bolboschoemus maritimus				+-1			+-2	II
Butomus umbellatus				1			+-1	I
Calamagrostis epigeios						+-4	+-2	II
Calystegia sepium			0.25	+-1		+-2	+-2	IV
Carduus acanthoides						+		I
Carex acutiformis				1-2				I
Carex elata							2	I
Carex melanostachya							+-2	I
Carex riparia	0.87							I
Centaurea pannonica					10.00			I
Centaurium pulchellum							+	I

Ceratophyllum demersum				+-2				I
Chara fragilis							+-4	I
Chenopodium polyspermum							+	I
Cicuta virosa	0.43							I
Cirsium arvense							+-2	I
Clematis integrifolia							+	I
Convolvulus arvensis						+-2	+-1	I
Conyza canadensis						+	+	II
Cuscuta lupuliformis						+-1	+-1	II
Cynodon dactylon							+-1	I
Cyperus fuscus							+	I
Dipsacus laciniatus							+	I
Echinochloa crus-galli						+	+-2	I
Eleocharis palustris							1-2	I
Epilobium hirsutum				+				I
Epilobium parviflorum							+-1	I
Equisetum arvense						+-2	+-2	II
Erigeron annuus							+-2	I
Eupatorium cannabinum							+	I
Euphorbia lucida						+	+-2	II
Euphorbia palustris							+	I
Fallopia convolvulus						+		I
Festuca pseudovina					30.00			I
Fraxinus excelsior						+	+-1	I
Galium aparine	0.01						+-1	I
Galium palustre	0.01			+				I
Galium rubioides							+-1	I
Glechoma hederacea							+-2	I
Glyceria aquatica						+		I
Glyceria maxima	14.29	0.13		1			+-3	II
Glycyrrhiza echinata						+-1	+	II
Gnaphalium uliginosum						+		I
Gratiola officinalis						+	+	I
Humulus lupulus							+-2	I
Hydrocharis morsus-ranae			8.75	1				I
Hypericum tetrapterum							+-1	I
Inula britannica						+-1		I

Iris pseudacorus	0.14			+-1		+	+-3	II
Isatis tinctoria							+-2	I
Juncus articulatus							+	I
Juncus compressus							+-2	I
Lactuca serriola							+	I
Lamium purpureum							+-1	I
Lathyrus tuberosus						+-2		I
Leersia oryzoides				1				I
Lemna minor		4.63	2.53	+-2			+-3	III
Lemna trisulca		18.40	4.03					II
Leucanthemella serotina							+-1	I
Lolium perenne							1	I
Lotus corniculatus					0.67			I
Lycopus europaeus	0.43		0.28	+-1			+-2	II
Lycopus exaltatus						+	+-2	II
Lysimachia nummularia						+-3	+-4	II
Lysimachia vulgaris	0.29			+-1		+	+-1	II
Lythrum salicaria	0.47			+-1			+-1	II
Lythrum virgatum						+	+-1	II
Melandrium album							+	I
Melilotus officinalius							+	I
Mentha aquatica						+	+-2	II
Mentha longifolia							+	I
Mentha pulegium							+	I
Najas marina				1-2				I
Nymphoides peltata				1				I
Oenanthe aquatica							+-2	I
Oenothera biennis						+-1	+-2	II
Ononis semihircina							+	I
Pastinaca sativa							+-1	I
Peucedanum officinale					0.67			I
Phragmites australis	81.14	95.00	80.00	4-5	43.33	4-5	1-5	V
Picris hieracioides						+	+-1	I
Plantago major						+-1	+	I
Poa angustifolia						+		I
Poa palustris							1	I
Poa trivialis							+-3	I

Polygonum amphibium						+-1	+-1	II
Polygonum hydropiper							+	I
Polygonum lapathifolium				+-1		+	+-1	I
Polygonum minus							+	I
Populus alba						+-1		I
Populus nigra						+	+	I
Potamogeton lucens							+	I
Potamogeton nodosus				+-2				I
Potamogeton perfoliatus				+				I
Potentilla reptans							+-1	I
Potentilla supina							+	I
Prunella vulgaris							+	I
Quercus robur	0.29							I
Ranunculus aquaticus							2	I
Ranunculus repens						+		I
Ranunculus sardous							+-1	II
Ranunculus sceleratus				+			+	I
Rorippa austiaca						+		I
Rorippa sylvestris						+		I
Rubus caesius				+		+-3	+-3	II
Rumex patientia						+		I
Rumex stenophyllus						+	+	I
Rumex conglomeratus						+	+-1	I
Rumex crispus							+	I
Rumex hydrolapathum				+				I
Salix alba				+-1			+-2	I
Salix cinerea	0.43							I
Salix triandra						1-3	+-2	II
Salix viminalis				1		+		I
Salvinia natans		2.51		+-2				II
Schoenoplectus lacustris							+-3	I
Scrophularia umbrosa							+	I
Scutellaria galericulata	0.43			1			+	I
Scutellaria hastifolia								I
Setaria glauca							+	I
Shoenoplectus lacustris				1				I
Sium latifolium							+-2	I

Solanum dulcamara	2.86			1		+	+-1	II
Solidago gigantea						+		I
Sonchus asper							+	I
Sparganium erectum				+			+-1	I
Spirodela polyrhiza		0.64	4.03	+-3			1-2	III
Stachys palustris			0.05			+	+-1	II
Stellaria aquatica							+-2	I
Stellaria graminea					1.00			I
Stratiotes aloides		0.14						I
Symphytum officinale	1.14			+		+-1		II
Symphytum officinale ssp. uliginosum							+-1	II
Tanacetum vulgare						+	+-1	I
Taraxacum officinale						+		I
Teucrium scordium							+-2	I
Thalictrum flavum				1		+		I
Thalictrum lucidum							+	I
Torilis arvensis							+	I
Tripleurospermum inodorum						+		I
Typha angustifolia				+-1			1-3	II
Typha latifolia				+-1			+	I
Ulmus laevis							+-1	I
Ulmus scabra						+		I
Urtica dioica	1.80		0.03	1				I
Utricularia vulgaris		0.04						I
Verbena officinalis							+	I
Verbena supina							+	I
Veronica anagallis-aquatica							+-1	I
Veronica spicata					0.67		+	I
Vicia angustifolia							+	I
Vicia cracca						+		I
Vicia sepium							+	I
Viola elatior							+	I
Vitis sylvestris							+	I
Xanthium italicum						+	+-2	I
Xanthium strumarium						+		I

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Lake of Bereg			
Bence-lake, Csaroda	2 (%)	June 1998	János Nagy (Nagy, 2002)
Bence-lake, Csaroda	5 (%)	July 2000	János Nagy (Nagy, 2002)
Bodrog			
Kengyel oxbow	8 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Lake Tisza			
Tisza-oxbow of Hordód, Poroszló	4 (%)	June 2004	András Balázs Lukács (unpublished)
Tiszavalk	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba, 1989)
Sarud	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba, 1989)
Abádszalók	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba, 1989)
Tisza-oxbow of Bere	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba, 1989)
Tisza from Szolnok to the southern border			
Fokközi-forest, Vésztő	3 (%)	June 1998	Károly Penksza, Gabriella Gubcsó (Penksza, Gubcsó 1998)
sugarfactory right-side, Szolnok	2 (AD)	June 1944	Lajos Tímár (Tímár, 1950)
sugarfactory left-side, Szolnok	2 (AD)	June 1944	Lajos Tímár (Tímár, 1950)
curve of Tószeg right-side Szolnok	1 (AD)	June 1944	Lajos Tímár (Tímár, 1950)
rim of high-side right-side, Tiszavárkony	1 (AD)	August 1944	Lajos Tímár (Tímár, 1950)
opposite with the distillery right-side, Tiszavárkony	1 (AD)	August 1944	Lajos Tímár (Tímár, 1950)
steep, clamy, right-side Tápé	1 (AD)	June 1946	Lajos Tímár (Tímár, 1950)
Maros			
Apátfalva	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)
Apátfalva	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)
Apátfalva	1 (AD)	June 1965	Mária Tóth (Tóth, 1967)
navvy hole, Makó	1 (AD)	September 1966	Mária Tóth (Tóth, 1967)
Csipkés-navvy hole, Makó	1 (AD)	May 1964	Mária Tóth (Tóth, 1967)
Csipkés (navvy hole), Makó	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)
strand forest, Makó	1 (AD)	July 1966	Mária Tóth (Tóth, 1967)
riverside, Kiszombor	1 (AD)	September 1965	Mária Tóth (Tóth, 1967)
well outlet, Ferencszállás	1 (AD)	June 1965	Mária Tóth (Tóth, 1967)
riverside, Klárafalva	1 (AD)	September 1965	Mária Tóth (Tóth, 1967)
Klárafalva	1 (AD)	October 1947	Mária Tóth (Tóth, 1967)
navvy hole, Maroslele	1 (AD)	August 1965	Mária Tóth (Tóth, 1967)
oxbow side, Deszk	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)
Deszk oxbow	1 (AD)	August 1965	Mária Tóth (Tóth, 1967)

Deszk oxbow	1 (AD)	July 1965	Mária Tóth (Tóth, 1967)
riverside, Szőreg	1 (AD)	September 1965	Mária Tóth (Tóth, 1967)

V.3 *Sparganietum erecti*

total number of the stands: 11	Lake Bereg	north-eastern border - Tokaj	Bodrog	Szolnok - southern border	Szolnok - southern border	
number of the relevés: 1 (AD) + 27 (%) = 28	average cover (%)	average cover (%)	average cover (%)	average cover (%)	range of the AD values	K
Agrostis stolonifera	0.11	0.29				I
Alga sp.		10.00				I
Alisma plantago-aquatica	0.56	1.16		1.00		II
Alopecurus pratensis	0.78		0.01			I
Ambrosia artemisiifolia	0.01					I
Bidens tripartitus	0.01	1.71				I
Butomus umbellatus	1.44		0.03	1.00		II
Carex pseudocyperus	0.11					I
Carex riparia	1.33					I
Ceratophyllum demersum			41.50			I
Ceratophyllum submersum	0.56					I
Chara sp.			0.30			I
Cirsium palustre		0.14	0.01			I
Cirsium vulgare	0.44					I
Echinocloa crus-galli		0.14	0.01			I
Elatine hungarica		0.71				I
Equisetum arvense	0.22					I
Equisetum palustre		1.86				I
Galium palustre		0.01				I
Glyceria maxima	4.78	1.86	0.75	3.00		III
Gratiola officinalis	3.22					I
Hydrocharis morsus-ranae	1.44	0.01	7.71	0.10		IV
Iris pseudacorus	3.89					I
Juncus tenuis		0.01				I
Lemna minor	9.23	1.05	0.04			III
Lemna trisulca	24.44					I
Lycopus exaltatus				0.10		I
Lysimachia nummularia	0.33					I
Lysimachia vulgaris	1.00		0.01			I
Lythrum virgatum	0.06		0.01			I

Marsilea quadrifolia		9.29	12.50			II
Mentha aquatica		0.43		1.00		I
Mentha arvensis	0.17					I
Myosotis palustris		1.43		1.00		I
Myriophyllum spicatum			0.12			I
Nuphar lutea		1.43	2.21			II
Nymphaea alba				0.10	2	I
Nymphoides peltata				10.00		I
Oenanthe aquatica	0.56					I
Phalaris arundinacea	4.67					I
Phragmites australis	0.11				+	I
Poa pratensis		0.14				I
Polygonatum lapathifolium		0.01	0.50			I
Ranunculus repens	1.22	0.14				I
Riccia fluitans	21.11					I
Rorippa austriaca			0.02			I
Rorippa islandica	1.34					I
Rorippa sylvestris		0.07				I
Rumex hydrolapathum			0.01			I
Sagittaria sagittifolia		0.71	0.70	0.10		II
Salix cinerea	3.89					I
Salvinia natans	16.89	0.14	0.26	5.00		III
Sium latifolium				5.00		I
Sparganium erectum	56.67	75.86	58.30	70.00	4	V
Spirodela polyrhiza	21.00	0.02	0.45			II
Stachys palustris	0.11	0.03				I
Stratiotes aloides	0.78					I
Symphytum officinale		0.43				I
Teucrium scoridum				3.00		I
Trapa natans		2.86	5.61			II
Tripleurospermum inodorum		0.01				I
Typha angustifolia			0.01		1	I
Typha latifolia				3.00		I
Utricularia vulgaris			0.51			I

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Lake Bereg			
Navat-streamlet, Csaroda	4 (%)	July 2003	János Nagy, Dániel Cserhalmi (unpublished)
Lake Bence, Csaroda	5 (%)	June 1999	János Nagy (Nagy, 2002)
Tisza from the north-eastern border to Tokaj			
Tisza-oxbow of Rózsás-dűlő, Mezőladány	4 (%)	June 2004	András Balázs Lukács (unpublished)
Pallagcsa-meadow, Pácin	2 (%)	June 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Channel, Szenna-tanya	1 (%)	June 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Bodrog			
Óbodrog-oxbow, Sárospatak	2 (%)	June 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Óbodrog-oxbow, Sárospatak	1 (%)	June 2004	Zoltán Tuba (in Szirmai et al., 2006)
Viss-oxbow, Viss	5 (%)	October 2005	Zoltán Tuba et al. (in Szirmai et al., 2006)
Kengyel-oxbow, Bodroghalász	2 (%)	July 2003	Zoltán Tuba (in Szirmai et al., 2006)
Tisza from Szolnok to the southern border			
Tiszaalpár-oxbow, Tiszaalpár	1 (%)	August 1982	György Bodrogközy (Bodrogközy, 1982)
Tiszaalpár-oxbow, Tiszaalpár	1 (AD)	October 1962	György Bodrogközy (Bodrogközy, 1965)

VI.2 *Alismato-Eleocharicetum*

number of relevés 1	**coverage (%)**
Alisma lanceolatum	5
Bidens tripartitus	0.1
Bolboschoenus maritimus	5
Carex gracilis	5
Eleocharis palustris	75
Rorippa amphibia	2
Sagittaria sagittifolia	1
Salvinia natans	5

locality of the stand	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Ányási Holt-Tisza, Hódmezővásárhely, Mártély Landscape Protection Area	1 (%)	October 2006	József Áron Deák

VI.3 *Oenantho aquaticae-Rorippetum amphibiae*

number of relevés: 1	**coverage (%)**
LK1	
Alisma lanceolatum	2
Bidens tripartitus	2
Bolboschoenus maritimus	5
Carex gracilis	10
Oenanthe aquatica	40
Polygonum lapathifolium	5
Rorippa amphibia	10
Sagittaria sagittifolia	1

locality of the stand	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Külső-Nagy-Gombás, Csongrád	1 (%)	August 2003	József Áron Deák

VI.4 *Butomo-Alismatetum lanceolati*

number of stands: 3	Butomo-Alismatetum lanceolati		Butomo-Alismatetum lanceolati alismatetosum		Butomo-Alismatetum lanceolati bolboschoenetosum	
number of relevés: 9 (%)	**K**	**average cover (%)**	**K**	**average cover (%)**	**K**	**average cover (%)**
Alisma lanceolatum	I	1	III	47	II	30
Bolboschoenus maritimus	I	10	I	7.4	III	60
Butomus umbellatus	V	80	I	1.6		
Cirsium arvense			I	0.5	I	0.1
Cirsium palustre			I	0.1		
Daucus carota					I	0.1
Eleocharis palustris	I	1				
Epilobium hirsutum					I	0.1
Inula britannica			I	0.05		
Lycopus europaeus			I	0.02		
Lysimachia vulgaris	I	0.1				
Lythrum salicaria	I	0.1				
Oenanthe aquatica			I	2.5		
Phalaroides arundinacea			I	0.1		
Plantago media			I	0.2		
Polygonum lapathifolium			I	1.4	I	0.1
Rumex crispus			I	0.02		
Sagittaria sagittifolia	I	2				
Sparganium erectum	I	1	I	2.5		
Stachys palustris			I	0.05		
Xanthium italicum			I	7.5		
Setaria pumila			I	0.02		

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Belső-Nagy-Gombás, Csongrád	3 (%)	June 2000	József Áron Deák (unpublished)
Szandaszőlős	3 (%)	June 2004	József Áron Deák (unpublished)
Hódmezővásárhely, Vajhát	3 (%)	June 2001	József Áron Deák (unpublished)

VII.1 *Carici vulpinae – Alopecuretum pratensis*

total number of the stands: 73	north-eastern border - Tokaj	north-eastern border - Tokaj	Tokaj-Szolnok	Tokaj-Szolnok	Szolnok - southern border	Szolnok - southern border	Hármas-Körös	Maros	Maros	
number of the relevés: 99 (AD) + 90 (%) = 189	**average cover (%)**	**range of the AD values**	**average cover (%)**	**range of the AD values**	**average cover (%)**	**range of the AD values**	**average cover (%)**	**average cover (%)**	**range of the AD values**	**K**
Achillea collina	0.34		0.13	+-2			0.002			I
Achillea millefolium	0.001	+		+-1		+			+-1	I
Achillea millefolium ssp. collina				+						I
Achillea pannonica								0.01		I
Achillea setacea	1.18									I
Aegopodium podagraria		+								I
Agrimonia eupatoria	0.11			+						I
Agrostis alba	0.11	+-3		+-3		+-3		5.19	2-3	II
Agrostis canina	0.36									I
Ajuga reptans		+-2								I
Alisma plantago-aquatica				+-2	0.01	+-2		0.00		I
Alliaria petiolata		+								I
Allium angulosum				+-2						I
Allium scorodoprasum								0.01		I
Allium vineale										I
Alopecurus geniculatus				+-1		4				I
Alopecurus pratensis	76.14	1-4	41.88	1-4	35.83	2-4	45.83	18.84	1-4	V
Althaea officinalis		+		+	0.18	+	0.34	0.03	+	II
Amorpha fruticosa				+		+	0.002	0.01		I
Anagallis arvensis								0.01	+-1	I
Anagallis femina									+-1	I
Anthoxanthum odoratum		2								I
Aracimospermum canum									+	I
Arctium lappa		+		+				0.01		I
Aristolochia clematitis		+		+-1		+	0.34		+-2	I
Arrhenatherium elatius				1				3.84		I
Artemisia absinthium				1						I

Artemisia sp.				+						I
Asparagus officinalis		+		+			0.003			I
Aster sedifolius ssp.sedifolius			0.06							I
Atriplex littoralis					0.01					I
Ballota nigra								0.003		I
Beckmannia eruciformis	0.11			1						I
Bidens tripartitus	0.001	1	0.63	2	0.22	+				I
Bolboschoenus maritimus				+-3	0.28	+-2			2-3	I
Bromus commutatus				+-3				0.003		I
Bromus imermis									+	I
Bromus mollis		+	0.63					0.01		I
Bromus sp.		1								I
Bromus squarrosus								2.44		I
Buglossoides arvensis									+-1	I
Bupleurum commutatum					1.56					I
Butomus umbellatus				+		+				I
Calamagrostis canescens	0.02									I
Calamagrostis epigeios	0.11			+-2				0.003	2	I
Calepina irregularis									+	I
Caltha palustris	0.04									I
Calystegia sepium	0.001			+		+-2				I
Campanula patula	0.001									I
Capsella bursa-pastoris		+						0.01	+-3	I
Cardaria draba									+-2	I
Carduus acanthoides	0.11									I
Carex riparia	0.50									I
Carex distans			28.25	+						I
Carex gracilis		+		+-3	1.06	+-2				I
Carex hirta	1.07	2		+-3	0.18	+-1	0.17	4.04		II
Carex melanostachya		1-2		+-3	3.67	1-4	5.33	0.17	+-2	III
Carex praecox	0.43	+-1	15.25	1-2	0.28	+-4	3.83	0.003	1-2	II
Carex sp.				+-2	0.01				1	I
Carex spicata								0.003		I
Carex stenophylla								5.84		I
Carex vulpina	0.001	+		+-2	0.17			0.83	+-2	II
Caucalis lappula									+	I
Centaurea jacea	0.36							0.17		I

Centaurea pannonica	0.11	1	0.06	+-1	0.01	+-1	0.17			I
Centaurea sp.					0.06					I
Centaurium erythrea	0.11					+			+	I
Centaurium pulchellum				+-1						I
Cerastium holosteoides		+				2				I
Cerastium vulgatum				+					+-3	I
Chaerophyllum bulbosum		1								I
Chaerophyllum sp.		1								I
Chenopodium polyspermum		1								I
Chenopodium urbicum				+						I
Cichorium intybus	0.04	+-1		+-2	0.57	+-2	0.002	0.01	+-1	I
Cicuta virosa	0.07									II
Cirsium arvense	1.39		0.13	+-1	0.28	+-2	0.50	4.30	+-2	I
Cirsium brachycephalum					0.01					I
Cirsium canum	0.82			+	0.28					I
Cirsium palustre				+	0.06					I
Cirsium sp.					0.01					I
Cirsium vulgare	0.04									I
Clematis integrifolia				+-2			1.67		+-2	I
Cnidium dubium				+						III
Convulvulus arvensis	0.20	+-1		+-2		+-1	0.34	0.06	+-2	I
Conyza canadensis	0.04			1				0.003	+-1	I
Coronilla varia									+	I
Crataegus monogyna						+				I
Crepis rhoeadifolia						+-2				I
Crepis setosa				1					+	I
Cuscuta epithymum				1-2	0.17					I
Cuscuta sp.		2		+-1	0.06	+-1				I
Cynodon dactylon			3.13			+-4		0.67		I
Dactylis glomerata	0.11								+-1	II
Daucus carota	0.68	+		+-2	0.17	+-2		0.24	+-1	I
Dipsacus laciniatus								0.14		I
Drepanocladus aduncus			12.50	1	1.11					I
Echinochloa crus-galli		1	0.06		0.03				1-2	I
Echinops sphaerocephalus									1	I
Eleocharis palustris			1.88	1-3	0.45	+-2	0.002			I
Elymus repens	0.001	1	0.25	+-2	0.72	+-4	0.67	11.44		II

Epilobium parviflorum	0.001			+-1						I
Epilobium tetragonum									+	I
Equisetum arvense	0.11	+		+-2		+-1		0.10	1-2	I
Erigeron annuus		+		+-2				0.003	+-1	I
Erigeron strigosus				+-3						I
Erodium cicutarium									+-1	I
Eryngium campestre		+		+		+		0.07	+	I
Eryngium planum		+		+-2					+	I
Euphorbia palustris	0.04			+-1		+				I
Euphorbia esula					0.01			0.003		I
Euphorbia lucida		+			0.37	+-1	2.75		+-2	II
Euphorbia salicifolia							0.42			I
Euphorbia sp.	0.07									I
Euphorbia virgata	0.001	+		+	0.01	+	0.002			I
Fallopia convolvulus									+-1	I
Festuca pratensis				+-1				4.00		I
Festuca pseudovina	0.39		0.13	1-2		+				I
Filipendula ulmaria			0.50							I
Fragaria vesca	0.08	+		1						I
Fragaria viridis	1.83									I
Galega officinalis						+		0.23		I
Galium aparine									1-2	I
Galium mollugo	0.18	+		+					+-1	I
Galium palustre	0.04			+	0.06	+				I
Galium rubioides		+-2		+-3		+	0.002		+-2	II
Galium schultesii		+						0.003		I
Galium verum	2.77	+						15.41		I
Gentianella ciliata				1						I
Geranium dissectum								0.01		I
Geranium pusillum								0.03	+-2	I
Geum urbanum		+								I
Glechoma hederacea	0.21	+-1		+-1	0.12	+-1	0.33	0.25	+-2	II
Glycyrrhiza echinata				+-3	1.56	+-3	3.75		+-3	III
Gratiola officinalis	0.39	+	0.01	+-2	0.18	+-1	1.67	0.10	+-2	III
Gypsophila muralis				+-1	0.11	1				I
Helianthus annuus						+				I
Hieracium umbellatum	0.001								+-1	I

Hypericum perforatum	0.04									I
Hypericum sp.		+								I
Hypericum tetrapterum					0.01					I
Inula britannica	0.38	1	0.25	+-2	0.84	+-2		0.07	1-2	II
Inula salicina		+		+-1						I
Inula salicina x britannica				+-2						I
Iris pseudacorus	1.77	+		+-1	2.13	+	0.51	0.07	+-2	III
Juncus effusus	0.18									I
Juncus articulatus				+						I
Juncus atratus				+						I
Juncus compressus				+-1	0.02	+-1			+-2	II
Juncus inflexus				+						I
Kickxia elatine									+	I
Knautia arvensis	0.004				0.06				+	I
Lactuca saligna				+		+				I
Lamium album		+								I
Lamium amplexicaule									+-2	I
Lamium purpureum		+	0.25		1.00			0.003	+-1	II
Lathyrus hirsutus						+			+	I
Lathyrus palustris		1		+						I
Lathyrus pratensis		+		+-1					+-1	I
Lathyrus sativus			1.88							I
Lathyrus tuberosus	0.04			+-2-		+-1	0.002	1.09	+-1	I
Leontodon autumnalis		+		1	0.45					I
Leontodon hispidus		2		+-2						I
Leontodon hispidus ssp. danubialis				+						I
Leontodon sp.					0.06					I
Leonurus cardiaca				+						I
Leonurus marrubiastrum					0.01					I
Leonurus sp.					0.01					I
Leucanthemella serotina	0.001				0.01	+-1				I
Leucanthemum vulgare ssp. vulgare		+-2		+			0.002		+-1	II
Leucojum aestivum									+	I
Limonium gmelinii			0.03		0.11	2				I
Linaria kochianovichi	0.0004									I

Linaria vulgaris	0.005					1		0.01		I
Lolium perenne				1-2		+-2		0.003	+-2	I
Lotus corniculatus	0.0004	+		+-3		+-2	0.34	0.003	+-2	I
Lotus corniculatus ssp. tenuifolius						+				II
Lotus glaber		+	0.25	1	0.61	+-2				I
Lychnis flos-cuculi		+		+	0.01					I
Lycopus europeus	0.001			+-1		+				I
Lycopus exaltatus						+		0.01	+-1	I
Lysimachia nummularia	0.32	+-2		+-3	1.17	+-2	5.84	0.07	+-3	I
Lysimachia vulgaris	0.39	1		+	1.17	+	0.09			III
Lythrum salicaria	0.21				3.23	+-1			+-1	I
Lythrum virgatum	0.43	+-1	1.25	+-2	1.42	+-2	0.34	0.003	+-1	II
Marrubium vulgare	0.004									III
Medicago lupulina		+		+-2		+-1		0.003	+	I
Medicago minima	0.07									I
Medicago sativa		+		+-2						I
Melandrium album				+-1				0.003		I
Melilotus officinalis		+		+						I
Mentha aquatica					0.44	+				I
Mentha arvensis		1		+-1	0.51	+-1			+	II
Mentha longifolia									1	I
Mentha pulegium	0.07	+	0.75	1	0.61	+-2		0.07	+	II
Mentha sp.							0.003			I
Morus sp.								0.01		I
Myosotis arvensis									+-2	I
Myosotis hirsuta								0.003		I
Myosotis ramosissima								0.03		I
Odontites rubra	0.11			1						I
Oenanthe aquatica				+	0.01					I
Oenothera biennis		+				+				I
Ononis arvensis	0.36									I
Ononis spinosa	0.54					+				I
Onopordium acanthium				1						I
Orchis laxiflora ssp. palustris					0.01					I
Ornithogalum umbellatum		+						0.28	+-1	I
Oxalis sp.						+				I

Pastinaca sativa	0.25							0.01	+-1	I
Peucedanum palustre	0.001									I
Peucedanum officinale			0.25							I
Phalaris arundinacea	3.64			+-3	1.00	+-1	0.002	0.33		II
Phragmites australis	0.11					+			+-1	I
Picris hieracioides	0.04					3			+	I
Pimpinella saxifraga	0.04	+-1								I
Plantago lanceolata	0.001		0.06	+-1	0.07	+-2	0.09	0.01	+-1	II
Plantago major		1	0.01	+-2	0.11	+-2	0.34	0.01		II
Plantago media		+								I
Poa angustifolia	0.64	1-2	0.25	+-3	0.17	+-3		1.54		II
Poa bulbosa						1				I
Poa pratensis	2.21	1-2	9.63			+-2		0.003		I
Poa pratensis s.str.						+-2	6.50		+-2	I
Poa sp.				2						I
Poa trivialis		+-1		+-1	0.56	+-1	0.002			I
Polygonum mite	0.001			1						I
Polygonum amphibium		1		+-1	0.12	1				I
Polygonum aviculare	0.01	1			0.11			0.01		I
Polygonum lapathifolium		+				+	0.003		+	I
Polygonum minus									+	I
Polygonum sp.								0.01		I
Populus alba						+				I
Populus nigra						+		0.003		I
Potentilla anserina					1.67	+-1				I
Potentilla argentea				+				0.01		I
Potentilla inpolita	0.38									I
Potentilla reptans	1.75	+-2	1.25	+-3	9.00	+-3	1.84	0.003	+-3	IV
Potentilla supina						1				I
Prunella vulgaris	0.001	+-1		+-2	0.12	+		0.01	+	II
Prunus spinosa	0.87									I
Pseudolysimachion longifolium		+		+						I
Pulicaria vulgaris						+				I
Pulmonaria mollis		+								I
Pulmonaria officinalis		+								I
Quercus robur		+		+						I

Ranunculus flammula	0.001	+								I
Ranunculus acris	0.32	+-4						0.04		I
Ranunculus auricomus		+		+-1						I
Ranunculus bulbosus			0.01							I
Ranunculus polyanthemos		+		+			0.003	0.22		I
Ranunculus repens	0.62	+-3	0.75	+-3	1.28	+-2	6.00	0.50	+-2	I
Ranunculus sardous			0.01	+	0.07	+			+-2	IV
Rhinanthus angustifolius					0.01					II
Rorippa × armoracioides				1-2						I
Rorippa × astylis				+-1						I
Rorippa amphibia		+		+-1	0.01				+	I
Rorippa austriaca		+		+-1	0.01	+-2	3.84	0.02	+-1	I
Rorippa kerneri		+		+						I
Rorippa sp.							2.67			I
Rorippa sylvestris		+		+-2	0.01	+-1	1.17		+-3	I
Rosa canina								0.003		II
Rubus caesius	0.18	+		+		+	0.002	0.07		I
Rumex acetosa	0.001	+-1		+-1						I
Rumex confertus				1						I
Rumex conglomeratus				1					+	I
Rumex crispus		+-1		+-2	0.06	+-3	1.17	0.01	+	I
Rumex hydrolapathum				+-1						II
Rumex obtusifolius									+-1	I
Rumex patientia		+		+-1						I
Rumex sp.					0.11					I
Rumex stenophyllus			0.01	1						I
Salix fragilis	1.82									I
Salix alba		+		+						I
Salix cinerea				+						I
Scabiosa ochroleuca				1						I
Scorzonera cana				1		+				I
Scutellaria galericulata	0.001	+		+	0.01	+				I
Scutellaria hastifolia	0.004			+	0.17		0.84		+-2	I
Senecio doria									+-1	I
Senecio erraticus ssp. barbareifolius	0.0004	+		+						I
Senecio jacobiensis			0.88	+-2						I

Senecio rivularis						+				I
Senecio sp.				1						I
Serrulata tinctoria				+						I
Setaria pumila	0.04	2		1-2	0.12	+		0.003	+	I
Setaria viridis									+	I
Silene multiflora				+						I
Sium latifolium				+		+				I
Sonchus arvensis		1		1		1-3				I
Sonchus asper									+	I
Sparganium erectum				+						I
Stachys palustris	0.01	+		+		+		0.04		I
Stellaria graminea							0.002			I
Stellaria media		+								I
Stenactis sp.		+								I
Symphytum officinale	0.20	+-1		+-2	0.91	+-2	2.01	0.003	+-1	III
Tanacetum vulgare	2.63	+-1		+-1	0.01	+	0.002	0.003	+	II
Taraxacum officinale	0.04	+-2		+-3	0.46	+-2	2.00	0.11	+-3	III
Teucrium scordium				+	0.01	+		0.03		I
Thalictrum flavum		+		+-1	0.01	+-1				I
Thalictrum lucidum		+		+-1	0.50	+-1	0.59	0.003	+-2	II
Torilis arvensis						+				I
Torilis japonica								0.003		I
Tragopogon crantzii				+-1						I
Tragopogon dubius		1		+-2						I
Tragopogon dubius ssp. major									+	I
Tragopogon dubius×orintalis		1								I
Tragopogon orientalis		1-2		+-2						I
Trifolium arvense				+-1						I
Trifolium campestre		+		+-1		+		0.003	1-2	I
Trifolium dubium					0.17					I
Trifolium fragiferum				1	0.39	+-2				I
Trifolium hybridum	0.001	+-1	0.13	+-2	0.06	+-2			+	I
Trifolium montanum		+								I
Trifolium pratense	0.02	+-3		+-4	0.11	+-2			+-1	II
Trifolium repens	0.36	+-3	0.13	+-3	1.12	+-3	1.75		+-2	III
Tripleurospermum inodorum	0.07		0.03	+-2	0.01	+-1		0.003		I
Typha angustifolia						+-1				I

Typha latifolia				+-1						I
Urtica dioica	0.02	+								I
Valeriana officinalis		+								I
Valerianella locusta								0.01	+-2	I
Valerianella sp.		+								I
Verbascum blattarum						+				I
Verbascum nigrum								0.01		I
Verbena officinalis								0.04	+-1	I
Veronica chamaedrys	0.001	+-1								I
Veronica scutellata	0.001									I
Veronica anagalloides									+	I
Veronica polita		+								I
Veronica serpyllifolia		+		+						I
Veronica triphyllos	0.21								+-2	I
Vicia angustifolia				+-1	0.01	1-2			+-1	I
Vicia cracca	0.04	1		+-2	0.24	+-1	1.00		+-1	II
Vicia grandiflora								2.07		I
Vicia grandifolia var. sordia									+-1	I
Vicia hirsuta			0.50				0.17	3.34	+-2	I
Vicia lathyroides				1	0.01	+				I
Vicia sativa								1.94		I
Vicia sepium	0.07	+								I
Vicia sp.					0.01		0.09			I
Vicia tetrasperma		+				+				I
Viola elatior	0.001	+							+-1	I
Viola arvensis	0.50							0.003		I
Viola hirta		+								I
Viola pumila					0.06		0.67			I
Viola riviniana		+								I
Viola stagnina				+-1						I
Viola sylvestris		+								I
Viola tricolor		+								I
Xanthium italicum				1	0.12			0.02		I
Xanthium strumarium						+				I

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Tisza from the north-eastern border to Tokaj			
Bábtava, Csaroda	1 (%)	1999	János Nagy, Márta Selényi (Nagy, 2002)
Lake Nyíres, Csaroda	4 (%)	1999	János Nagy, Márta Selényi (Nagy, 2002)
Bereg, Csaroda	5 (%)	June 1998	János Nagy (Nagy, 2002)
Bereg, Csaroda	8 (%)	July 2000	János Nagy (Nagy, 2002)
near by Cigánd	6 (%)	July 2006	Zoltán Tuba et al. (Gál et al., 2006)
Cigánd-Pácin	4 (%)	October 2006	Zoltán Tuba et al. (Gál et al., 2006)
Kisar	1 (AD)	May 1958	György Bodrogközy (unpublished)
Vásárosnamény	1 (AD)	July 1966	György Bodrogközy (unpublished)
Vásárosnamény	1 (AD)	May 1958	György Bodrogközy (unpublished)
Tiszaadony-Tiszakerecsend	1 (AD)	July 1966	György Bodrogközy (unpublished)
Tímár	2 (AD)	June 1959	György Bodrogközy (unpublished)
Rakamaz	1 (AD)	June 1981	György Bodrogközy (unpublished)
Tisza from Tokaj to Szolnok			
Csikólegelő, Sarud	1 (%)	August 1971	György Bodrogközy (unpublished)
Cserőköz	1 (%)	August 1970	György Bodrogközy (unpublished)
Jászapáti	4 (%)	June 2003	János Nagy (unpublished)
Jásztelek	2 (%)	May 1999	János Nagy (unpublished)
surrounding of Tokaj	27 (AD)	1962	György Bodrogközy, (Bodrogközy, 1962)
Tiszalök	2 (AD)	June 1959	György Bodrogközy (unpublished)
Taktabáj	2 (AD)	June 1959	György Bodrogközy (unpublished)
Taktakenéz	1 (AD)	June 1959	György Bodrogközy (unpublished)
opposite with Tiszakeszi on the left-side of Tisza	2 (AD)	1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Tiszabábolna	1 (AD)	1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Tiszafüred	10 (AD)	June 1964	György Bodrogközy (unpublished)
Sarud	1 (AD)	Autumn 1969	György Bodrogközy (unpublished)
Sarud	1 (AD)	July 1970	György Bodrogközy (unpublished)
Cserőköz	1 (AD)	August 1971	György Bodrogközy (unpublished)
Abádszalók	1 (AD)	July 1971	György Bodrogközy (unpublished)
Tisza from Szolnok to the southern border			
Tőserdő	1 (%)	May 1983	György Bodrogközy (unpublished)
Tőserdő	2 (%)	August 1982	György Bodrogközy (unpublished)
Tiszaalpár	1 (%)	May 1980	György Bodrogközy (unpublished)
Tiszaalpár	1 (%)	June 1983	György Bodrogközy (unpublished)
Bokros	1 (%)	May 1980	György Bodrogközy (unpublished)

Bokros felső	1 (%)	May 1981	György Bodrogközy (unpublished)
Nagy-legelő, Bokros	1 (%)	August 1982	György Bodrogközy (unpublished)
Bokros	1 (%)	August 1982	György Bodrogközy (unpublished)
Körtvélyes	3 (%)	September 1978	György Bodrogközy (unpublished)
Körtvélyes	1 (%)	June 1979	György Bodrogközy (unpublished)
Körtvélyes	2 (%)	July 1979	György Bodrogközy (unpublished)
Körtvélyes	2 (%)	September 1979	György Bodrogközy (unpublished)
Körtvélyes	1 (%)	June 1980	György Bodrogközy (unpublished)
Közép-Tisza meadows	3 (AD)	May 1959	György Bodrogközy (1961)
Vezseny	1 (AD)	July 1958	György Bodrogközy (1961)
Nagyrév	1 (AD)	April 1958	György Bodrogközy (1961)
Nagyrév	2 (AD)	July 1958	György Bodrogközy (1961)
Tiszaug	4 (AD)	July 1958	György Bodrogközy (1961)
Tiszaalpár	6 (AD)	June 1963	György Bodrogközy (1961)
Bokros	2 (AD)	June 1963	György Bodrogközy (1961)
Mártély	4 (AD)	June 1963	György Bodrogközy (1961)
Hármas-Körös			
between Álomzug és Öcsöd bridge	1 (%)	1996	Tóth et al.(1996)
Álomzug	1 (%)	1996	Tóth et al.(1996)
Belső-Tehenes	1 (%)	1996	Tóth et al.(1996)
Őzén-zug	1 (%)	1996	Tóth et al.(1996)
west from Gyügér-zug-oxbow	1 (%)	1996	Tóth et al.(1996)
more west from Gyügér-zug-oxbow	1 (%)	1996	Tóth et al.(1996)
Maros			
Bezdin	3 (%)	July 2000	Katalin Margóczi (unpublished)
Semlac	3 (%)	July 2000	Katalin Margóczi (unpublished)
Makó	24 (%)	May 2001	Orsolya Makra (Makra, 2002)
Apátfalva	1 (AD)	May 1964	Mária Tóth (Tóth, 1967)
Apátfalva	1 (AD)	May 1965	Mária Tóth (Tóth, 1967)
Makó	1 (AD)	May 1964	Mária Tóth (Tóth, 1967)
Makó	1 (AD)	May 1965	Mária Tóth (Tóth, 1967)
Makó-csipkés	1 (AD)	September 1964	Mária Tóth (Tóth, 1967)
Kiszombor töltésalja	1 (AD)	August 1965	Mária Tóth (Tóth, 1967)
Ferencszállás pasture	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)
Ferencszállás clearing	1 (AD)	June 1965	Mária Tóth (Tóth, 1967)
Maroslele	2 (AD)	May 1964	Mária Tóth (Tóth, 1967)
Maroslele pasture	1 (AD)	June 1964	Mária Tóth (Tóth, 1967)

Tápérét	1 (AD)	June 1965	Mária Tóth (Tóth, 1967)
Tápérét töltésalja	2 (AD)	August 1965	Mária Tóth (Tóth, 1967)
Tápérét töltésalja	2 (AD)	July 1965	Mária Tóth (Tóth, 1967)
Tápérét füzes	1 (AD)	July 1965	Mária Tóth (Tóth, 1967)
Tápérét	1 (AD)	April 1965	Mária Tóth (Tóth, 1967)
Tápérét	2 (AD)	May 1965	Mária Tóth (Tóth, 1967)

IX.2. *Polygono hydropiperi-Salicetum triandrae*

total number of the stands: 60	lower-Tisza		middle-Tisza		Polgár-Tokaj section		upper-Tisza		Szamos		Körös	Maros		
number of the coenological relevés: 103 (AD)	**K**	**range of the AD values**	**K**	**range of the AD values**	**K**	**range of the AD values**	**K**	**range of the AD values**	**K**	**range of the AD values**	**range of the AD values**	**K**	**range of the AD values**	**overall K**
canopy layer														
Acer negundo												I	+	**I**
Fraxinus excelsior			I	+								I	+	**I**
Fraxinus sp.											1			**I**
Populus alba	II	1-2	III	1-2	I	1-3	I	1-2	II	+-2		II	+-1	**II**
Populus nigra	IV	+-1	IV	+-4	I	1	III	+-5	II	+-3		II	+-2	**III**
Robinia pseudoacacia												I	+-2	**I**
Salix alba	I	1-2	I	1	I	1-2	III	+-2			2	II	+	**II**
Salix eleagnos							I	4						**I**
Salix fragilis					I	1			II	+	1			**I**
Salix purpurea					I									
Salix triandra	V	2-5	IV	1-5	III	1-4	IV	1-5	V	+-5	3-4	V	3-5	**V**
Salix viminalis			I	1-4	II	1-4	II	1-4	IV	+-1	1			**I**
Ulmus minor												I	+	**I**
Ulmus glabra	II	+	I	3										**I**
shrub layer														
Amorpha fruticosa	I	+	II	+-1			I	+	IV	+-2	1	III	+-2	**II**
Populus alba			I	3										**II**
herbaceous layer														
Acer negundo			I	+										**I**
Achillea millefolium					I	1					+	I	+	**I**
Agrimonia eupatoria			I	+										**I**
Agrostis stolonifera	IV	+-3	IV	+-2			II	+-2			1	III	+-2	**III**
Alisma lanceolatum					I									
Alisma plantago-aquatica			I	+										**I**
Alliaria petiolata											+			**I**
Allium cepa	I	+												**I**
Alopecurus pratensis	I	+	I	+	I	1			II	+				**I**
Althaea officinalis			I	+					II	+				**I**
Amaranthus albus			II	+	I	1						I	+	**I**

Amaranthus crispus			I	+	I	1								**I**
Amaranthus retroflexus	I	+	I	+	I							I	+	**I**
Amarantus deflexus			I	+										**I**
Ambrosia artemisifolia											+			**I**
Andropogon ischaenum					I									
Angelica sylvestris							I	+						**I**
Anthemis arvensis											+			**I**
Arctum lappa	I	+	I	+								I	+	**I**
Aristolochia clematitis			II	+					II	+		I	+	**I**
Armoracia macrocarpa	I	+	I	+										**I**
Arrhenatherium elatius											1			**I**
Artemisia absinthium					II	1-2	II	+						**I**
Artemisia annua							I	+				I	+	**I**
Artemisia scoparia					I	1								
Artemisia vulgaris			I	+	II	1-2	III	+				III	+-1	**II**
Aster amellus	I	+												**I**
Atriplex hastata	IV	+	II	+								I	+-1	**II**
Atriplex oblongifolia												I	+	**I**
Atriplex patula												I	+	**I**
Atriplex sagittata	I	+										II	+	**I**
Atriplex tatarica	I	+	I	+										**I**
Avena sativa			I	+										**I**
Bidens cernuus			I	+								I	+	**I**
Bidens tripartitus	V	+-3	IV	+-2	IV	1-2	IV	+-1	IV	+-1		V	+-3	**V**
Bolboschoenus maritimus	II	+							II	2		I	+	**I**
Bromus sterilis	I	+												**I**
Bryum argenteum							II	+-1						**I**
Butomus umbellatus	I	+												**I**
Calamagrostis epigeios			II	+-1								III	+-2	**I**
Calystegia sepium	IV	+-1	III	+-1	I	1	II	+-2	II	+	+	IV	+-3	**III**
Capsella bursa-pastoris					II	1								
Carduus acanthoides			I	+							+			**I**
Carex acutiformis							I	+	II	1				**I**
Carex brizoides			I	+					II	3				**I**
Carex distans			I	+-1										**I**
Carex hirta	I	+										I	+	**I**
Centaurium pulchellum					I									

Cerastium dubium			I	+										**I**
Chenopodium album	II	+	II	+	II	1-2					+	I	+	**II**
Chenopodium botrys							I	+						**I**
Chenopodium ficifolium												I	+	**I**
Chenopodium glaucum			II	+	II	1						I	+	**I**
Chenopodium murale	I	+	I	+	I	1								**I**
Chenopodium polyspermum					I							I	+	**I**
Chenopodium rubrum	I	+										I	+-1	**I**
Chenopodium urbicum	III	+-1	II	+-2	III	1-2								**II**
Chenopodium vulvaria			I	+										**I**
Cichorium intybus	I	+	I	1								I	+	**I**
Cirsium arvense	II	+	II	+	I		I	+	II	+		I	+	**II**
Citrullus lanatus	I	+												**I**
Convolvulus arvensis	I	+	III	+-2	I	1-2					+-1			**I**
Conyza canadensis	II	+	II	+	IV	1-3	III	+				III	+-1	**II**
Crepis setosa			I	+	I									**I**
Crepis tectorum					I	1								
Cucubalus baccifer							I	+				I	+	**I**
Cucurbita pepo	I	+	I	+										**I**
Cuscuta lupuliformis	I	+-3										I	+	**I**
Cynodon dactylon			I	+-1	II	1						I	+	**I**
Cyperus fuscus	I	+-1	I	+	III	1	II	+				II	+-2	**I**
Cyperus glomeratus	I	+	I	+-2								III	+-1	**I**
Cyperus michelianus	III	+-2	II	+-1								I	+	**II**
Daucus carota					I	1	II	+				I	+	**I**
Digitaria sanguinalis					III	1-2								
Diplotaxis muralis					I	1								
Diplotaxis tenuifolia												I	+	**I**
Echinochloa crus-galli	IV	+-2	III	+-1	IV	1-3	III	+-1	II	1		III	+-2	**III**
Echinocystis lobata							III	+-2			+	I	2	**I**
Eleocharis acicularis	I	+	I	+										**I**
Eleocharis palustris	I	+	I	+										**I**
Elymus repens	I	+	III	+-2	I	1-2	IV	+-2	II	2		I	+	**II**
Elysimum cheiranthoides					I	1								
Epilobium hirsutum					I	1								
Epilobium tetragonum	I	+			I							II	+	**I**
Equisetum arvense	II	+-1	I	+	I		II	+-3				I	+	**I**

Equisetum fluviatile					I	1			IV	+				**I**
Equisetum ramosissimum							II	+						**I**
Eragrostis minor					I									
Eragrostis pilosa					I		I	+				I	+	**I**
Erigeron annuus ssp. strigosus	I	+	I	+			I	+				IV	+-1	**II**
Eupatorium cannabinum	I	+												**I**
Euphorbia lucida			I	+										**I**
Festuca pratensis	I	+												**I**
Galinsoga parviflora					I		I	+				I	+	**I**
Galium aparine												I	+-1	**I**
Galium palustre	I	+	I	+			II	+	II	+				**I**
Galium rubioides											+			**I**
Glechoma hederacea			I	1										**I**
Glycyrrhiza ecinata	I	+	III	+-1										**I**
Gnaphalium uliginosum	III	+-1	III	+-2	V	1						II	+	**II**
Gratiola officinalis	I	+	I	+										**I**
Gypsophila muralis					II	1			II	+				**I**
Heleochloa alopecuroidis	II	+-1	II	+-2	I	1								**I**
Heleochloa schoenoides	I	+			I	1								**I**
Helianthus annuus			I	+										**I**
Herniaria glabra					I	1-2								
Humulus lupulus											0.5	I	1-2	**I**
Iris pseudacorus									II	+				**I**
Juncus articulatus	II	+	I	+	II	1						I	+-2	**I**
Juncus bufonius	I	+	I	+	I	1						I	+	**I**
Juncus compressus	II	+-1	II	+								I	+-1	**II**
Juncus effusus	I	+	II	+										**I**
Juncus geraldii					I									
Juncus glaucus	I	+										I	+-1	**I**
Lactuca serriola	I	+										I	+-1	**I**
Lamium amplexicaule			I	+										**I**
Lathyrus palustre			I	+										**I**
Lathyrus pratensis					I									
Lathyrus tuberosus			I	+								I	+	**I**
Leontodon autumnale					I									
Lepidium draba	I	+												**I**
Lepidium ruderale					I									

Limosella aquatica	I	+	I	+										**I**
Linaria vulgaris					I									
Lindernia procumbens			I	+										**I**
Lolium perenne	I	+	I	+										**I**
Lotus corniculatus			I	+										**I**
Lotus glaber					I									
Lycopersicon esculentum	I	+												**I**
Lycopus europaeus	IV	+	II	+			IV	+-1	IV	+		IV	+-1	**III**
Lycopus exaltatus	II	+	II	+-1	I							I	+	**II**
Lysimachia nummularia							I	+						**I**
Lysimachia vulgaris	I	+	II	+					II	+	+			**I**
Lythrum hyssopifolia					I	1								
Lythrum salicaria	II	+	II	+	I	1					+	I	+-1	**I**
Lythrum tribacteatum	I	+	I	+										**I**
Lythrum virgatum	II	+	II	+-1	I	1								**I**
Medicago lupulina							I	+						**I**
Melilotus albus											+			**I**
Mentha aquatica	I	+			I	1						II	+-1	**I**
Mentha arvensis	IV	+	II	+			II	+-1			+	I	+	**II**
Mentha longifolia					I						+	I	+	**I**
Mentha pulegium	I	+	I	+	I	1						I	+-1	**I**
Microrrhinum minus					I	1								
Morus nigra			I	+										**I**
Myosotis palustris	I	+	I	+										**I**
Myosoton aquaticum							I	+				I	+-1	**I**
Oenanthe aquatica	I	+	II	+								I	+	**I**
Oenothera biennis	II	+	II	+	II	1						I	+	**II**
Oxalis stricta	I	1			I	1								**I**
Panicum miliaceum	I	+												**I**
Pastinaca sativa												I	+	**I**
Persicaria amphibia	I	+	II	+-3					IV	+		I	+	**I**
Persicaria hydropiper	I	2										III	+-1	**I**
Persicaria lapathifolia	IV	+-2	II	+	V	1-5	III	+-1			+	III	+-2	**III**
Persicaria maculosa			I	+							1			**I**
Persicaria minor												II	+-1	**I**
Phalaris arundinacea	I	+	II	+-1								II	+-1	**I**
Phragmites australis	II	+	III	+-1					IV	+-5		III	+-2	**II**

Physcomitrella patens							II	3						**I**
Plantago lanceolata	I	+	I	+							+			**I**
Plantago major	IV	+-1	III	+-1	IV	1	II	+				II	+	**III**
Poa annua					I									
Poa compressa	I	+					II	+						**I**
Poa palustris							II	+						**I**
Poa pratensis	I	+	I	+					II	+				**I**
Poa trivialis	I	+					I	+				I	+-2	**I**
Polygonum aviculare	I	+	I	+	III	1	II	+				I	+	**I**
Portulaca oleracea	I	+	I	+	I	1-2	I	+				I	+	**I**
Potentilla anserina			II	+	I	1			II	+				**I**
Potentilla reptans	I	2	I	+	I		I	+	II	+				**I**
Potentilla supina	IV	+-1	II	+	IV	1-2	III	+				IV	+	**III**
Prunella vulgaris			I	+										**I**
Pseudolysimachion longifolium	I	+												**I**
Pulicaria vulgaris			I	+	II	1-2						I	+	**I**
Ranunculus arvensis			I	+										**I**
Ranunculus repens	II	+-1	I	+	I	1	I	+						**I**
Ranunculus sardous			I	+								I	+	**I**
Ranunculus sceleratus	III	+	II	+	I	1						II	+-1	**II**
Robinia pseudo-acacia							II	+						**I**
Rorippa amphibia	I	+	I	+								II	+	**I**
Rorippa anceps	I	+	II	+										**I**
Rorippa armoracioides					II	1								
Rorippa austriaca	II	+	III	+-1	I	1								**II**
Rorippa barbaraeoides					I	1								
Rorippa islandica					I	1						I	+	**I**
Rorippa sylvestris	V	+	III	+-2	III	1	III	+				I	+	**III**
Rubus caesius	III	+-1	III	+-1	I		II	+-5	IV	+-2	+-2	IV	+-3	**III**
Rumex conglomeratus	III	+-1	II	+-1	I		I	+			+	I	+	**II**
Rumex crispus	I	1	II	+-1							+	I	+	**I**
Rumex palustris	II	+	II	+-1										**I**
Rumex patientia			I	+										**I**
Rumex sanguineus							II	+-1						**I**
Rumex sp.	I	+												**I**
Rumex stenophyllus					I	1								
Sagina procumbens												I	+	**I**

Salix alba							II	+	II	+				**I**
Salix purpurea			I	+										**I**
Salix triandra							I	+						**I**
Salsola kali	I	+												**I**
Sambucus ebulus												I	+-1	**I**
Scrophularia nodosa	I	+												**I**
Scrophularia umbrosa												I	+	**I**
Scutellaria galericulata	I	+	I	+			II	+				III	+-2	**II**
Scutellaria sp.	I	+												**I**
Senecio vulgaris			I	+										**I**
Setaria glauca					I	1	I	+				I	+	**I**
Setaria viridis	I	+										I	+	**I**
Solanum dulcamara	II	+	II	+			II	1			+	III	+-1	**II**
Solanum nigrum			I	+	I		I	+				I	+	**I**
Solidago gigantea ssp. serotina	I	+					I	+						**I**
Sonchus arvensis	I	+	I	+-1	II	1	I	+				I	+	**I**
Sonchus asper	I	+	I	+			II	+				I	+	**I**
Sonchus oleraceus												I	+	**I**
Spergularia rubra					I	1								
Stachys palustris	II	+	I	+								I	+	**I**
Stellaria media			I	+								II	+-1	**I**
Stenactis annua							I	1						**I**
Symphytum officinale			I	+							+	I	+	**I**
Tanacetum vulgare	II	+	II	+	III	1	II	+			+	II	+	**II**
Taraxacum officinale	II	+	II	+	II	1	II	+				I	+	**II**
Teucrium scordium	I	+												**I**
Thalictrum flavum			I	+										**I**
Thalictrum lucidum			I	+					II	+				**I**
Trifolium repens			I	+										**I**
Tripleurospermum inodorum	II	+	III	+	III	1	I	+				I	+	**II**
Triticum vulgare	I	+												**I**
Tussilago farfara	I	+	I	1								I	+	**I**
Typha angustifolia			I	+										**I**
Typha latifolia	I	+	I	+								I	+	**I**
Urtica dioica	I	+	I	+			I	+						**I**
Valerianella locusta			I	+										**I**
Verbascum blattaria			I	+										**I**

Verbascum lychnitis					I									
Verbena officinalis			I	+	I	1						I	+	**I**
Verbena supina			I	+								I	+	**I**
Veronica anagallis-aquatica	II	+	I	+	I	1						I	+	**I**
Veronica anagalloides					I	1	I	+				I	+	**I**
Veronica beccabunga			I	+								II	+-1	**I**
Vicia angustifolia			I	+										**I**
Vicia cracca			I	+			I	+	II	+	+	II	+-2	**II**
Xanthium italicum	II	+										II	+-1	**I**
Xanthium spinosum	I	+												**I**
Xanthium strumarium	II	+	II	+-1			I	+	II	+-5				**I**
Xanthium strumarium+italicum											+			**I**
Zea mays	I	+												**I**

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
lower-Tisza			
from Szeged to the southern border	1 (AD)	June 1960	György Bodrogközy (unpublished)
Tápé	1 (AD)	August 1943	Lajos Timár (Timár 1950/a)
Tápé	2 (AD)	June 1946	Lajos Timár (Timár 1950/a)
Szeged	3(AD)	May 1946	Lajos Timár (Timár 1950/a)
Szeged	1 (AD)	June 1946	Lajos Timár (Timár 1950/a)
Tiszaug	1 (AD)	July 1944	Lajos Timár (Timár 1950/a)
Tiszaug	1 (AD)	July 1958	György Bodrogközy (unpublished)
Nagyrév	3 (AD)	July 1944	Lajos Timár (Timár 1950/a)
middle-Tisza			
Tiszaföldvár	2 (AD)	July 1944	Lajos Timár (Timár 1950/a)
Tiszavezseny	2 (AD)	August 1944	Lajos Timár (Timár 1950/a)
Tiszavárkony	1 (AD)	July 1944	Lajos Timár (Timár 1950/a)
Tószeg	1 (AD)	June 1944	Lajos Timár (Timár 1950/a)
Szolnok	6 (AD)	June 1944	Lajos Timár (Timár 1950/a)
Szolnok	2 (AD)	May 1944	Lajos Timár (Timár 1950/a)
Szolnok	3 (AD)	July 1944	Lajos Timár (Timár 1950/a)
from Polgár to Tokaj	25 (AD)	1935	Miklós Újvárosi (Újvárosi 1940)
Taktabáj	1 (AD)	June 1959	György Bodrogközy (unpublished)
upper-Tisza			
Tímár	1(AD)	June 1959	György Bodrogközy (unpublished)

Tiszaszalka	2(AD)	August 1953	Tibor Simon (Simon 1957)
Bag (Gergelyiugornya:Bagiszeg)	6(AD)	August 1953	Tibor Simon (Simon 1957)
Maros			
Magyarcsanád	1(AD)	June 1964	Mária Tóth (Tóth 1967)
Makó	1(AD)	September 1964	Mária Tóth (Tóth 1967)
Makó	1(AD)	October 196	Mária Tóth (Tóth 1967)
Makó	2 (AD)	September 1966	Mária Tóth (Tóth 1967)
Kiszombor	1(AD)	September 1966	Mária Tóth (Tóth 1967)
Kiszombor	1(AD)	September 1965	Mária Tóth (Tóth 1967)
Ferencszállás	1(AD)	September 1966	Mária Tóth (Tóth 1967)
Klárafalva	2(AD)	September 1966	Mária Tóth (Tóth 1967)
Klárafalva	1(AD)	October 1947	Lajos Timár (Timár 1950/b)
Szeged-Marostorok	4(AD)	October 1947	Lajos Timár (Timár 1950/b)
Körös			
Körös-Kisinyov (Fehér-Körös)	1 (AD)	August 1994	Constantin Dragulescu (unpublished)
Gyula (Fehér-Körös)	1 (AD)	August 1994	Constantin Dragulescu (unpublished)
Szamos			
Szamosbecs-sziget	10 (AD)	August 1965	István Fintha (Fintha 1969)
Szamosbecs-palaj	10 (AD)	August 1965	István Fintha (Fintha 1969)
Penyige	1(AD)	July 1953	Tibor Simon (Simon 1957)

IX.3 *Salicetum albae-fragilis*

total numbers of the stands: 144 (Tisza= 89, tributaries=55)	from the frontier to Csongrád: willow-poplar gallery forest		from the frontier to Csongrád: navvy willow/ kubikfüzes		from the frontier to Csongrád: willow-poplar gallery forest		from Csongrád to Szolnok: willow-poplar		from Csongrád to Szolnok: willow-poplar		from Szolnok to Tokaj, willow-poplar gallery forest		from Polgár to Tokaj on the base of Újvárosi's (1940) 20 relevees		north of Tokaj: willow poplar galery forest	north of Tokaj: willow poplar galery forest	
numbers of the relevés: 91 (AD) + 144 (%)= 235	**K**	**average cover (%)**	**K**	**average cover (%)**	**K**	**range of the AD values**	**K**	**average cover (%)**	**K**	**range of the AD values**	**K**	**range of the AD values**	**K**	**range of the AD values**	**average cover (%)**	**K**	**range of the AD values**
Canopy																	
Acer campestre															0.9	I	+ - 1
Acer negundo	IV	3.388	II	2.222			III	3.529								I	+ - 1
Acer saccharinum	I	0.544															
Alnus glutinosa													I	1-2	0.8	I	+ - 1
Carpinus betulus																I	2
Celtis occidentalis	I	0.018	II	2.778			I	0.059									
Echinocystis lobata							II	0.353									
Fraxinus angustifolia	I	0.088							II	+ - 3					24.7		
Fraxinus excelsior					II	+										I	+ - 1
Fraxinus pennsylvanica	V	24.018	V	18.517	II	+ - 2	III	20.888							0.1	I	+
Fraxinus pennsylvanica/excelsior																I	1
Humulus lupulus																I	+ - 1
Morus alba	II	0.428	II	0.556					II	+ - 1							
Morus sp.							II	2.065									
Populus alba	IV	8.684	IV	4.167	II	+	III	8.588	III	2-4	V	+ -3	III	1-5		II	+ - 3
Populus alba + canescens	II	7.105	II	1.667												I	1-5
Populus canadensis/hybrida									I	2-4						I	+
Populus canescens	I	1.439													1.0	I	+ - 3
Populus nigra	IV	11.458	II	0.278	IV	+ - 1	V	22.353	III	1-4	V	1	II	1-5	0.4	IV	+ - 3
Populus tremula															4.4		
Quercus robur							II	4.118								I	+ - 2
Salix alba	V	16.491	V	46.111	II	2	V	19.412	V	+ - 5	IV	1-3	III	1-5	50.6	IV	+ - 5
Salix fragilis									I	5			III	1-5		I	+ - 2
Salix purpurea																I	+

Salix triandra					V	+ - 3			II	1			V	1-4		II	+ - 2
Salix viminalis													II	1-3		I	+ - 2
Ulmus glabra													I	2			
Ulmus laevis	I	2.596	II	0.278	II	+									0.8	I	+ - 2
Ulmus minor	I	0.089	II	0.556													
Vitis riparia	II	0.912	III	0.389			II	1.235	II	+ - 2							
shrub layer																	
Acer campestre				0.333											0.1	I	+
Acer negundo	V	6.377	II				V	11.059	III	+	II	+	I	1		I	+
Acer pseudoplatanus	I	0.018															
Acer saccharinum	I	1.005															
Acer tataricum																I	2
Alnus glutinosa													I	1	0.6	I	+
Amorpha fruticosa	V	11.532	V	9.389	II	+	IV	11.235	IV	1-5	II	2	I	1-2	11.7	II	+ - 4
Carpinus betulus																I	2
Celtis occidentalis	I	0.111	II	4.722					I	+ - 3	II	2				I	+
Cornus mas															3.5	I	2
Cornus sanguinea	I	0.088									II	1	I	2	0.7	III	+ - 4
Corylus avellana															0.2	I	+ - 1
Crataegus monogyna									I	2			I	1		I	+ - 1
Crataegus sp.																I	+
Echinocystis lobata	III	0.481	IV	0.839			V	2.653									
Euonymus europaeus																I	+
Euonymus sp.																I	+
Frangula alnus									I	+ - 2			I	1		I	+ - 1
Fraxinus angustifolia									II	+ - 5					8.0	I	+
Fraxinus excelsior									II	+							
Fraxinus pennsylvanica	V	14.635	V	16.389			V	24.888			II	+			0.8	I	+ - 1
Hedera helix																I	1
Humulus lupulus	I	0.077									II	1	II	1-2		I	+ - 1
Juglans nigra																I	+
Ligustrum vulgare																I	+
Malus sylvestris													I	1			
Morus alba	I	0.040					I	0.059	II	+ - 2						I	+ - 1
Morus nigra							I	0.006									
Populus alba	I	0.105							III	+ - 2			II	1-2			
Populus nigra	I	0.002							II	1-2						I	+ - 1

Prunus avium																I	+
Prunus cerasifera	I	0.002															
Prunus padus	I	0.035															
Prunus spinosa																I	+ - 1
Rhamnus cathartica													I	1			
Robonia pseudo-acacia															4.0	I	+ - 1
Rosa canina																I	+
Rosa sp.																I	+
Salix alba	I	0.386					I	0.588			II	+	I	1	1.5	I	+
Salix fragilis													I	1			
Salix triandra	I	0.351							III	+ - 1			III	1-2			
Salix viminalis									II	1-2			II	1-4		I	+ - 1
Sambucus ebulus																I	+
Sambucus nigra																III	+ - 2
Ulmus campestris																I	
Ulmus glabra									II	+			I	1			
Ulmus laevis	II	0.425	II	0.556							IV	+ -2				II	+ - 2
Ulmus minor	II	0.056	II	0.556					I	2							+
Ulmus sp.																I	+
Viburnum lantana											II	+				I	+
Viburnum opulus																I	1-2
Vitis riparia	III	3.725	III	1.222					II	+ - 5							
herb layer																	
Acer negundo	V	1.561	III	1.228			IV	1.241									
Acer pseudoplatanus	I	0.037															
Acer saccharinum	I	0.409															
Achillea collina																I	1
Achillea millefolium													I	1		I	+
Aegopodium podagraria																I	+ - 4
Agrimonia eupatoria																I	1
Agrostis capillaris	I	0.123															
Agrostis stolonifera	I	0.002	II	0.167	IV	+ - 2			III	+ - 4	II	1	I	1		II	+ - 3
Ajuga reptans																I	+
Alisma plantago-aquatica									II	+					0.1	I	+
Alliaria petiolata											II	+				I	+ - 1
Alopecurus pratensis					II	1			II	+							
Althaea officinalis					IV	+			II	+ - 1			I	1		II	+ - 1

Amaranthus blitum	I	0.018															
Ambrosia artemisiifolia	I	0.019															
Amorpha fruticosa	V	1.481	V	3.739			V	3.006	II	+ - 2					0.8	I	1
Anagallis arvensis																I	+
Anemone ranunculoides																I	+
Angelica sylvestris											II	1	IV	1-2		II	+ - 2
Anthriscus caucalis															0.8		
Anthriscus sylvestris											II	+			0.7	I	+
Arctium lappa	I	0.002	II	0.111	II	+					IV	+ -1	I	1		II	+ - 1
Arenaria serpyllifolia					II	+			I	+							
Aristolochia clematitis	V	1.458	IV	0.228	II	+	II	0.359	IV	+ - 4	IV	+	III	1-4		II	+ - 2
Artemisa absinthium																I	+
Artemisia annua	III	0.216					I	0.012									
Artemisia vulgaris							I	0.006			II	+	I	1		II	+ - 1
Asparagus officinalis									II	+	II	+	I	1			
Athyrium filix-femina																I	+
Atriplex oblongifolia																I	+
Atriplex tatarica					II	+											
Ballota nigra																I	+
Bidens cernuus															1.5		
Bidens tripartitus	V	4.458	V	9.622	II	+	III	0.088	IV	+	II	+	II	1		I	+
Bolboschoenus maritimus									II	+							
Brachypodium sylvaticum											II	+				I	+ - 1
Bryonia alba											II	+					
Bryonia sp.											II	+				I	+
Butomus umbellatus									II	+							
Calamagrostis epigeios					IV	+ - 1			III	+ - 4	II	+	II	1-2		I	+
Calystegia sepium	I	0.004	II	0.006	IV	+			IV	+	V	+	III	1-3		II	+ - 1
Campanula patula																I	+
Carduus acanthoides																I	+
Carduus crispus	I	0.002															
Carex distans									I	+							
Carex gracilis	I	0.021														I	+
Carex hirta	I	0.002			II	+			I	+							
Carex praecox									I	+ - 2							
Carex riparia																I	+
Carex sp.									I	+ - 5							

Carex spicata													I	1			
Carex vulpina											II	+			0.1		
Celtis occidentalis	II	0.012	II	0.611					I	+ - 2							
Centaurea pannonica									I	+						I	1
Chaerophyllum sp.											II	+				I	+
Chelidonium majus	I	0.004														I	+
Chenopodium album	I	0.035			II	+	I	0.006								I	+
Chenopodium polyspermum													I	1			
Chenopodium rubrum	I	0.105															
Chenopodium urbicum	I	0.088															
Cichorium intybus					II	+			I	+						I	+
Circaea lutetiana																I	+
Cirsium arvense					IV	1			II	+	II	1				I	+ - 1
Cirsium sp.											II	+					
Cirsium vulgare					II	+											
Clematis vitalba							I	0.006								I	+ - 2
Cnidium dubium													I	1			
Conium maculatum																I	+
Convallaria majalis																I	+
Convolvulus arvensis					II	+	I	0.006	II	+ - 1						I	+
Conyza canadensis	II	0.040					I	0.006	II	+			I	1		II	+ - 1
Cornus sanguinea															0.5	I	+
Crataegus monogyna	I	0.005							I	+							
Crepis setosa									II	+							
Cucubalus baccifer	I	0.018											III	1-3		II	+
Cuscuta australis									I	+							
Cuscuta lupuliformis					II	1			II	+			III	1-3			
Cynodon dactylon									I	+						I	3
Cyperus difformis	I	0.002															
Cyperus fuscus	I	0.002															
Dactylis glomerata					II	1											
Daucus carota									I	+						I	+
Descurainia sophia									I	+							
Dipsacus laciniatus					II	+										I	+
Echinochloa crus-galli	II	0.023			II	+										I	+
Echinocystis lobata	I	0.004	IV	0.339			II	3.235								II	+ - 3
Eleocharis palustris									I	+							

Elymus repens	I	0.018	II	0.167	V	+ - 4			IV	+ - 1			I	1		I	+ - 2
Epilobium angustifolium																I	+
Epilobium dodonaei																I	+
Epilobium hirsutum													I	1			
Epilobium montanum													I	1			
Epipactis purpurata													I	1			
Equisetum arvense	I	0.004			II	+			IV	+ - 1	IV	+	III	1	0.1	II	+
Equisetum palustre							I	0.006									
Equisetum ramosissimum																I	+
Erigeron annuus ssp. strigosus													II	1		I	+
Eryngium campestre									II	+							
Eryngium planum									I	+							
Erysimum cheiranthoides													II	1			
Erysimum repandum									I	+							
Eupatorium cannabinum											II	+	I	1		I	+ - 1
Euphorbia esula																I	+
Euphorbia lucida					IV	+			II	+							
Euphorbia palustris	I	0.002															
Euphorbia platyphyllos													I	1			
Fallopia convolvulus													II	1			
Fallopia dumetorum																I	+
Fallopia japonica																I	+
Festuca gigantea													II	1			
Festuca pratensis																I	+
Festuca rupicola																I	+
Filipendula ulmaria											II	+	I	1			
Frangula alnus									I	+ - 1							
Fraxinus angustifolia ssp. pannonica	I	0.002							II	+ - 5					1.2		
Fraxinus pennsylvanica	V	11.653	V	8.561			V	13.294								I	+ - 1
Galega officinalis																I	1
Galeopsis pubescens																I	+ - 1
Galeopsis speciosa															0.7	I	+
Galeopsis tetrahit																I	+
Galium aparine	II	0.026			II	3										II	+ - 2
Galium mollugo					II	+										I	+
Galium palustre					II	+			II	+	II	1	I	1		I	+ - 1

Galium rubioides					II	+										I	+
Genista tinctoria													I	1			
Geranium robertianum																I	+
Geum urbanum															0.1	I	+
Glechoma hederacea	III	0.451			II	+ - 1			I	+	II	+	II	1-3	5.4	I	+ - 2
Gleditsia triacanthos	I	0.002															
Glycyrrhiza echinata					IV	1			III	1							
Gnaphalium sylvaticum																I	+
Gratiola officinalis									III	+							
Hedera helix																I	+
Helianthus decapetalus																I	+ - 1
Heracleum sphondylium																I	+
Hordelymus europaeus											II	+					
Hordeum murinum					II	+			II	+							
Humulus lupulus	I	0.533														III	+ - 1
Impatiens parviflora																I	+
Impatiens roylei																I	+
Impatiens sp.																I	+
Iris pseudacorus	I	0.007	III	0.011	II	+ - 1			II	+	IV	+			3.0	II	+ - 2
Iris sibirica													I	1			
Juglans regia	I	0.002															
Juncus compressus									I	+							
Juncus effusus											II	+				I	+
Juncus sp.																I	+
Juncus tenuis																I	+
Lactuca serriola									II	+ - 1							
Lamium purpureum	I	0.002			II	+											
Lapsana communis																I	+
Lathyrus grandiflorus											II	1				I	1
Lathyrus latifolius													I	1			
Lathyrus palustris									II	+							1
Lathyrus pratensis																I	
Lathyrus tuberosus									II	+ - 1						I	+
Leersia oryzoides													I	1		I	+
Leontodon autumnalis																I	+
Leonurus marrubiastrum					II	+											
Leucanthemella serotina					II	+							I	1		I	+ - 2

Leucojum aestivum									I	+			II	1-2		I	+
Lolium perenne					II	1			II	+			II	1-2		I	+
Lotus corniculatus					II	+			I	+							
Lycopus × intercendens											II	1				I	1
Lycopus europaeus	III	0.100	II	0.006	II	+					II	1	II	1-2	0.1	III	+ - 2
Lycopus exaltatus	I	0.018			II	+	II	0.018	IV	+ - 2	IV	+ -1				I	+ - 1
Lysimachia nummularia	II	0.147			II	+	II	0.012	II	+	IV	+	III	1-3	2.5	I	+ - 1
Lysimachia vulgaris	I	0.011	III	0.083	II	+			IV	+	IV	+	II	1-2	1.5	II	+ - 1
Lythrum salicaria			III	0.172	II	+			II	1			I	1		I	+ - 1
Lythrum virgatum									II	+						I	+
Malva neglecta																I	+
Medicago varia																I	1
Melilotus albus																I	+
Melilotus officinalis																I	+
Mentha aquatica													I	1			
Mentha arvensis									I	1	II	+	I	1		I	+
Mentha longifolia											II	+	I	1		I	+ - 1
Mentha pulegium			II	0.278												I	+
Morus alba	II	0.009							II	+							
Morus nigra							I	0.006									
Myosotis palustris																I	+
Myosoton aquaticum	I	1.053			II	2			I	+	IV	+ -1	I	1-2		I	+ - 1
Oenothera biennis					IV	+			II	+			I	1		I	+
Oxalis stricta													I	1		I	+
Parthenocissus inserta									II	2						I	+
Parthenocissus sp.	I	0.002	II	0.556													
Pastinaca sativa																I	+
Persicaria amphibia					IV	+			I	+						I	+
Persicaria hydropiper	I	0.018									IV	+ -1	II	1-2		I	+ - 5
Persicaria lapathifolia													I	1		I	+
Persicaria maculosa									I	+						II	+ - 4
Persicaria minor									I	+ - 1							
Persicaria mitis													I	1			
Petasites hybridus																I	+
Phalaris arundinacea									II	+						I	+ - 2
Phragmites australis					II	+			III	+ - 1	II	+	II	1-2		I	+ - 1
Physalis alkekengi											II	1			0.1		

Plantago lanceolata									I	+						I	+
Plantago major	I	0.019							III	+ - 1			II	1		II	+ - 1
Plantago media							I	0.006									
Poa angustifolia									II	+							
Poa annua																I	+
Poa compressa									I	+							
Poa nemoralis											II	1				I	1
Poa palustris													IV	1-5		I	+
Poa trivialis					II	1					IV	+ -2				I	+ - 1
Polygonatum odoratum																I	1
Polygonum aviculare													I	1		I	+
Populus alba	III	0.323	II	0.167					I	+ - 1							
Populus nigra	I	0.002														I	+
Populus × euramericana	I	0.002															
Potentilla anserina																I	+
Potentilla reptans					II	+ - 1			III	+ - 2			I	1		I	1-2
Potentilla sp.																I	+
Prunella vulgaris					II	+ - 1			I	+	II	1	I	1		I	+ - 1
Prunus padus	I	0.004															
Pyrus pyraster									I	+							
Quercus robur	II	0.221							II	+ - 1							
Ranunculus ficaria																I	1
Ranunculus repens			II	0.278	II	1-2			III	+	II	+	III	1		II	+ - 1
Ranunculus sardous	I	0.002															
Ranunculus sceleratus	I	0.018															
Rorippa amphybia																I	+
Rorippa austriaca					II	+			I	+			I	1		I	1
Rorippa palustris	I	0.035															
Rorippa sp.							I	0.006			II	+					
Rorippa sylvestris					II	+			I	+			III	1		I	+
Rorippa sylvestris + austriaca																I	+
Rubus caesius	V	11.568	V	23.722	V	1-5	IV	13.882	V	+ - 4	V	3	V	1-5	53.7	V	+ - 5
Rumex confertus							I	0.006									
Rumex conglomeratus					IV	+			I	+							
Rumex crispus					II	+					II	+				I	+ - 1
Rumex obtusifolius													I	1			
Rumex patientia									II	+							

Rumex sanguineus	I	0.018									II	+	II	1		II	+ - 1
Rumex sp.									I	+	II	+					
Rumex stenophyllus					II	+					II	1				I	1
Salvia glutinosa																I	+
Salvinia natans	I	0.053															
Sambucus ebulus																I	+
Sambucus nigra	I	0.004													0.1	I	+
Saponaria officinalis																I	+ - 1
Schrophularia nodosa	I	0.002									II	+	I	1		I	+ - 1
Scutellaria galericulata	I	0.004			II	+					II	1	II	1-2		II	+ - 2
Senecio erraticus																I	+
Setaria glauca													I	1			
Setaria viridius									I	+						I	+
Silene latifolia ssp. alba															0.01		
Silene sp.																I	+
Sium latifolium											V	+ -1	II	1-2		I	+ - 1
Solanum dulcamara	III	0.042							I	+ - 1	IV	+	II	1-2		II	+ - 3
Solanum nigrum	I	0.023					I	0.006									
Solidago gigantea ssp. serotina									II	+ - 2	II	+	II	1-3	0.1	I	+ - 3
Sonchus arvensis					IV	+					II	+				I	+
Sonchus asper					II	+											
Sonchus oleaceus	I	0.005														I	+
Stachys palustris									II	+	V	+	III	1-3	0.2	III	+ - 2
Stellaria media	I	0.005											I	1-2		I	+
Stenactis annua					II	+ - 1										I	+ - 1
Symphytum officinale	I	0.282	II	6.111	II	+ - 2			I	+ - 2	II	+	I	1		II	+ - 1
Tanacetum vulgare					II	+			III	+			II	1		II	+ - 1
Taraxacum officinale	I	0.002			II	+	I	0.006	III	+			I	1-2		I	+
Teucrium scordium													I	1			
Thalictrum flavum					II	+											
Thalictrum lucidum					II	+											
Thlaspi arvense					II	+											
Torilis arvensis					II	+			II	+						I	+
Trifolium campestre									I	+			I	1			
Trifolium medium																I	+
Trifolium pratense																I	+
Trifolium repens					II	+							I	1		I	+ - 1

Tripleurospermum inodorum					II	+			I	+						I	+
Tussilago farfara																I	+
Typha latifolia													I	1			
Ulmus laevis	II	0.098															
Ulmus minor	I	0.005					I	0.006	II	+ - 1							
Urtica dioica	V	1.367	II	0.167	II	+	III	1.959	II	+ - 1	IV	2	II	1-5	1.6	V	+ - 3
Valeriana officinalis													I	1		I	+ - 1
Verbascum blattaria									II	+							
Verbena officinalis																I	+
Veronica anagallis-aquatica													I	1			
Veronica hederifolia																I	+
Veronica serpyllifolia													I	1			
Vicia angustifolia									I	1							
Vicia cracca									III	+			III	1-2		I	+ - 1
Vicia hirsuta									I	+							
Vicia sepium																I	+
Vicia sp.			II	0.006													
Viola sylvestris																I	+
Vitis riparia	V	1.153	II	0.056					II	+ - 2							
Xanthium italicum	II	0.005	II	0.278			I	0.059									
Xanthium strumarium									I	+							
Xanthium strumarium+italicum																I	+ - 1

	Körösszug: willow-poplar gallery forest %		Körösszug: navvy willow/kubikfüzes %		Bodrogzug: willow-poplar gallery forest AD		Bodrog %		Szamos AD		Körösök AD		Hungarian section of the Maros %		Hungarian section of the Maros AD		Romanian section of the Maros %		Romanian section of the Maros AD	
	K	average cover (%)	K	average cover (%)	K	range of the AD values	K	average cover (%)	K	range of the AD values	K	range of the AD values	K	average cover (%)	K	range of AD values	K	average cover (%)	K	range of AD values
Canopy																				
Acer campestre							II	1.333												
Acer negundo	II	4.468	I	3					I	+	III	+	IV	8.677			II	1.818		
Alnus glutinosa									I	+	III	+							I	1
Celtis occidentalis													I	0.023						
Cerasus avium							II	0.200												
Echinocystis lobata											V	+-2	II	0.256			II	0.009		
Fraxinus angustifolia							II	0.670									II	1.364		
Fraxinus excelsior															I	+				
Fraxinus pennsylvanica	V	26.896	V	16.9			II	0.667	II	+			II	5.586	I	+				
Gleditsia triacanthos													I	0.002						
Humulus lupulus											III	+	I	0.070			II	0.464		
Juglans nigra															I	+				
Juglans regia													I	0.349						
Morus alba	II	0.075									III	+	III	3.958						
Morus nigra									I	+			I	0.349						
Morus sp.													I	0.542						
Partenocyssus inserta									I	+	III	+								
Populus alba			I	2	IV	0.1-5	IV	9.267	II	1 - +			IV	10.814	III	+ - 4	IV	14.364	IV	+ - 1
Populus alba + canescens									II	+ - 3										
Populus canadensis/hybrida													I	1.512	III	1-4				
Populus canescens	IV	20.393	III	9.7	I	3							I	8.023						
Populus nigra	II	0.750	II	1.51	III	0.1-4	IV	20.667	IV	+ - 3	III	1	III	3.653	II	+ - 2	V	2.273	II	1-2

Populus tremula							II	0.333												
Prunus domestica																	II	1.191		
Prunus padus									I	1										
Pyrus communis							II	0.267												
Quercus robur									I	+			I	1.465			II	0.018		
Robinia pseudoacacia	I	0.179							I	+	III	+	I	0.260						
Salix alba	V	28.179	V	26.7	V	0.1-5	IV	17.733	V	+ - 5	V	3	V	21.628	V	2-5	IV	13.182	V	+ - 3
Salix fragilis					II	0.1-1			III	1-2	V	1-2	II	0.930	II	+ - 2			V	1-3
Salix purpurea									II	+ - 1										
Salix triandra					II	1-2			II	+ - 2	III	1								
Salix viminalis					II	0.1-1			II	+ - 3	III	+							IV	+ - 2
Ulmus laevis					IV	0.1-1			I	+			IV	10.005			IV	0.100		
Ulmus minor													I	0.767	I	+				
Vitis sylvestris																	II	0.909		
shrub layer																				
Acer campestre																	II	1.909		
Acer negundo					I	1	II	0.007	I	+			III	4.953	II	+ - 3	IV	1.136		
Acer pseudoplatanus													I	1.467						
Ailanthus altissima													I	1.233						
Amorpha fruticosa	V	5.929	V	5.03	II	1-3			III	+ - 5	III	+	V	6.542	III	1-3	V	7.818		
Calystegia sepium													I	0.840			II	4.091		
Celtis occidentalis													I	0.267						
Cerasus avium							III	0.073												
Clematis vitalba													II	0.540	I	+ - 1	II	0.018		
Cornus mas					I	0.1-1														
Cornus sanguinea							II	12.000	I	+			IV	2.681	II	1-2	IV	8.845		
Crataegus monogyna							II	0.034					I	0.233	II	+ - 2	II	0.191		
Cucubalus baccifer													I	0.123			II	0.027		
Echinocystis lobata					I	0.1							II	0.751			II	5.909		
Euonymus europaeus									I	+			I	0.002						

Frangula alnus							II	0.001							I	+ - 2	II	0.091		
Fraxinus angustifolia							III	1.133					I	0.002			II	0.191		
Fraxinus excelsior															II	+ - 1				
Fraxinus pennsylvanica					III	0.1-5	III	10.667					III	6.005						
Gleditsia triacanthos													I	0.002						
Glycyrrhiza echinata	II	0.136	I	0.01																
Hedera helix																	II	0.009		
Humulus lupulus													I	0.237			IV	3.836		
Juglans nigra							II	0.007												
Juglans regia							II	0.067					I	0.030	I	+				
Ligustrum vulgare																	II	0.009		
Morus alba													I	0.005	I	+ - 1				
Morus nigra													I	0.302						
Parthenocissus quinquefolia															I	2				
Parthenocissus sp																	II	2.727		
Populus alba													I	0.072	IV	+ - 2	II	1.818		
Populus nigra					I	2									IV	+ - 2	II	0.455		
Populus tremula							II	0.007												
Prunus spinosa							II	0.200							I	1	II	2.727		
Pyrus pyraster							II	0.007												
Quercus petraea							II	0.007												
Quercus robur							II	0.067							II	+ - 2	II	0.009		
Rhamnus cathartica															I	2				
Robonia pseudo-acacia					I	1									I	+				
Rosa canina	I	0.004	I	0.5											I	+ - 1				
Salix alba					III	0.1	II	0.067									II	0.455		
Salix cinerea							II	0.133												
Salix triandra															II	+ - 1				
Sambucus nigra					II	0.1-1	II	0.067	III	+ - 1			III	2.679			II	2.736		
Tamus communis																	II	0.009		

Tilia platyphyllos															I	+				
Ulmus campestris															I	+				
Ulmus glabra									I	+										
Ulmus laevis					I	1							II	0.863	III	+ - 2				
Ulmus minor													I	0.140			II	0.227		
Viburnum opulus					I	0.1											II	0.091		
Vitis riparia													I	0.005						
Vitis sp.													I	0.163						
Vitis sylvestris													I	1.047	II	1-3	II	0.227		
herb layer																				
Acer campestre							II	0.001												
Acer negundo					I	1							III	0.823			II	0.009		
Acer pseudoplatanus					I	1														
Achillea millefolium									III	+ - 1					III	+ - 2			V	+ - 1
Achillea pannonica	I	0.004																		
Aegopodium podagraria					I	0.1			III	+ - 1							IV	3.200		
Agrostis stolonifera					I	0.1-2			IV	+ - 2	III	+	I	0.002	IV	+ - 2	II	1.182	V	+ - 2
Ajuga reptans					II	0.1-1											II	0.009		
Alisma plantago-aquatica							II	0.133									II	0.018		
Alliaria petiolata													I	0.078			II	0.009	I	+
Allium angulosum	I	0.004																		
Alnus glutinosa					I	0.1			I	+										
Alnus incana																			I	1
Alopecurus pratensis	I	0.357					II	0.007							II	1-3	II	1.464		
Althaea officinalis	I	0.036	II	0.02	I	0.1-1					III	+			II	+ - 1	II	0.027	I	+
Ambrosia artemisiifolia	I	0.007									III	1								
Amorpha fruticosa					III	0.1-2							III	1.128			IV	0.036	I	+
Angelica sylvestris					III	0.1-4	II	0.267	I	+							II	0.027	II	+
Anthemis arvensis																			I	+
Anthriscus caucalis							II	1.587									II	0.027		

Anthriscus sp.					I	0.1													
Anthriscus sylvestris							II	0.001	I	+	III	+	I	0.002						
Arctium lappa	I	0.007	II	0.02	I	0.1	II	0.033	II	+	III	+	I	0.002	II	+ - 1	IV	0.018		
Arctium tomentosum					I	0.1														
Arenaria serpyllifolia	I																			
Aristolochia clematitis	I	0.004	I	0.02					II	+ - 1			II	0.467	IV	+ - 1	II	0.009		
Arrhenatherium elatius	I	0.004							I	+	III	1							I	+
Artemisa absinthium															I	+ - 1				
Artemisia annua													II	0.140						
Artemisia austriaca					I	0.1														
Artemisia vulgaris					I	0.1	II	0.007	IV	+ - 1	V	+-2			I	+	II	0.018	V	+ - 1
Asparagus officinalis															I	+				
Aster sp.									I	+										
Astragalus glycyphyllos															II	+ - 2				
Athyrium filix-femina							II	0.001												
Atriplex acuminata	I	0.075																		
Atriplex hastata									I	+										
Atriplex nitens									II	+									I	+
Atriplex oblongifolia															I	+ - 1				
Atriplex sp.									I	+										
Ballota nigra											III	+					II	0.009	I	+
Bidens cernuus							II	1.000												
Bidens frondosa													III	1.047						
Bidens tripartitus	IV	15.389	V	25.52	II	0.1-2	III	0.593	III	+			II	1.393	II	+ - 1	IV	0.936		
Bidens tripartitus+cernuus																			II	+ - 1
Bilderdykia concolvulus													I	0.029					I	+
Brachypodium sylvaticum							II	0.001			III	+					IV	0.200	I	+
Bromus benekenii							II	2.000												
Bromus mollis															I	+				
Bromus sp.									II	+										

Bryonia alba															I	+				
Bryonia dioica									I	+										
Calamagrostis epigeios									I	+ - 1										
Calamagrostis pseudophragmites									I	+										
Calystegia sepium					III	0.1-2			IV	+ (6)	III	+	I	0.007	V	+ - 3	IV	0.018	IV	+ - 1
Capsella bursa-pastoris									I	+					I	+				
Cardamine amara					I	0.1														
Cardamine sp.					I	0.1														
Carduus acanthoides									I	+	III	+							II	+
Carduus crispus																	II	0.009		
Carduus sp.					I	0.1														
Carex flacca															I	1				
Carex gracilis	II	2.575	II	0.11	I	0.1	III	0.473					I	0.002						
Carex hirta															II	+	IV	0.745		
Carex melanostachya	II	0.393	I	0.01											II	+ - 1				
Carex praecox															I	+ - 2				
Carex riparia					II	0.1-2														
Carex sp.													I	0.002						
Carex sylvatica																	II	0.009		
Carex vulpina					I	0.1									II	+ - 1				
Caucalis platycarpos															I	+				
Celtis occidentalis													I	0.002						
Centaurea jacea					I	0.1									II	+				
Centaurea pannonica	I	0.004																		
Cephalanthera damasonium															I	+				
Cerastium holosteoides									I	+					I	+			I	+
Cerasus avium							II	0.007												
Chaerophyllum hirsutum																			I	+
Chelidonium majus									II	+			II	0.567						
Chenopodium album													I	0.002	I	+	II	0.009	II	+ - 1

Chenopodium glaucum	I	0.004																		
Chenopodium polyspermum	II	0.057	II	0.02					I	+					I	+ - 1				
Chenopodium rubrum	I	0.821	I	0.1																
Cichorium intybus	I	0.004			I	0.1					III	1			III	+ - 1	II	0.009		
Circaea lutetiana																	II	1.091		
Cirsium arvense	I	0.004	I	0.01					I	+	III	1			II	+ - 2	IV	0.018	IV	+
Cirsium brachycephalum	I	0.004	II	0.02																
Cirsium palustre	I	0.004																		
Cirsium vulgare															I	+				
Clematis integrifolia															I	+	II	0.009		
Clematis vitalba									II	+										
Conium maculatum									III	+ - 1									II	+
Convallaria majalis							II	5.700												
Convolvulus arvensis	II	0.014	II	0.02									I	0.009	I	+				
Conyza canadensis	I	0.004			I	0.1			I	+	III	+	I	0.012	II	+ - 2			II	+
Cornus sanguinea					I	0.1	II	0.200					I	0.098			IV	0.364		
Crepis setosa															I	+				
Cucubalus baccifer							II	0.001	I	+ (6)			II	0.334	II	+ - 1	II	0.009	II	+
Cuscuta campestris			I	0.01																
Cuscuta lupuliformis															I	+ - 1				
Cynodon dactylon	I	0.004																	I	+
Dactylis glomerata	I	0.004			I	0.1	IV	0.014	II	+					II	+ - 2				
Daucus carota	I	0.004							I	+					III	+ - 2			II	+ - 1
Descurainia sophia									I	+									II	+
Dipsacus laciniatus															II	+ - 1	II	0.009		
Dipsacus fullonum									I	+										
Echinochloa crus-galli	II	0.371							I	+			I	0.047	I	+ - 1	IV	0.018	III	+ - 1
Echinocystis lobata	III	0.654	II	1.51	III	0.1-1			II	+ - 1			III	0.965	I	+ - 2			IV	+ - 2
Echinops sphaerocephalus															II	+ - 2				
Eleocharis acicularis							III	0.001												

Eleocharis palustris	I	0.071																
Elymus repens	I	0.007	I	0.1											I	2				
Elymus sp.									I	+										
Epipactis helleborine													I	0.002	I	+				
Equisetum arvense	I	0.075					II	0.021	I	+			II	0.007	III	+ - 2	II	0.009	II	+ - 1
Equisetum fluviatile									I	+										
Equisetum hyemale					I	0.1														
Erigeron annuus ssp. strigosus									I	+	III	+			II	+ - 1				
Eryngium campestre															I	+				
Eryngium planum															I	+				
Eupatorium cannabinum									I	+	III	+					II	0.009	I	+
Euphorbia cyparissias															I	1				
Euphorbia esula																	II	0.009		
Euphorbia lucida	I	0.007													II	+				
Euphorbia palustris					I	0.1							I	0.002						
Euphorbia virgata	I	0.039																		
Fallopia japonica									II	+	III	1							I	+
Festuca gigantea							II	0.007												
Festuca rupicola															II	+ - 3				
Fraxinus angustifolia ssp. pannonica							II	0.340									II	0.009		
Fraxinus pennsylvanica					I	0.1-1							III	2.302						
Fumaria officinalis															I	+				
Galega officinalis															II	+				
Galeopsis pubescens					I	2														
Galeopsis speciosa																	II	0.291		
Galinsoga parviflora																			I	+
Galium aparine					I	0.1-1	II	0.001	III	+			II	0.158	II	+ - 2	V	0.055		
Galium boreale	I	0.007																		
Galium mollugo															I	+	IV	0.200		
Galium palustre							III	0.268							I	+				

Galium rubioides															II	+ - 2				
Galium schultesii															I	+				
Galium verum															I	+				
Geum urbanum					I	0.1			II	+							IV	0.209		
Glechoma hederacea	I	0.039	III	0.03	III	0.1-3	II	0.673	II	+			III	0.420	III	+ - 2	IV	0.764	II	+
Gleditsia triacanthos													I	0.002						
Glyceria aquatica																			I	+
Glyceria maxima	I	0.643																		
Glycyrrhiza echinata															III	+ - 2	II	0.200		
Gnaphalium uliginosum	I	0.004																		
Hedera helix																	II	0.027		
Helianthus decapetalus									IV	+ - 3	III	1-2							IV	+ - 4
Heracleum sphondylium									II	+ - 1							II	0.009	II	+
Hordeum murinum															I	2				
Humulus lupulus	I	0.039	II	0.12	II	0.1	II	0.007	III	+ - 1			III	1.731	II	+ - 3				
Hypericum perforatum					I										I	+				
Impatiens noli-tangetre																			I	1
Inula britannica	I	0.004			II	0.1									II	+ - 1	II	0.009		
Inula helenium																	II	0.009		
Iris graminea							II	0.007												
Iris pseudacorus	II	0.054	III	0.03	II	0.1-1	IV	0.060					I	0.005	I	+ - 1	IV	0.036		
Juglans regia									I	+										
Juncus effusus					I	0.1														
Juncus tenuis																			II	+
Lactuca saligna													I	0.002	II	+				
Lactuca serriola	I	0.004							I	+			I	0.014	I	+ - 1	II	0.009	I	+
Lamium album									II	+										
Lamium maculatum									I	+			I	0.005			II	0.009		
Lamium purpureum															I	+				
Lapsana communis															I	+				

Lathyrus hirsutus					I	0.1									I	+				
Lathyrus sylvestris																	II	0.009		
Lathyrus tuberosus															II	+ - 1				
Lemna minor							III	12.673												
Leontodon autumnalis					I	0.1														
Leonurus marrubiastrum															I	+				
Lepidium ruderale																			I	+
Leucanthemella serotina					I	0.1	III	0.001												
Leucojum aestivum							II	1.000							I	+				
Ligustrum vulgare																	II	0.009		
Linaria vulgaris	I	0.004													I	+				
Lolium perenne					I	0.1			II	+	III	+							IV	+ - 1
Lotus corniculatus	I	0.004							I	+					II	+ - 1			II	+
Lycopus × intercendens									I	+										
Lycopus europaeus	II	0.011	II	0.07	V	0.1-5	III	0.440					II	0.191	III	+			I	+
Lycopus exaltatus					III	0.1-2			I	1					III	+ - 2				
Lysimachia nummularia	I	0.361	II	0.02	V	1-3	II	0.134	I	+	III	+	II	0.095	III	1-3	V	0.845	II	+
Lysimachia vulgaris	III	0.879	III	0.04	II	0.1-4	III	0.155	I	+	III	+			II	+ - 2	II	0.009		
Lythrum salicaria	II	0.968	III	0.13	III	0.1-2			I	+	III	+	II	0.163	II	+ - 1	II	0.009	IV	+
Lythrum virgatum	I	0.004			I	0.1			I	+					I	+	II	0.009		
Malva sylvestris					I	0.1														
Marchantia polymorpha							III	0.003												
Marrubium vulgare															I	+				
Medicago lupulina									I	+					I	+			II	+
Medicago minima															I	+				
Melilotus albus	I	0.004									III	+			II	+ - 1				
Mentha aquatica					I	0.1			I	+										
Mentha arvensis															II	+ - 2	II	0.282		
Mentha longifolia									II	+ - 1					I	+			IV	+ - 1
Mentha pulegium	I	0.007			II	0.1-1														

Myosotis arvensis															I	+				
Myosotis palustris																			I	+
Myosoton aquaticum									I	+			I	0.007	I	+				
Oenanthe aquatica	I	0.007	I	0.4			III	0.002					I	0.002						
Oenothera biennis									I	+ - 1					II	1				
Oxalis stricta	I	0.004	I	0.01	I	1							I	0.005	I	+	II	0.009	I	+
Parthenocissus sp.																	II	0.009		
Pastinaca sativa							II	0.001	III	+					I	+			II	+
Persicaria amphibia					II	0.1-1			I	+										
Persicaria hydropiper															I	+				
Persicaria lapathifolia	II	0.114	II	0.3			III	1.003	III	+ - 2					I	+			III	+ - 1
Persicaria maculosa																			III	+ - 1
Persicaria minor															II	+ - 2				
Petasites hybridus											III	+							I	2
Phalaris arundinacea									I	+			I	0.093	II	+ - 2	II	1.827		
Phragmites australis	I	0.361			II	0.1-2			III	+ - 1			II	0.363	III	+ - 3	II	0.018		
Physalis alkekengi															II	+ - 1				
Picris hieracioides	I	0.004													II	+ - 1				
Plantago lanceolata	I	0.004							I	+					I	+			I	+
Plantago major	II	0.018			II	0.1-1			I	-1					II	+	II	0.027	IV	+ - 1
Poa angustifolia					II	1									II	2-3	II	0.009		
Poa palustris			I	0.01					I	+										
Poa trivialis									I	+					II	+ - 3			I	+
Polygonatum latifolium																	II	0.009		
Polygonatum odoratum																	II	0.018		
Polygonum aviculare					I	0.1			II	+ - 1	III	+			I	1			V	+ - 1
Populus alba					I	0.1							II	0.544			IV	0.109		
Populus canescens													I	0.007						
Populus nigra					I	0.1	III	0.007					I	0.005						
Potentilla alba					I	0.1														

Potentilla anserina					II	0.1			III	+ - 2									IV	+ - 1
Potentilla argentea															I	+				
Potentilla reptans	I	0.357			I	2					III	+			II	+ - 1	II	1.545	III	+
Potentilla supina															I	+				
Prunella vulgaris					I	0.1									II	+ - 1	II	0.455	II	+
Prunus spinosa	I	0.004					II	0.007												
Pulicaria vulgaris																			II	+
Quercus petraea							II	0.007												
Quercus robur													III	0.031			IV	0.036		
Ranunculus acris					III	0.1-2	II	0.040									II	0.009	II	+ - 1
Ranunculus lingua					I	0.1														
Ranunculus repens					II	1-2	IV	0.009	III	+ - 2							IV	1.191	V	+ - 1
Ranunculus sardous	I	0.018													IV	+ - 1				
Reynoutria japonica																	II	0.009		
Riccia fluitans							III	0.173												
Robinia pseudoacacia					I	0.1	III	0.221												
Rorippa × armoracioides									I	+										
Rorippa amphybia							III	0.113												
Rorippa austriaca					I	1			I	+	III	+			II	+			II	+
Rorippa islandica	I	0.007													I	+				
Rorippa sylvestris																	II	0.009		
Rubus caesius	IV	11.204	IV	10.35	IV	1-5	V	11.633	V	+ - 5	III	+	V	22.629	V	1-4	V	22.455	IV	+ - 2
Rudbeckia laciniata											III	+								
Rumex conglomeratus									I	+					II	+	V	0.055	I	+
Rumex crispus	II	0.014	II	0.02					II	+ - 1										
Rumex obtusifolius																			I	+
Rumex sanguineus					II	0.1-3											II	0.191		
Rumex sp.													I	0.001						
Rumex stenophyllus													I	0.002						
Sagittaria sagittifolia							II	0.001												

Salix alba					I	1	II	0.007												
Salvia glutinosa																	II	0.200		
Salvinia natans							III	4.067												
Sambucus ebulus															I	+ - 2				
Sambucus nigra					II	0.1													I	+
Schoenoplectus lacustris	I	0.004																		
Schrophularia nodosa																	II	0.009		
Scirpus silvaticus																			II	+ - 1
Scutellaria galericulata					II	1-2			I	+					II	+	II	0.018		
Scutellaria hastifolia	II	0.232	I	0.05																
Securigera varia															II	+ - 1				
Senecio fluviatilis									I	+ - 2										
Setaria glauca															I	+				
Setaria viridius											III	+								
Silene latifolia ssp. alba									I	+	III	+			II	+				
Silene vulgaris									I	+										
Sinapis arvensis									II	+									I	+ - 1
Sium latifolium					II	1	II	0.007												
Solanum dulcamara	I	0.007			III	0.1-2	II	0.013	II	+ - 1			II	0.421	II	+	IV	0.036		
Solanum nigrum	I	0.004											I	0.002	I	+				
Solidago canadensis	I	0.004																		
Solidago gigantea ssp. serotina					II	1-4			I	1	III	+	I	0.002	I	2				
Sonchus arvensis									I	+					I	+	II	0.009	II	+
Sonchus asper															I	+				
Sonchus oleaceus															I	+	II	0.018		
Spirodela polyrhiza							III	16.000												
Stachys annua			I	0.01																
Stachys palustris	I	0.007	II	0.02	III	0.1-3	II	0.001	I	+			I	0.070	II	+ - 1	IV	0.573		
Stachys sylvestris																	IV	0.291		
Stellaria graminea					I	0.1									I	+				

Stellaria media									I	+			I	0.002			II	0.009	II	+
Stellaria neglecta															II	+ - 1				
Stellaria nemorum									III	+ - 1										
Stenactis annua					I	0.1-2							I	0.002			IV	0.045		
Succisella inflexa															I	+				
Symphytum officinale	II	0.886	V	1.73	I	0.1	III	0.001	I	+			II	0.035	III	+ - 2	II	0.936	IV	+
Tanacetum vulgare			I	0.01	I	0.1			III	+	III	+			II	+ - 1	II	0.009	IV	+
Taraxacum officinale	I	0.004							V	+ - 1					II	+ - 1			V	+ - 1
Telekia speciosa																	II	0.009		
Thalictrum aquilegiifolium					I	3														
Thalictrum flavum																	II	0.009		
Thalictrum lucidum			I	0.01											I	+ - 2	II	0.009		
Thlaspi arvense															I	+				
Torilis japonica															I	1	II	0.009		
Tragopogon dubius															II	+				
Trifolium campestre									I	+					I	+				
Trifolium pratense									I	+					I	+ - 2				
Trifolium repens									III	+ - 1					I	+ - 2			V	+ - 2
Trifolium sp.					I	0.1														
Tripleurospermum inodorum	I	0.007			I	0.1														
Turgenia latifolia															I	+				
Tussilago farfara					I	0.1			I	+									II	+
Typha latifolia			I	0.01			II	0.007												
Ulmus glabra																			I	+
Ulmus laevis					I	0.1							I	0.001						
Ulmus minor													II	0.007			II	0.091		
Urtica dioica	III	0.296	II	0.03	II	0.1-2	IV	0.440	V	+ - 2	V	+-2	V	2.492	IV	+ - 3	IV	7.291	V	+ - 3
Verbascum austriacum															I	+				
Verbascum densiflorum											III	+								
Verbena officinalis	I	0.004							I	+					I	+ - 1			II	+

Veronica arvensis															I	+				
Veronica polita															I	+				
Vicia angustifolia															II	+ - 1				
Vicia cracca	I	0.004			II	0.1			I	+					II	+ - 2			II	+
Vicia dumetorum									I	+										
Vicia grandiflora															II	+				
Vicia hirsuta															II	+				
Vicia sepium									I	+										
Vicia tetrasperma															I	+				
Viola cyanea															I	+ - 1				
Viola elatior															I	+				
Viola hirta													I		I	+				
Viola sp.													I	0.002						
Viola sylvestris							II	0.001									II	0.273		
Vitis riparia	II	1.829	II	0.11	I	0.1								0.237						
Vitis sylvestris																	II	0.018		
Xanthium italicum	II	0.043											I	0.140	I	+	II	3.182		
Xanthium sp																	II	0.009		
Xanthium spinosum					I	0.1														
Xanthium strumarium	II	0.014	II	0.11					I	+ - 1										
Xanthium strumarium+italicum									I	+ - 1	III	+							IV	+ - 2

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Tisza from the southern border to Csongrád			
Between Szeged and the border	3 (AD)	June 1960	György Bodrogközy (unpublished)
Szeged, right bank, navvy hole forest	7 (%)	August 2004	Orsolya Makra (Gallé et al. 2004)
Szeged, right bank, gallery forest	4 (%)	August 2004	Orsolya Makra (Gallé et al. 2004)
Szeged, left bank	18 (%)	October 2004	Bálint Czúcz, András Révész (Gallé et al. 2004)
Tápé	2 (AD)	June 1946	Lajos Timár (Timár 1950)

Atka, left bank	2 (%)	August 2004	László Körmöczi, Márta Zalatnai, Orsolya Makra (Gallé et al. 2004)
Atka, right bank	7 (%)	September 2004	Katalin Margóczi (Gallé et al. 2004)
Atka, right bank, navvy hole forest	3 (%)	September 2004	Katalin Margóczi (Gallé et al. 2004)
Mártély	5 (%)	September 2001	Katalin Margóczi Gallé (2002/b)
Mindszent, left bank	4 (%)	July 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Mindszent, right bank	2 (%)	July 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Csanytelek, navvy hole forest	3 (%)	July 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Szegvár,	10 (%)	September 2001	Katalin Margóczi (Virág 2003)
Szegvár, (navvy hole forest)	5 (%)	September 2001	Katalin Margóczi (Virág 2003)
Csanytelek	2 (%)	July 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Szentes	2 (%)	September 2005	Anikó Böszörményi (unpublished)
Köröszug			
Köröszug (gallery forest)	14 (%)	Summer 2000	Áron József Deák (Deák 2001)
Köröszug (navvy hole forest)	9 (%)	Summer 2000	Áron József Deák (Deák 2001)
Köröszug (gallery forest)	15 (%)	October 2004	Áron József Deák (Gallé et al. 2004)
Tisza from Csongád to Szolnok			
Tőserdő	10 (AD)	July-September 1977	Katalin Margóczi (Horváth et al 1979)
Tiszaug	1 (AD)	July 1958	György Bodrogközy (unpublished)
Tiszaug	2 (AD)	July 1944	Lajos Timár (Timár 1950)
Martfű	7 (%)	July 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Vezseny	2 (%)	September 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Tószeg	2 (%)	August 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Szandaszőlős	5 (%)	August 2004	Orsolya Makra, Márta Zalatnai (Gallé et al. 2004)
Tisza from Szolnok to Tokaj			
Szolnok	4 (AD)	June 1944	Lajos Timár (Timár 1950)
Szolnok	2 (AD)	June-July 1944	Lajos Timár (Timár 1950)
Tiszalök	1 (AD)	June 1959	György Bodrogközy (unpublished)
Taktabáj	2 (AD)	June 1959	György Bodrogközy (unpublished)
Tisza from Polgár to Tokaj	20 (AD)	Summer 1953	Miklós Újvárosi (Újvárosi 1940)
Bodrogzug			
Zalkod	1 (AD)	1983	Zoltán Tuba (unpublished)
Kenézlő	2 (AD)	1990	Zoltán Tuba (unpublished)
Bodrogzug	9 (AD)	1983	Zoltán Tuba (unpublished)
Tokaj-Bodrogzug	2 (AD)	1983	Zoltán Tuba (unpublished)
Tisza mente, Gelin erdő	3 (AD)	1983	Zoltán Tuba (unpublished)

Tisza from Tokaj to the north-eastern border			
Timár	1 (AD)	June 1959	György Bodrogközy (unpublished)
Tiszacsermely	10 (%)	October 2005	János Nagy, Orsolya Szirmai, Tibor Szerdahelyi, Dániel Cserhalmi (Gal et al., 2006)
Dombrád	3 (AD)	July 1966	György Bodrogközy (unpublished)
Tiszavid	1 (AD)	July 1966	György Bodrogközy (unpublished)
Tiszaszalka	1 (AD)	August 1953	Tibor Simon (Simon 1957)
Gergelyiugornya: Bagiszeg	6 (AD)	September 1952 and 1953	Tibor Simon (Simon 1957)
Vásárosnamény	1 (AD)	August 1995	Constantin Dragulescu (unpublished)
Vásárosnamény	1 (AD)	May 1958	György Bodrogközy (unpublished)
Jánd	1 (AD)	September 1952	Tibor Simon (Simon 1957)
Jánd	2 (AD)	August 1995	Constantin Dragulescu (unpublished)
Kisar	1 (AD)	September 1952	Tibor Simon (Simon 1957)
Kisar-Badaló	3 (AD)	1952-53	Tibor Simon (Simon 1952)
Kisar	1 (AD)	May 1958	György Bodrogközy (unpublished)
Bosteny-Ukrajna	2 (AD)	August 1995	Constantin Dragulescu (unpublished)
Vinogradov-Ukrajna	2 (AD)	August 1995	Constantin Dragulescu (unpublished)
River Bodrog			
Sárospatak (south of Bodroghalász)	7 (%)	October 2005	János Nagy, Orsolya Szirmai, Zsolt Ürmös, Tibor Szerdahelyi, Dániel Cserhalmi
Bodroghalász	2 (%)	May 2004	Zoltán Tuba (Gal et al., 2006)
Sárospatak, Ó-Bodrog, backwater	2 (%)	October 2006	János Nagy, Bernadett Gál (Gal et al., 2006)
Sárospatak (old railway bridge)	4(%)	October 2005	János Nagy (unpublished)
River Szamos			
under Kolozsvár	2 (AD)	June 1992	Constantin Dragulescu (unpublished)
Nima	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Casei	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Beclean	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Salsig	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Benerat	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Gergelyiugornya	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Olcsva	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Paulesti	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Beclean	1 (AD)	June 1992	Constantin Dragulescu (unpublished)
Szamoskér	1 (AD)	October 1952	Tibor Simon (Simon 1957)
Szamosbecs	10 (AD)	August 1965	István Fintha (Fintha 1969)

River Körös			
Háromalmás	1 (AD)	August 1994	Constantin Dragulescu (unpublished)
Békéscsaba (Gerla)	1 (AD)	August 1994	Constantin Dragulescu (unpublished)
River Maros			
Szeged	1 (AD)	October 1964	Mária Tóth (Tóth 1967)
Vetyehát	5 (%)	June 2001	Katalin Margóczi, Orsolya Makra (Gallé 2002/a)
Vetyehát renewed poplar forest	5 (%)	June 2001	Katalin Margóczi, Orsolya Makra (Gallé 2002/a)
Tápérét	1 (AD)	September 1965	Mária Tóth (Tóth 1967)
Maroslele	3 (AD)	August 1965	Mária Tóth (Tóth 1967)
Makó-Landor	4 (%)	June 2005	Orsolya Makra (unpublished)
Makó-Landor	1 (%)	July 1997	Károly Penksza (Penksza et al 1997)
Ferencszállás	2 (AD)	September 1965	Mária Tóth (Tóth 1967)
Kiszombor	3 (AD)	June-September 1965	Mária Tóth (Tóth 1967)
Makó	3 (AD)	May-June 1966	Mária Tóth (Tóth 1967)
Makó, Csordajárás	5 (%)	August 2001	Orsolya Makra (Makra 2002)
Makó, Csordajárás, gallery forest	5 (%)	October 2001	Orsolya Makra (Makra 2002)
Apátfalva	2 (AD)	October 1965	Mária Tóth (Tóth 1967)
Apátfalva	1 (%)	2000 and 2001	Károly Penksza (Penksza et al 2001)
Bökény	5 (%)	August 2001	Orsolya Makra (unpublished)
Bökény	1 (%)	2000 and 2001	Károly Penksza (Penksza et al 2001)
Csigai-Szilvás	2 (%)	2000 and 2001	Károly Penksza (Penksza et al 2001)
Maros sandbank	1 (%)	November 1997	Károly Penksza (Penksza et al 1997)
Maros island	1 (%)	November 1997	Károlya Penksza (Penksza et al 1997)
Határsziget	7 (%)	August 2005	Orsolya Makra (unpublished)
Bezdin, kisporond	3 (%)	July 2000	Katalin Margóczi (Gallé et al. 2002/b)
Bezdin, navvy willow	3 (%)	July 2000	Katalin Margóczi (Gallé et al 2002/b)
Szolcsva, willow forest	5 (%)	August 2001	Katalin Margóczi, Orsolya Makra (Gallé 2002/a)
Mihalt, firth of Küküllő	2 (AD)	July 1991	Constantin Dragulescu (unpublished)
between Nyárádtő and Moresti	2 (AD)	August 1991	Constantin Dragulescu (unpublished)
Santimbru	1 (AD)	July 1991	Constantin Dragulescu (unpublished)
between Ratosnya and Lunca Bradului	1 (AD)	August 1991	Constantin Dragulescu (unpublished)
Kutyfalva/Cicu	1 (AD)	August 1991	Constantin Dragulescu (unpublished)
between Ludas and Gheja	2 (AD)	August 1991	Constantin Dragulescu (unpublished)
Iernut	1 (AD)	August 1991	Constantin Dragulescu (unpublished)
Lechinţa/ Lekence	1 (AD)	August 1991	Constantin Dragulescu (unpublished)

X.1 *Paridi quadrifoliae-Alnetum*

	A-D	K
Upper canopy layer (A1)		
Acer negundo	1	I
Alnus glutinosa	3-4	V
Betula pendula	+	I
Fraxinus angustifolia ssp. pannonica	1-3	V
Juglans nigra	+	I
Populus alba	1	I
Populus nigra	+	I
Populus tremula	+	I
Populus × canadensis	1	I
Quercus robur	+-1	III
Tilia tomentosa	+	I
Ulmus minor	1	I
Lower canopy layer (A2)		
Acer negundo	+-2	III
Acer tataricum	+	I
Alnus glutinosa	1	III
Betula pendula	+	I
Celtis occidentalis	+	II
Fraxinus angustifolia ssp. pannonica	+-2	V
Fraxinus pennsylvanica	+	II
Juglans nigra	+	I
Populus alba	1	I
Quercus robur	+	I
Tilia tomentosa	+	II
Ulmus laevis	2	III
Ulmus minor	+	I
Shrub layer (B1)		
Acer campestre	+	II
Acer negundo	1-2	III
Alnus glutinosa	+	II
Celtis occidentalis	+-1	II

Cornus sanguinea	+-2	V
Corylus avellana	+-2	IV
Crataegus monogyna	+-2	IV
Euonymus europaea	+-1	III
Frangula alnus	+	II
Fraxinus angustifolia ssp. pannonica	1-2	V
Fraxinus pennsylvanica	+	III
Humulus lupulus	+	II
Juglans nigra	+	I
Ligustrum vulgare	+-1	IV
Malus sylvestris	+	I
Populus alba	+	I
Populus tremula	+	I
Rhamnus catharticus	+	II
Ribes rubrum ssp. sylvestre	+	I
Rosa canina agg.	+	I
Sambucus nigra	+-3	V
Tilia tomentosa	+	II
Ulmus laevis	+-2	II
Ulmus minor	+-2	III
Viburnum opulus	+	I
saplings (B2)		
Acer campestre	+	III
Acer negundo	+	III
Acer tataricum	+	I
Alnus glutinosa	+	II
Celtis occidentalis	+	III
Cornus sanguinea	+	V
Corylus avellana	+	II
Crataegus monogyna	+	V
Euonymus europaea	+-1	V
Euonymus verrucosa	+	I
Frangula alnus	+	III
Fraxinus angustifolia ssp. pannonica	+-2	V
Juglans nigra	+	I
Ligustrum vulgare	+	V
Malus sylvestris	+	I

Morus alba	+	I
Populus alba	+	I
Populus tremula	+	I
Prunus spinosa	+	I
Quercus robur	+	III
Rhamnus catharticus	+	IV
Robinia pseudo-acacia	+	I
Rosa canina agg.	+	I
Rubus caesius	+-3	IV
Sambucus nigra	+-1	IV
Tilia tomentosa	+	I
Ulmus minor	+	IV
Viburnum opulus	+	V
Herbaceous layer (C)		
Aegopodium podagraria	+-2	V
Agropyron caninum	+	II
Ajuga reptans	+-1	III
Alliaria petiolata	+	III
Allium ursinum	5	III
Anemone ranunculoides	+	I
Angelica sylvestris	+	II
Anthriscus cerefolium ssp. trichosperma	+	I
Arctium lappa	+	I
Arctium minus	+	II
Athyrium filix-femina	+	I
Brachypodium pinnatum	+	I
Brachypodium sylvaticum	+-3	V
Bromus ramosus agg.	+	I
Campanula trachelium	+	III
Carex acutiformis	+	II
Carex remota	+	II
Carex spicata	+	I
Carex sylvatica	+-1	III
Chaerophyllum temulum	+-1	V
Chelidonium majus	+	I
Circaea lutetiana	+-2	V
Cirsium canum	+	I

Cirsium rivulare	+	II
Clinopodium vulgare	+	II
Convallaria majalis	+-1	II
Cruciata glabra	+	I
Cucubalus baccifer	+	V
Cynoglossum officinale	+	I
Dactylis polygama	+	III
Dentaria bulbifera	1	I
Deschampsia caespitosa	+	IV
Dryopteris carthusiana s.str.	+	I
Dryopteris filix-mas s.str.	+	II
Epilobium hirsutum	+	I
Epilobium tetragonum	+	I
Epipactis helleborine agg.	+	I
Equisetum arvense	+	III
Equisetum palustre	+	I
Eupatorium cannabinum	+	III
Fallopia dumetorum	+	II
Festuca gigantea	+	IV
Ficaria verna	+	I
Filipendula ulmaria	+	I
Fragaria vesca	+	I
Galeopsis bifida	+	I
Galeopsis pubescens	+	II
Galeopsis speciosa	+-1	I
Galium aparine	+-2	IV
Geranium robertianum	+-2	V
Geum urbanum	+-1	V
Glechoma hederacea s.str.	+-2	IV
Heracleum sphondylium	+	IV
Humulus lupulus	+	V
Lapsana communis	+	V
Lathraea squamaria	+	I
Lilium martagon	+	I
Listera ovata	+	II
Lychnis flos-cuculi	+	I
Lycopus europaeus	+	I

Lysimachia nummularia	+-1	V
Melittis carpatica	+	I
Mentha aquatica	+	I
Milium effusum	+-1	V
Moehringia trinervia	+	V
Mycelis muralis	+	I
Platanthera bifolia	+	I
Poa nemoralis	+	I
Poa trivialis	+	III
Polygonatum latifolium	+-2	III
Polygonatum multiflorum	+	III
Pulmonaria mollis	+	I
Pulmonaria officinalis s.str.	+-1	III
Ranunculus auricomus agg.	+	I
Ranunculus repens	+	I
Rumex sanguineus	+	I
Scrophularia nodosa	+	I
Solanum dulcamara	+	II
Stachys sylvatica	+-2	V
Stellaria media	+	II
Symphytum tuberosum ssp. angustifolium	+	I
Taraxacum officinale	+	II
Torilis japonica s.str.	+	IV
Urtica dioica	+-2	IV
Veratrum album	+	I
Veronica chamaedrys	+	I
Veronica hederifolia	+	II
Veronica officinalis	+	I
Viola cyanea	+	II
Viola mirabilis	+	III
Viola sylvestris	+	III

locality of the stands	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Nyírség	10 (AD)		Balázs Kevey (unpublished)

X.2. *Fraxino pannonicae-Ulmetum*

	Kv1		Kv2		Ny1		Ny2		Ny3		Sz1		Sz2		Bg1		Bg2	
	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K
upper canopy layer (A1)																		
Acer campestre			+-2	I	+-1	III			+-3	II	1-2	II			+-1	I	+-1	I
Acer platanoides									+-1	I								
Acer pseudo-platanus			1	I					+-1	I							+	I
Acer tataricum					1	I					1	I			+	I		
Alnus glutinosa											2	I					+-1	I
Betula pendula					1	I			+-1	I								
Carpinus betulus					1	I			+	I	1-4	I			+	I		
Cerasus avium							+	I	+	I	1-2	I					+-1	I
Cornus sanguinea					2	I												
Fraxinus angustifolia ssp. pannonica	+-5	V	+-4	V	1-5	V	1-4	V	+-4	V	1	II	1-2	II	+-2	III	+-4	IV
Fraxinus excelsior			1	I														
Hedera helix									+	I								
Juglans nigra			1	I					+	I							+-3	I
Larix deciduca	1	I																
Loranthus europaeus	1	I	+	I			+	I	+	I			+	II				
Malus sylvestris					1	I												
Pinus sylvestris	1	I																
Populus alba	1	I	1-3	I	1-2	II	+-4	III	+-4	III	1-2	I			1-2	I	1	I
Populus nigra									+	I								
Populus tremula					+-5	III	+-1	I	+-1	I	1	I	1	I	1	I	1	I
Populus × canescens											1-2	I			2-3	I		
Pyrus pyraster	+-1	I			1	I	1	I			1-2	I			+	I		
Quercus cerris	+-5	I	+-1	I					+-1	I	1	II			1	II		
Quercus petraea agg.			1	I														
Quercus robur	+-5	IV	+-5	V	1-4	IV	1-4	IV	+-4	V	1-5	V	4-5	V	+-3	V	1-5	V
Quercus rubra																	+	I
Robinia pseudo-acacia			+-1	I			+	I	+-2	I	1	I			+-1	I		
Salix alba																	+	I
Salix cinerea					1	I												
Salix fragilis					1	I	+-1	I	+	I	+	I						

Salix triandra															1	I		
Tilia cordata					+-4	II			+-3	II								
Tilia platyphyllos	1	I	1	I			2	I	+-2	I								
Tilia tomentosa					1-3	II	+-1	I	+-3	II							+-1	I
Ulmus glabra					1	II					1-2	I			1	I		
Ulmus laevis	+-2	I	+-1	I	1-2	II	+-2	II	+-4	III					1-3	I	+-2	II
Ulmus minor					1-5	IV					1-3	II			+-5	II	+	I
Viscum album					1	I			+	I								
lower canopy layer (A2)																		
Acer campestre	+-5	II	+-4	IV			+-1	I	+-3	V	1	I	1-3	IV	+-1	II	+-3	V
Acer negundo	1	I	+-3	II			+-2	II	+	I								
Acer platanoides									1	I							+	I
Acer pseudo-platanus			+-2	I					+	I							+-2	I
Acer tataricum			+-2	II					+-2	II			1-2	V	+	I	+-2	II
Aesculus hippocastanum			+	I													+	I
Alnus glutinosa							+	I									+-1	I
Betula pendula	1	I							+	I								
Carpinus betulus	1	I							+-1	III	1	I	+	II	+-2	II	+-1	III
Celtis occidentalis			+	I			+	I										
Cerasus avium							+	I	+-1	II							+	I
Clematis vitalba			+	I														
Cornus sanguinea							+	I	+	I							+	I
Corylus avellana							+-2	II	+-2	II			1	I				
Crataegus monogyna			+	I			+-1	I	+	I							+	I
Fraxinus angustifolia ssp. pannonica			+-3	IV			1-3	V	+-3	III	+	I	+-1	II	1	I	+-2	IV
Fraxinus excelsior			+-2	I														
Fraxinus pennsylvanica			+-1	I			+-2	I	+	I			+	I			+-1	II
Hedera helix			+	I					+	II			+	I			+	I
Malus sylvestris	1	I	+-2	I			+	I	+	I			+	I			+	I
Morus alba			+-1	I														
Padus avium			+-3	I			+	I	+	I							+-1	I
Populus × canescens											+	I						
Populus alba							1	I	+	I							+	I
Populus tremula							1	I					+	II				
Pyrus pyraster			+	I			+-2	II	+-1	I			+-1	II	1-2	I	+	I
Quercus robur			+-1	I			+-1	I	+	I	+-1	I	1	II	1-2	II	+-1	I
Rhamnus catharticus							+	I	+	I								

Robinia pseudo-acacia			+-1	II			+	I	+	I							+	I
Salix fragilis	+-1	I							+	I								
Staphylea pinnata									+	I								
Tilia cordata									+-2	II								
Tilia platyphyllos			1	I			2	I	+-2	I								
Tilia tomentosa							+-2	I	+-2	II								
Ulmus glabra	+-1	I													+-1	I		
Ulmus laevis			+-3	III			+-3	II	+-2	IV							+-3	III
Ulmus minor			+-2	III			+-3	V	+-3	IV	+-2	I	+-1	III	+-2	III	+-2	V
Vitis sylvestris			+	I														
Vitis vulpina							+	I										
shrub layer (B1)																		
Acer campestre			+-4	V			+	I	+-3	V	+-1	I	+-3	V	+-2	III	+-3	V
Acer negundo			+-3	I			+-1	II										
Acer platanoides			+	I	1	I	+	I	+-2	I							+	I
Acer pseudo-platanus			+-3	I													+	I
Acer tataricum	1	I	+-2	II	1-2	III	+	I	+-2	III	+-2	III	+-3	V	+-1	III	+-3	III
Ailanthus altissima			+	I														
Amorpha fruticosa			+	I														
Calystegia sepium	+-1	I																
Carpinus betulus									+	I			+	IV	+-1	II	+-1	II
Celtis australis											1	I						
Celtis occidentalis			+	I			+	I										
Cerasus avium	1	I							+	I							+	I
Clematis vitalba	1	I	+-1	I														
Cornus mas			+-2	I					+-4	II	1	I						
Cornus sanguinea	+-1	I	+-3	III	1-3	IV	+-3	V	+-3	V	+-3	III	+-2	III	+-4	IV	+-4	V
Corylus avellana	1	I	1	I	1	III	+-4	IV	+-4	V	1-2	II	+-3	II	1-2	I	+-1	I
Crataegus monogyna	+-1	I	+-3	IV	+-1	III	+-3	V	+-3	V	+-2	III	+	IV	+	II	+-2	III
Crataegus oxyacantha			+	I							+-2	I	+-1	IV	+-1	II	+-2	III
Deutzia scabra							+	I										
Euonymus europaea	+-1	I	+	II	1	I	+	II	+	III	+-2	III	+	IV	+-1	II	+-1	III
Euonymus verrucosa					1	I	+	I	+	I								
Frangula alnus			+	I	1	III	+	II	+	II	+-1	II	+	V	+-2	II	+	I
Fraxinus angustifolia ssp. pannonica			+-3	IV			+-2	IV	+-4	IV	+-1	I	+	II	+-1	II	+-2	V
Fraxinus pennsylvanica			+	I			+-1	I	+	I			+	I			+	I
Hedera helix			+	I					+	II			+	I			+	I

Humulus lupulus	1	II	+	I			+	I	+	I							+-1	I
Juglans nigra																	+	I
Juglans regia									+	I							+	I
Ligustrum vulgare	+-1	III	+-1	II	1	II	+-3	V	+-2	III	+-2	II			+	II	+	I
Malus sylvestris			+	I					+	I	+-1	I	+	I			+	I
Morus alba			+	I													+	I
Padus avium	1	I	+-3	I			+	I	+-1	I							+-3	III
Padus serotina									+	I								
Populus × canescens											+	I			+	I		
Populus alba			+	I			+	II	+	II	1	I						
Populus tremula							+	I	+	I	+-1	I	+	II	+-1	I	+	I
Prunus spinosa			+-2	III	1	I	+	I	+	I	+-2	II	+	II	+-1	III	+	I
Pyrus pyraster			+	I			+	II	+	I	+-1	I	+	I	+-1	I	+	I
Quercus cerris			+	I														
Quercus robur							+	I	+	I	+-1	I			+-1	II	+	I
Rhamnus catharticus			+	I	1	I	+	III	+	I	+	I	+	I			+	I
Ribes rubrum			+	I					+	I								
Ribes uva-crispa			+	I			+	I										
Robinia pseudo-acacia			+	I					+	I					+-1	I	+	I
Rosa canina agg.							+	I	+	I	+-1	I			+	I	+	I
Rubus caesius											+-1	II			+-3	IV	+	I
Rubus hirtus											+	I						
Salix alba											1	I						
Salix caprea											1	I					+	I
Salix cinerea					1	I					+-2	I						
Sambucus nigra	+-3	III	+-3	V	1	I	+-1	III	+-3	III	1-2	II	+	I	+	I	+-3	III
Sorbus aucuparia											+	I						
Staphylea pinnata					1-2	I			+-3	II	1-3	I						
Tilia cordata									+-2	III								
Tilia platyphyllos							+-1	I	+-1	I	1	I						
Tilia tomentosa							+	I	+-2	II							+	I
Ulmus glabra									+	I	+	I			+-1	I		
Ulmus laevis			+-2	II			+	I	+-2	III					+-1	I	+-2	III
Ulmus minor			+-2	III			+-2	IV	+-2	V	+-1	II	+-2	III	+-3	IV	+-3	V
Viburnum lantana															2	I		
Viburnum opulus	+-1	I	+-1	I	1	III	+	I	+	I	+-2	I	+	I	1	I	+-1	I
Vitis sylvestris	+-1	I																

Vitis vulpina			+	I			+	I								
saplings (B2)																
Acer campestre			+-2	V			+	I	+-1	V	+	I	+-2	V	+-1	III	+-1	V
Acer negundo			+	I			+	III	+	I							+	I
Acer platanoides			+	I			+	I	+-1	I							+	I
Acer pseudo-platanus			+	II					+	I							+	I
Acer tataricum			+	II			+	I	+-1	II	+	I	+-1	V	+-1	I	+	III
Aesculus hippocastanum			+	I													+	I
Ailanthus altissima			+	I					+	I								
Carpinus betulus							+	I	+	I	+	I	+	II	+-1	II	+	III
Celtis occidentalis			+	I			+	II										
Cerasus avium			+	I			+	II	+	II							+	II
Clematis vitalba			+-1	II													+	I
Cornus mas									+-1	I								
Cornus sanguinea			+-1	IV			+-2	V	+-1	V	+-1	I	+-2	V	+-1	I	+-2	V
Corylus avellana			+	I			+	IV	+	IV			+	III			+	I
Crataegus monogyna			+	IV			+	V	+	IV	+	I	+	IV	+	I	+	III
Crataegus oxyacantha			+	I							+	I	+	IV	+	I	+	III
Euonymus europaea			+	V			+	IV	+-1	V	+-1	I	+-1	V	+	II	+-2	V
Euonymus verrucosa							+	I	+	I								
Frangula alnus							+-1	II	+	I	+	I	+	V	+	I	+	I
Fraxinus angustifolia ssp. pannonica			+-2	V			+-2	V	+-2	V	+-1	I	+-1	III	+-1	II	+-2	V
Fraxinus excelsior			+	I														
Fraxinus pennsylvanica							+	I					+	I			+	II
Gleditsia triacanthos			+	I														
Hedera helix			+	II	1-3	II			+-4	II			2	I	+	I	+	II
Juglans nigra			+	I													+	I
Juglans regia							+	I	+	I							+	I
Ligustrum vulgare			+	II			+-2	V	+-1	IV	+	I	1	II	+	I	+	II
Malus sylvestris			+	I			+	I	+	I			+	II	+	I	+	I
Morus alba			+	I													+	I
Padus avium			+-1	I			+	I	+-1	I			+	II			+-1	II
Padus serotina							+	I	+	I								
Parthenocissus quinquefolia			+	I			+	I	+	I							+	I
Parthenocissus tricuspidata											+-2	I			+	I		
Populus × canescens											+	I			+	I		
Populus alba			+	I			+	III	+	II	1	I						

Populus tremula							+	I	+	II	+	I	+	IV			+	I
Prunus spinosa			+-1	IV			+	III	+	I	+	I			+	II	+	II
Pyrus pyraster			+	I			+	II	+	I			+	II	+	I	+	I
Quercus cerris			+	II					+	I							+	I
Quercus petraea agg.			1	I														
Quercus robur			+	III			+	IV	+	IV	+-1	II	+	III	+-1	III	+	IV
Quercus rubra									+	I								
Rhamnus catharticus			+	II			+	III	+	II					+	I	+	I
Ribes rubrum			+	I			+	I	+	I								
Ribes uva-crispa									+	I								
Robinia pseudo-acacia			+	II			+	I	+	II	+	I					+	I
Rosa canina agg.	1	I	+	I			+	I	+	I			+	IV			+	I
Rosa dumalis agg.	1	I																
Rosa tomentosa agg.	+-1	I																
Rubus caesius	+-1	IV	+-2	V	1-4	IV	+-1	V	+-2	V	1-2	II	+-1	IV	2-3	I	+-3	V
Rubus fruticosus agg.																	+	I
Sambucus nigra			+-1	V			+	III	+	III			+	V	+	I	+	III
Staphylea pinnata									+-1	II								
Tilia cordata									+	II								
Tilia platyphyllos			+	I			+-1	I	+	I								
Tilia tomentosa			+	I			+	I	+	II							+	I
Ulmus glabra															+	I		
Ulmus laevis			+	II			+	I	+	II							+	II
Ulmus minor			+-2	IV			+-1	V	+	V	+-1	I	+-1	IV	+-1	II	+-2	V
Urtica dioica									+	I								
Viburnum opulus			+	I			+	V	+-1	IV	+	I	+	III			+	I
Vitis sylvestris					1	I												
Vitis vulpina			+	I													+	I
herbaceous layer (C)																		
Abutilon theophrasti	+-1	I																
Achillea millefolium s.str.											1	I						
Achillea ptarmica											1	I						
Actaea spicata					1	I			+	III	1	I						
Aegopodium podagraria			+-3	I	+-5	III	+-5	I	+-3	III	2-5	I			+-5	II	+-4	IV
Aethusa cynapium			+	I											+	I	+	II
Agrimonia eupatoria	+-1	I													+	I		
Agropyron caninum	1-4	III	+-1	IV	1	I	+-1	IV	+-1	II	+-1	I	+	II				

Agropyron repens											1-2	I						
Agrostis stolonifera					1-2	I					1-3	II			+	I	+	I
Ajuga genevensis											1	I						
Ajuga reptans	+-3	III	+-1	III	1-2	I	+-1	I	+-1	IV	+-3	III	+	V	+-2	III	+	V
Alisma plantago-aquatica					1	I					1	I						
Alliaria petiolata	+-1	II	+-2	V	1	I	+	IV	+-2	V	+-1	I	+	V	+-1	II	+	V
Allium oleraceum			+	I			+	I	+	I							+	I
Allium scorodoprasum	+-1	II	+	II			+	I	+	I	+-1	I						
Allium ursinum					1-5	II			+-5	III					+	I	+-5	III
Alopecurus geniculatus											1	I						
Alopecurus pratensis	+-3	I									+-4	II			5	I		
Althaea officinalis	+-1	I			1	I												
Anemone nemorosa			+	I							+-1	I					+-4	I
Anemone ranunculoides	+-2	I	+-1	II	1-2	II			+-2	III	1-2	I			+-1	I	+-2	III
Angelica palustris							+	I	+	I								
Angelica sylvestris	1	I	+	I	1	II	+	III	+	I	+-2	I			+-1	II	+	I
Anthoxanthum odoratum											1	I						
Anthriscus cerefolium ssp. trichosperma	+-1	I	+	I			+	I	+-1	I								
Anthriscus sylvestris							+	I							+	I	+	I
Aquilegia vulgaris			+	I														
Arabidopsis thaliana											1	I						
Arctium lappa	+-1	III	+	I			+	I									+	I
Arctium minus			+	IV			+	IV	+	III							+	I
Arctium nemorosum					1	I												
Aristolochia clematitis	+-1	II	+	IV							+	I	+	I	+	I	+	I
Arrhenatherum elatius	1	I																
Arum orientale ssp. besseranum	+-1	III	+-1	V							1	I						
Asarum europaeum			+	I	1-4	I			+	I							+-1	II
Astragalus glycyphyllos	+-1	II	+	I	1	I	+	I	+	I	+-1	I			1	I		
Athyrium filix-femina			+	I					+	I	1-2	I	+	II			+	I
Atropa bella-donna																	+	I
Ballota nigra	+-1	I													+	I		
Betonica officinalis							+	I	+	I	+-2	I						
Brachypodium pinnatum	+	I							+-1	II								
Brachypodium sylvaticum	1	I	+-2	V	1	II	+-4	V	+-2	III	+-3	II	+-1	V	+-3	III	+	V
Bromus mollis											1	I						
Bromus ramosus agg.	+-1	I	+-1	II					+-1	III	1	I						

Bromus sterilis									+	I								
Bryonia alba			+	I														
Calamagrostis arundinacea											+-1	I						
Calamagrostis canescens							+	I										
Callitriche palustris											1	I						
Caltha palustris					1-3	II			+	I	+-2	I					+	I
Calystegia sepium					1	I			+	I					1	I	+	I
Campanula glomerata	+-1	I					+	I			1	I						
Campanula patula											+-1	I						
Campanula persicifolia									+	I	1	I						
Campanula trachelium			+	I	1	I	+-1	II	+-1	II	1	I						
Cannabis sativa							+	I										
Cardamine impatiens													+	I			+	I
Cardamine pratensis	+	I			1	I	+	I	+	I	+-2	I					+	I
Carduus acanthoides											+-1	I						
Carduus crispus	+-1	II	+	III	1	I	+	I			1	I					+	I
Carex acutiformis					1-5	II	+	II	+	I	+-4	II	+	II	+	I	+	II
Carex brizoides			1	I	1-3	I			+	I	+-5	II	+	II	+-5	II	+-3	III
Carex cuprina							+	I	+	I								
Carex digitata					1	I												
Carex disticha											1	I						
Carex divulsa	+-1	I	+-1	IV			+	II	+	II	1	I	+-1	III			+-3	II
Carex elata																	+	I
Carex elongata											1	I						
Carex gracilis									+	I					1	I		
Carex hirta											1	I			+	I		
Carex leporina					1	I					1	I						
Carex melanostachya											1-5	I						
Carex michelii					1	I	+	I										
Carex pairae	1	I			1-2	II			+	I	+	I			+	I		
Carex pallescens											+-2	I			+	I		
Carex pilosa					1	II			+-1	I							+	I
Carex praecox	1	I									1	I						
Carex remota	1	I	+	I	1-5	II	+-2	I	+	III	+-3	II			+-4	I	+	I
Carex riparia					2	I	+-1	II	+-1	I							+	I
Carex spicata	+-1	I					+	I										
Carex sylvatica	1-2	II	+-1	III	1-3	I	+-1	III	+-1	III	1	I	+	I			+	II

Carex tomentosa											+-1	I						
Carex vesicaria											2	I						
Carex vulpina	1	I			1	I					2	I						
Centaurea indurata											1	I						
Centaurea pannonica											1-2	I						
Cephalanthera damasonium							+	I										
Cephalanthera longifolia							+	I							+	I		
Cephalaria pilosa	+-1	I	+	I													+	I
Cerastium fontanum											1	I						
Cerastium sylvaticum									+	I	+	I	+	II	+	I	+-1	III
Cerinthe minor	+-1	I																
Chaerophyllum aromaticum									+	I								
Chaerophyllum bulbosum	+-4	I			1	I									1	I		
Chaerophyllum temulum	+-3	I	+-1	V	1	II	+-3	IV	+-2	IV	1	I	+	III	+	I	+	III
Chelidonium majus			+	II			+	II	+-1	IV	1	I					+	II
Chenopodium polyspermum											+	I						
Chrysanthemum leucanthemum agg.											1	I						
Chrysanthemum serotinum											+	I						
Cichorium intybus															+	I		
Circaea lutetiana	+-1	IV	+-3	V	1-3	II	+-2	III	+-3	V	+-5	II	+-2	IV	+	II	+-2	V
Cirsium arvense															+	I		
Cirsium canum					1	I	+	I			1-2	I						
Cirsium pannonicum											1	I						
Cirsium rivulare							+	I										
Cirsium vulgare											1	I						
Clematis recta									+	I								
Clinopodium vulgare	+-1	I	+	I	1	I	+	I	+	I	+-2	I					+	I
Colchicum autumnale					2	I	+	I	+	II	+-1	I					+	I
Conium maculatum	1	I									1	I						
Convallaria majalis	1-5	III	+-1	I	1-5	IV	+-4	IV	+-4	V	+-4	III	+-2	V	+-2	III	+-1	II
Coronilla varia	+-1	I																
Corydalis cava	+-3	III	+-5	V			2-3	I	+-1	I	1-3	I	+	V			+-5	III
Corydalis solida			+-1	I	1	I	+-2	I										
Crepis praemorsa					1	I												
Crepis tectorum											1	I						
Crocus heuffelianus																	+	I
Cruciata glabra					1	I	+	I	+	I	+-1	II			+	I		

Cruciata laevipes	+-1	I	+	I	1	I	+	I			+-1	I					+	I
Cruciata pedemontana	+-1	I																
Cucubalus baccifer	+-1	II	+-1	V	1	I	+	V	+	III	+	I	+	III	+	I	+	I
Cuscuta europaea			+	I														
Cynoglossum officinale			+	I			+	I										
Dactylis polygama	+-3	II	+-1	V	1	I	+-1	III	+	III	+-2	II	+	IV	+-4	II	+	III
Daucus carota ssp. carota											+-1	I						
Dentaria bulbifera					1	II	2-4	I	+-4	III	1	I						
Deschampsia caespitosa	1	I	+	I			+-2	III	+-1	II	+-3	II	+	II	+-3	II	+	II
Dianthus armeria	+-1	I																
Dipsacus laciniatus	+-1	I									1	I						
Dipsacus sylvestris	+-1	I													+	I		
Dryopteris carthusiana s.str.							+	I	+	I			+	I			+	I
Dryopteris expansa																	+	I
Dryopteris filix-mas s.str.	1	I	+	I					+-1	II	1	I			+	I	+	I
Echinocystis lobata							+	I							+-1	I		
Eleocharis palustris s.str.											1-2	I						
Epilobium angustifolium											1-2	I						
Epilobium hirsutum											1	I						
Epilobium montanum					1	I					+-1	I						
Epilobium obscurum											1	I						
Epilobium parviflorum					1	I					2	I						
Epilobium tetragonum									+	I	1	I			+	I		
Epipactis helleborine agg.			+	I	1	I	+	II	+	III							+	I
Epipactis purpurata					1	I												
Equisetum arvense	+	I			1	I	+	III	+	I								
Equisetum hyemale					1	I	+	I	+-5	I								
Equisetum palustre					1	I												
Erigeron canadensis											+	I			+	I		
Erysimum cheiranthoides	+-1	I																
Eupatorium cannabinum	+-1	I	+	I	1	II	+	II	+	I	1	I			+	I		
Euphorbia amygdaloides					1	II			+	II							+	I
Euphorbia angulata					1	I					1	I						
Euphorbia lucida					1	I												
Euphorbia platyphyllos											+	I						
Euphorbia salicifolia											1	I						
Euphorbia stricta	1	III																

Euphorbia villosa					1	I					1	I						
Euphorbia virgata											1	I						
Fallopia dumetorum	+-1	I	+	IV	1	I	+	II	+	III	+	I	+	IV	+	I	+	III
Festuca gigantea	+-1	II	+	IV	1	I	+-1	IV	+	III	+-1	I	+	III	+	I	+	V
Festuca pratensis											1	I						
Festuca pseudovina															2	I		
Festuca rupicola															+	I		
Ficaria verna	+-3	II	+-4	V	1-2	I	+	I	+-4	V	1-3	III	+-2	V	+-2	I	+-3	V
Filipendula ulmaria					+-1	I	+	II			+-2	I			+-1	I	+	I
Filipendula vulgaris							+	I									+	I
Fragaria vesca	+-1	I					+	I	+	I	1-2	I			+	II	+	I
Fragaria viridis	+-1	I																
Fritillaria meleagris											+	I			+	I	+	II
Gagea lutea			+-1	III							+	I	+	III	+	I	+-1	IV
Gagea minima																	+	I
Gagea pratensis							+	II	+	I								
Gagea spathacea													+-2	V			+-3	III
Galanthus nivalis											1-2	I					+-1	I
Galega officinalis	1	I							+	I	1	I						
Galeobdolon luteum			1-4	I	1-2	II			+-2	II					+	I	2-3	I
Galeopsis bifida			+	II					+	I	+	I	+	II			+	I
Galeopsis ladanum	1	I																
Galeopsis pubescens	+	I			1	I	+	III	+	III	+-1	I	+	III			+	I
Galeopsis speciosa	1	I	+	I			+	I	+-1	I	+-2	II	+	IV	+	I	+	IV
Galeopsis tetrahit																	+	I
Galium aparine	1-4	IV	+-2	V	1-2	III	+-2	V	+-1	V	+-2	II	+	V	+-2	II	+-1	V
Galium mollugo	+-1	I			1	I	+	I			+-1	I						
Galium odoratum	+	I	+-1	I	5	I			+-2	II	1-2	I	+-1	IV	+-3	I	+-1	III
Galium palustre	1	I			1	I	+	I	+	I	+-1	II					+	I
Galium rivale	+	I			1	I												
Galium rubioides	1	I			1	I					1	I			+	I		
Galium uliginosum											1	I						
Galium verum	+-1	I									1	I						
Genista tinctoria ssp. elatior	1	I									+	I						
Geranium divaricatum					1	I												
Geranium palustre					+-1	II	+	II	+	I	2	I						
Geranium phaeum											1-2	I						

Geranium robertianum	+-1	II	+-1	IV	1	I	+-1	IV	+-2	V	+-2	II	+	III	+	I	+-1	III
Geum urbanum	+-1	III	+-1	V	1	II	+-1	V	+-1	V	+-2	IV	+	V	+-1	IV	+-1	V
Gladiolus imbricatus											+-1	I						
Glechoma hederacea s.str.	+-3	II	+-1	III			+	III	+	I	+-2	II	+-2	V	+-2	III	+-3	V
Glechoma hirsuta					1	I	+	I										
Glyceria maxima s.str.											+-3	I						
Glyceria plicata											1-2	I						
Gnaphalium uliginosum											1	I						
Gratiola officinalis											1	I						
Gypsophila muralis											1	I						
Helictotrichon pubescens											1	I						
Heracleum sphondylium					1	II	+	II	+	II	+-1	II			1	I	+	I
Hesperis sylvestris	+-1	I																
Hieracium floribundum											1	I						
Hieracium sabaudum agg.											1	I						
Hieracium umbellatum agg.											+	I			+	I		
Hordelymus europaeus									+	I								
Humulus lupulus			+	I	1	I	+	II	+	I	1-2	I			+-2	I	+-1	II
Hypericum hirsutum	+-1	II									+-1	I			+	I	+	I
Hypericum perforatum	+-1	I									1	I						
Hypericum tetrapterum	1	I									1-2	I			+	I	+	I
Impatiens noli-tangere									+-3	I	1-5	II					+	I
Impatiens parviflora															+	I		
Inula britannica											1-2	I						
Inula helenium											1	I						
Inula hirta											1	I						
Inula salicina											1	I						
Iris pseudacorus					1	I	+	I	+	I	+-1	I			+	I	+	I
Isopyrum thalictroides					1-2	II			+-1	I	1	I					+	I
Juncus compressus											1-2	I						
Juncus effusus											+-2	I					+	I
Knautia arvensis											1	I						
Lactuca quercina ssp. quercina							+	III										
Lactuca quercina ssp. sagittata					1	I	+	I			1	I						
Lactuca serriola																	+	I
Lamium album							+	I										
Lamium maculatum	1	II	+-2	III											+-1	I	+-1	III

Lamium purpureum	+-4	V	+	II					+	I								
Lapsana communis	+-1	II	+	V	1	I	+	III	+	IV	+-1	II	+	II	+	I	+	III
Lathraea squamaria					1	I			+	I	1	I						
Lathyrus niger											1	I						
Lathyrus pratensis	+-1	I			1	I	+	I			1-2	I			+	I		
Lathyrus sylvestris	+										+	I						
Lathyrus vernus									+	I	+	I			1	I		
Leontodon autumnalis											+-1	I						
Leontodon hispidus											1	I						
Leonurus cardiaca	+-1	I	+	I			+	I										
Leonurus marrubiastrum	+-1	I																
Leucojum aestivum	1	I			1	I			+	I	1-2	I						
Leucojum vernum																	+-1	I
Lilium martagon					1	II	+	I	+-1	II	1	I						
Linaria vulgaris											1	I						
Listera ovata			+	I	1	II	+	II	+-1	IV	1-2	I						
Lithospermum officinale	+-1	I																
Lotus corniculatus											1	I						
Luzula campestris											1	I						
Lychnis flos-cuculi					1	I	+	II			+-1	II			+	I	+	I
Lycopus europaeus					1	II	+	I	+	I	+-1	I	+	I	+-1	I	+	I
Lycopus exaltatus	+-1	I			1	I					1-2	II						
Lysimachia nummularia	1	I	+	II	1-2	II	+-1	IV	+	III	+-2	IV	+	V	+-3	IV	+-1	III
Lysimachia vulgaris					1	I			+	I	+-2	I	+	II	+	I	+	I
Lythrum salicaria					1	II					+	I			+	I	+	I
Lythrum virgatum											1	I						
Majanthemum bifolium					1	II			+	II					+	I	+	I
Malva sylvestris											1	I						
Melampyrum bihariense											1	I						
Melampyrum nemorosum					1	I			+	I			+	V	+-1	I	+	I
Melampyrum nemorosum ssp. debreceniense											1-2	I						
Melandrium album											1	I			+	I		
Melandrium noctiflorum			+	I														
Melica altissima	+-4	II	+	II														
Melica picta					1	I			+	I	+-1	I						
Melica uniflora			+-1	I													+	I
Melilotus officinalis	+-1	I																

Melissa officinalis			+	I														
Melittis carpatica					1	I			+	I	1	I						
Mentha aquatica					1-2	II			+	I	1-2	I						
Mentha longifolia											2	I						
Mercurialis perennis					1	I			+	I								
Milium effusum			+	I	1	II	+	II	+	V	1	I	+	II	+	I	+	II
Moehringia trinervia	+-3	II	+	V	1-2	I	+	IV	+	V	+-1	II	+	III	+	I	+-1	IV
Molinia coerulea											1	I						
Muscari comosum											1	I						
Mycelis muralis			+	I			+	II	+	II	1	I						
Myosotis arvensis											+-1	I						
Myosotis palustris					1	I			+	I	+-2	I						
Myosotis sparsiflora	+-1	I	+	I	2	I	+	I			1-2	I						
Myosoton aquaticum	+-1	I	+	I	1	I	+	I	+	I	+-1	I			+	I	+	I
Neottia nidus-avis					1	I			+	I	1	I			+	I		
Odontites vulgaris											2	I						
Oenanthe aquatica					1	I					1	I					+	I
Oenanthe banatica					2	I			+	I	+-5	II	+	III	+	I	+	II
Oenothera biennis	1	I																
Ononis arvensis											+-1	I						
Ophioglossum vulgatum			+	I			+	II			+	I			+	I		
Orchis militaris					1	I	+	I										
Ornithogalum boucheanum							+	I	+	I							+	I
Ornithogalum umbellatum	1	I	+	I			+	II	+	I			+	III	+	I	+	II
Oxalis fontana	1	I															+	I
Paris quadrifolia					1-2	II			+-2	II								
Pastinaca sativa									+	I								
Peucedanum alsaticum	+-1	I																
Peucedanum oreoselinum	1	I									1	I						
Peucedanum palustre					+-1	I												
Phalaroides arundinacea											+	I					+	I
Phragmites australis					+	I									+	I		
Physalis alkekengi									+	I								
Phytolacca americana			+	I														
Pimpinella saxifraga											1	I						
Plantago major	1	I									1	I						
Platanthera bifolia	+	I	+	II			+	I	+	I	+-1	I	+	IV	+	I	+	I

Platanthera chlorantha	+-1	I			1	I					1	I						
Poa annua									+	I								
Poa nemoralis	+-1	I	+	I	1	II	+	I	+	I	+-2	I	+	III			+	I
Poa palustris							+	I	+	I	+-4	I			+-5	II		
Poa pratensis s.str.											1-2	I						
Poa trivialis	1	II	+	II	1	I	+	I	+	I	1-2	I					+	III
Podospermum canum	+-1	I																
Polygonatum latifolium	+-3	III	+-2	V	3	I	+-4	IV	+-1	II	1	I	+-4	IV			+	I
Polygonatum multiflorum					1	III	+	II	+-1	V	+-2	II	+-2	V	+-1	II	+-1	V
Polygonatum odoratum					1	I	+	I			+-1	I			+-1	I		
Polygonum amphibium											1	I						
Polygonum aviculare s.str.											+	I						
Polygonum hydropiper	1	II													+	I	+	I
Polygonum lapathifolium											1-2	I						
Polygonum minus	+	I									+	I						
Polygonum mite			+	I													+	I
Polygonum persicaria											+	I						
Polypodium vulgare											1	I						
Polystichum aculeatum									+	I								
Potentilla alba											1	I						
Potentilla argentea s.str.	+-1	I									1	I						
Potentilla erecta											1	I						
Potentilla reptans					1	I												
Primula veris					+-2	I	+	III	+	I								
Primula vulgaris											+	I						
Prunella vulgaris	+-1	II			1	I					+-1	I			+-1	I	+	I
Pteridium aquilinum											1	I						
Pulicaria vulgaris											1	I						
Pulmonaria mollis					2	I	+-1	II	+	I	+-1	I			+	I		
Pulmonaria officinalis	+-3	III	+-2	III	1	I	+	I	+-1	IV	1-2	I			+-1	II	+-1	IV
Ranunculus acris							+	I							+	I		
Ranunculus arvensis											1	I						
Ranunculus auricomus agg.			+	I	1	II	+	II	+	II	+-1	II			+	II	+	II
Ranunculus cassubicus	1	I			1	II			+	I	1	I					+	I
Ranunculus polyanthemos											1	I						
Ranunculus repens					1-2	I	+	I	+	I	+-2	II			+-1	I	+	I
Ranunculus sardous											+	I						

Ranunculus strigulosus											1-2	I						
Rhinanthus borbasii											1	I						
Rorippa austriaca											1	I						
Rorippa × anceps											+-1	I						
Rumex conglomeratus					1	I			+	I								
Rumex crispus											1	I						
Rumex obtusifolius	1	I									+-1	I					+	I
Rumex sanguineus	1	II	+	V	1	II	+	III	+	II	+-2	II	+	II	+-1	I	+	IV
Sagina procumbens											1	I						
Salvia glutinosa					1	I	+	I	+	I								
Sambucus ebulus											1-2	I						
Sanguisorba officinalis											1	I						
Sanicula europaea	1	I			1	I	+	I	+	II	1	I					+	I
Saponaria officinalis											1	I						
Scabiosa ochroleuca											1	I						
Scilla kladnii					+-2	I			+-2	II	1	I			+	I	+-1	I
Scilla vindobonensis	1	I	+-1	II														
Scrophularia nodosa	+-2	II	+	III	1	I	+	IV	+	IV	+-1	II	+	IV	+-1	II	+-1	II
Scrophularia scopolii			+	I														
Scrophularia umbrosa					1	I	+	I	+	I								
Scutellaria galericulata	+-1								+	I	1-2	I						
Scutellaria hastifolia	1	I									1	I						
Sedum maximum									+	I	1	I						
Selinum carvifolia							+	I	+	I	+-1	I						
Senecio erraticus ssp. barbaraeifolius											1	I						
Senecio nemorensis ssp. nemorensis							+	I										
Senecio paludosus											1	I						
Serratula tinctoria	+-1	I					+	I			+-1	I			+	I	+	I
Silene nutans											1	I						
Silene vulgaris											1	I						
Sium latifolium					1	I	1	I			1	I						
Sium sisaroideum					1	I												
Solanum dulcamara			+	I					+	I	1-2	I	+	I			+	I
Solanum nigrum											+	I						
Solidago gigantea ssp. serotina																	+	I
Sonchus arvensis											1-2	I						
Sonchus asper											+	I						

Stachys palustris									+	I	+-2	II	+	II	+-1	II	+	I
Stachys sylvatica	+-1	II	+-1	IV	1	I	+-1	IV	+-2	IV	1-2	II			+-1	I	+-1	IV
Stellaria graminea	+-1	I									1	I						
Stellaria holostea			2	I			+	I	+	I							+	I
Stellaria media	+-5	III	+	I			+	II	+	II	2	I					+	I
Stellaria palustris											+	I						
Stenactis annua	1	I					+	I	+	I					+	I	+	I
Succisa pratensis											1	I						
Succisella inflexa											+	I			+-1	I		
Symphytum officinale	+-1	I	+	I	1-2	I	+	I			+-2	I					+	I
Symphytum tuberosum ssp. angustifolium					+-1	I			+	I	1	I						
Tamus communis			+	I														
Tanacetum vulgare											1	I						
Taraxacum officinale	+-1	II			1	II	+	II	+	I	+-1	I					+	I
Teucrium chamaedrys	1	I																
Teucrium scordium											2	I						
Thalictrum lucidum	+-1	I			1	I					1	I						
Thelypteris palustris					1-2	I												
Torilis arvensis															1	I		
Torilis japonica s.str.	+-1	I	+	II			+	V	+	IV	+	II	+	IV	+-1	II	+	III
Trifolium alpestre											2	I						
Trifolium medium							+	I										
Trifolium pratense									+	I	1	I						
Trifolium repens	+-1	I									1-2	II						
Trollius europaeus					+	I	+	I										
Tussilago farfara									+	I	+-1	I						
Urtica dioica	+-4	IV	+-3	V	1	I	+-2	V	+-1	IV	+-2	II	+	II	+	I	+-1	IV
Valeriana dioica									+	I								
Valeriana officinalis s.str.					1	I	+	I			+-1	I			+	I		
Veratrum album					1	II	+-2	III	+	II	1	I						
Verbascum blattaria	+-1	I																
Veronica chamaedrys	+-2	II	+	I	1	I	+	I	+	II	+-2	II			+	I	+	I
Veronica hederifolia	+-4	II	+-2	V	1	I	+-1	IV	+-1	III	1-3	I	+-1	V	+	I	+	III
Veronica longifolia							+	I			+-1	I			+	I		
Veronica montana																	+	I
Veronica officinalis									+	I								
Veronica serpyllifolia											1	I						

Vicia angustifolia ssp. segetalis	+-1	I																
Vicia cracca	1	I					+	I			1	I						
Vicia dumetorum	1	I	+	I														
Vicia hirsuta	+-1	I									+	I						
Vicia narbonensis ssp. serratifolia	+-1	I																
Vicia sepium	1	I			1	I	+	I	+	I	+-2	II	+	I	+	I	+	I
Vicia tetrasperma	+-2	I																
Vinca minor							3	I			1	I						
Vincetoxicum hirundinaria	+-1	I	+	I			+	I			+-1	I	+	II				
Viola cyanea	+-4	II	+-2	V			+	I	+-2	I	1	I	+	I			+	III
Viola elatior							+	I			1	I						
Viola hirta	1	I			1	I					1	I						
Viola mirabilis					1	II	+-2	I	+-2	III	1-2	I						
Viola montana									+-2	I								
Viola odorata	+	I							+	I							+	I
Viola riviniana											+-1	I						
Viola sylvestris	+-3	II	+-2	V	1	I			+-1	V	+-2	IV	1	V	+-2	IV	+-1	V
Viscaria vulgaris											1	I						

	Bk1		Bk2		TP1		TP2		Lt		Mv	
	A-D	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**
upper canopy layer (A1)												
Acer campestre	1-2	II	1-3	II					+-2	IV	+-2	IV
Acer negundo							3	I	+-1	IV		
Acer platanoides							+-5	II				
Alnus glutinosa	+	I			2	I			+	I		
Carpinus betulus	1-2	I										
Cerasus avium	+	I										
Fraxinus angustifolia ssp. pannonica	3-5	IV	1-4	III	1-3	II	1-4	V	+-4	V	3	V
Fraxinus excelsior	1	I							+-2	I		
Fraxinus pennsylvanica			+-2	II	3	I			+-2	V		
Juglans nigra			2	I								
Loranthus europaeus			+	II								
Pinus strobus	1-2	I										
Populus alba			+-4	III	1-5	II			+-2	V	2	II
Populus nigra					1-5	II						
Populus tremula			+-2	II								

Populus × canadensis			2	I								
Populus × canescens							+-2	I	+	I		
Pyrus pyraster			1	I								
Quercus robur	+-4	II	1-4	IV	1-5	V	+-5	IV	+-5	V		
Robinia pseudo-acacia			+	I								
Tilia cordata			1	I								
Tilia platyphyllos							1	I				
Ulmus laevis	+-1	II	1-2	III	1-3	II	+-3	III	+-2	IV		
Ulmus minor			1	I	1-4	II			+	IV	+-2	V
Viscum album	+	I	+	II								
Vitis vulpina									+-1	I		
lower canopy layer (A2)												
Acer campestre	+-3	II	+-3	IV								
Acer negundo									1	I		
Acer platanoides	2-3	I										
Acer pseudo-platanus	4	I										
Acer tataricum			+-1	IV								
Alnus glutinosa	1	I										
Carpinus betulus			+-1	IV								
Cerasus avium			+	I								
Cornus mas	1	I										
Cornus sanguinea	1	I										
Corylus avellana			+-1	II								
Crataegus monogyna			+	I								
Euonymus europaea	1	I	+	I								
Fraxinus angustifolia ssp. pannonica	+-1	II	+-1	I								
Fraxinus pennsylvanica	+-1	I	1-2	I								
Malus sylvestris			+-2	II								
Morus alba					1	I						
Parthenocissus quinquefolia			+	II								
Pyrus pyraster			1	I								
Quercus robur	+-4	II	+-1	II								
Robinia pseudo-acacia			+	II								
Salix alba	2	I										
Ulmus glabra					2-5	III						
Ulmus laevis	1-3	III	1-3	V								
Ulmus minor			1-3	V								

Vitis sylvestris			+	I	1-3	II						
Vitis vulpina			+-1	I								
shrub layer (B1)												
Acer campestre	+-3	II	+-3	IV							+-2	V
Acer negundo			+	I			+-4	III	+	IV	+	IV
Acer platanoides	+-2	II					1-3	I				
Acer pseudo-platanus	+-2	I			+	I	4	I				
Acer tataricum			+-2	IV								
Amorpha fruticosa	1-4	II	+	II					+-5	V	+-1	V
Berberis vulgaris					+	I						
Carpinus betulus	1	I	+	II			2	I				
Cornus mas	1-3	II			3	I						
Cornus sanguinea	+-2	III	2-3	V	1-3	IV	+-1	III	+	IV	3-4	V
Corylus avellana	+-1	I	1-2	III					+	IV		
Crataegus monogyna	+	I	+-1	III					+	IV	1-3	IV
Crataegus oxyacantha			+	IV							+	II
Euonymus europaea	+	I	+	IV					+	IV		
Frangula alnus			+	II	1	I	+-2	II				
Fraxinus angustifolia ssp. pannonica	1-3	II	+-2	III	1	I	+-3	III	+-4	V	+	II
Fraxinus pennsylvanica	+	I	+-2	II					+	IV		
Humulus lupulus			+	I	1	I					+	II
Ligustrum vulgare	+	I	+	I								
Malus sylvestris			+-2	II							+	IV
Morus alba			+	II	+	I						
Parthenocissus quinquefolia			+	I								
Populus alba			+	I								
Populus tremula			+-1	II								
Prunus spinosa	1	I	+	II								
Quercus robur	+	I			1	I						
Quercus rubra	+	I										
Rhamnus catharticus			1	I								
Ribes rubrum			+	I			+-1	I				
Robinia pseudo-acacia	+-2	II	+	I	+	I	+-1	I				
Salix triandra					2	I						
Sambucus nigra	2-5	II	+	II	1-3	III	+-4	III	+	IV		
Tilia cordata			+	I								
Tilia platyphyllos							2	I				

Ulmus glabra	2	I										
Ulmus laevis	+-4	III	+-1	IV	+-2	II	1-3	IV				
Ulmus minor	+	I	+-2	V			1-2	I	3	I	+-1	V
Viburnum opulus			+	III	1	I	1	I				
Vitis sylvestris			+	II								
Vitis vulpina			+-1	II					+-1	V	+-1	IV
saplings (B2)												
Acer campestre	+-1	II	+	IV			+	I	+	II	+	IV
Acer negundo	+	II	+	I			+-1	III	+-1	III		
Acer platanoides	+-1	I					+-2	II				
Acer pseudo-platanus	2	I					+	I				
Acer tataricum			+-1	III								
Amorpha fruticosa			+	I			1	I	+-5	III	+	II
Carpinus betulus			+	III			1	I				
Celtis occidentalis							+	I				
Cerasus avium							+	I				
Clematis vitalba							+-2	II				
Cornus mas	+	I										
Cornus sanguinea			+-1	III	2	I	+-2	III			+	V
Corylus avellana			+	II			+	I				
Crataegus monogyna			+	I			+	I			+	IV
Crataegus oxyacantha			+	II								
Euonymus europaea	+	I	+	IV			+-2	II			+	II
Frangula alnus	+	I	+	III	1	I	+-1	II	+	I		
Fraxinus angustifolia ssp. pannonica	+-1	III	+	IV			+-3	III	+-4	IV	+	IV
Fraxinus pennsylvanica	+	I	+-1	IV					+-2	IV		
Hedera helix							+-2	IV			+	IV
Juglans nigra			+	I								
Ligustrum vulgare			+	I							+	II
Malus sylvestris			+	I								
Morus alba			+	I	+	I	+	I				
Parthenocissus quinquefolia			+-1	IV			+	I			+	IV
Populus × canescens									+-1	II		
Populus alba	+	I	+	III							+	II
Populus tremula			+	I								
Prunus spinosa			+	II								
Quercus robur	+-1	II	+	V			+	II	+-1	I		

Quercus rubra			+	III								
Rhamnus catharticus			+	I								
Ribes rubrum			+	I			+	I				
Robinia pseudo-acacia	+	I	+	I	+	I	+	I	+-1	II		
Rosa canina agg.			+	II								
Rubus caesius	+-3	V	+-2	V	+-1	III	+-1	IV	+-3	II	+-1	V
Sambucus nigra			+	I	3	I	+-1	V				
Tilia cordata			+	I								
Tilia platyphyllos							+	I				
Ulmus laevis	+-2	III	+	II	+	I	+-1	II				
Ulmus minor			+-2	V					+-3	II	+	II
Viburnum opulus			+	IV			+-1	II				
Vitis sylvestris			+	II	1	I			+	I		
Vitis vulpina			+-1	II			+	I	+-2	II		
herbaceous layer (C)												
Aegopodium podagraria			+-2	III							1	II
Aethusa cynapium			+	II	1	II						
Agropyron caninum									+	I		
Agropyron repens					+	I						
Agrostis stolonifera									+	I		
Ajuga reptans			+	II								
Alisma plantago-aquatica	+	I										
Alliaria petiolata	+	I	+	IV	1-2	I	+-1	V	+-2	I		
Althaea officinalis					+	I						
Angelica sylvestris	+	II	+	IV	1-2	III	+	II				
Anthriscus caucalis	1	I										
Anthriscus cerefolium ssp. trichosperma					+-5	II	1	I				
Anthriscus sylvestris	+	II							1	I		
Arctium lappa			+	II	+-1	II	+	II				
Aristolochia clematitis	+-1	II	+	IV	+-2	IV	+-1	II	+-2	II		
Arrhenatherum elatius					1	I						
Artemisia vulgaris							+	I				
Arum orientale ssp. besseranum							+	I				
Asparagus officinalis					1	I						
Astragalus glycyphyllos					+-1	II	+	I				
Athyrium filix-femina			+	I	1-2	II						
Atriplex prostrata									+	I		

Atropa bella-donna									+	I		
Ballota nigra							+-2	I				
Barbarea stricta			+	I					1	I		
Bidens tripartita	+	I	+	III					1	I		
Brachypodium pinnatum							+-1	I				
Brachypodium sylvaticum	+-1	II	+-1	III	1-5	V	+-3	V				
Bromus ramosus agg.							+	I				
Bromus sterilis					1	I	+	I				
Calystegia sepium			+	I	+	I			+	I		
Campanula trachelium	+	I										
Cardamine impatiens			+	II								
Cardamine pratensis									+-2	I		
Carduus crispus					+-1	II	+	I				
Carex divulsa			+	II	+	I	+	I				
Carex gracilis			+	I					+-1	III		
Carex hirta			+	I								
Carex remota	+-1	III	+	II	2	I	+-1	I				
Carex riparia			+	I								
Carex spicata					1	I	+	I				
Carex sylvatica	1	I	+-1	IV			+	I				
Cephalaria pilosa			+	I	1-2	I	+	I				
Cerastium sylvaticum			+	II								
Chaerophyllum temulum			+	I	1-5	II	+-4	V				
Chelidonium majus	+	I	+	I	+-1	II	+-2	III				
Chenopodium album							+	I				
Chrysanthemum serotinum	1	I	+	II								
Circaea lutetiana	+-2	IV	+-3	V	1-5	V	+-3	V	+-3	III	+	IV
Cirsium arvense	+	I	+	I	1	I	+	I				
Cirsium palustre	+	I										
Cirsium vulgare							+	I				
Conium maculatum					1	I	+	I				
Convallaria majalis	1-3	I	+-4	V	1-5	II	+-3	IV				
Corydalis cava			1-4	III								
Corydalis solida			+-2	II								
Cucubalus baccifer			+	II	+	I	+-1	IV				
Dactylis polygama	+	I	+	III	1	I	+	I				
Deschampsia caespitosa	+	I										

Dipsacus sylvestris	+-1	I										
Echinocystis lobata			+	I								
Epilobium parviflorum							+	I				
Epipactis helleborine agg.							+	I				
Equisetum arvense			+	III	1	II	1	I	+-3	I		
Erysimum cheiranthoides									+	I		
Euphorbia palustris			+	I								
Fallopia dumetorum			+	III	1	I	+-1	II	+-1	I		
Festuca gigantea	1	I	+	IV	1	II	+-1	I				
Ficaria verna			+-4	V								
Gagea lutea			+-1	III								
Galega officinalis			+	I								
Galeopsis pubescens	+	I	+	I	1-2	III	+	I				
Galeopsis speciosa	+	I	+	II	+-2	II	+-1	IV				
Galeopsis tetrahit	+	I										
Galium aparine			+	III	1-3	V	+-4	V	1	I		
Galium mollugo	+	I	+	II								
Galium odoratum	4	I										
Galium palustre	+	I	+	III			+	I	+-2	II		
Genista tinctoria ssp. elatior			+	I								
Geranium robertianum					+-1	IV	+-2	V				
Geum urbanum	+-1	III	+	III	+-1	III	+-3	V	+	I		
Glechoma hederacea s.str.	+-3	IV	+-3	V	+-4	III	+-1	II	+-5	IV	+	IV
Humulus lupulus	+	I	+	III	+-1	I	+-2	II				
Impatiens parviflora			+	I								
Iris pseudacorus	+-1	I	+	IV	+	I	+	I				
Iris sibirica					1	I						
Lactuca quercina ssp. quercina					+	I	+	III				
Lactuca serriola			+	I					+	I		
Lamium album					1	I						
Lamium maculatum	2	I									+	II
Lamium purpureum							+	I				
Lapsana communis			+	III	+-2	III	+-1	II	+-1	I		
Lathyrus niger			+	I								
Leonurus cardiaca					+-1	II	+	I				
Leucojum aestivum			+	III	+-1	II	+	I	+	I		
Lycopus europaeus	+	I	+	II	1	I			+-2	IV		

Lycopus exaltatus			+	I					+	I		
Lysimachia nummularia	+-1	II	+	II	+-1	III	+-2	II	+-1	I	+-1	V
Lysimachia vulgaris	+	I	+	II								
Lythrum salicaria	+	I			1	I						
Melampyrum nemorosum			1	I								
Melandrium album	+	I			+	I						
Melica altissima							+	I				
Mentha aquatica									1-2	II		
Milium effusum			+-1	II								
Moehringia trinervia			+	IV			1-2	I				
Mycelis muralis	+	I			+-1	II	+	I				
Myosoton aquaticum	+	I	+	II	+	I	+-2	II	+	I		
Neottia nidus-avis							+	I				
Oenanthe banatica			+	I								
Onopordum acantium	+	I										
Oxalis fontana	+	I			+	I					+	IV
Phalaroides arundinacea			+	III								
Plantago major							+	I			+	II
Platanthera bifolia			+	II								
Poa angustifolia	+	I										
Poa nemoralis			+	I								
Poa palustris	+	I			1	II						
Poa trivialis			+	III	+	I	+-1	I	+	I		
Polygonatum latifolium	+	I					+-2	III			+	II
Polygonatum multiflorum	+	I	+-1	IV								
Polygonatum odoratum							2	I			+	II
Polygonum amphibium	+	I										
Polygonum hydropiper					1	I			+	I		
Polygonum lapathifolium	+	I										
Polygonum minus					1	I						
Polygonum mite									+-1	II		
Prunella vulgaris					1	I			+-2	II		
Pulmonaria officinalis	3	I	+	III								
Ranunculus auricomus agg.			+	I								
Ranunculus cassubicus			+	II								
Ranunculus repens	+	I	+	I	1	I			+-2	II		
Rumex obtusifolius					1	I						

Rumex sanguineus			+	III			+	I			+	V
Sambucus ebulus					1	I						
Scrophularia nodosa	+	I	+-1	IV	+-1	II	+	II	+	I		
Scutellaria galericulata			+	I					+	I		
Sium latifolium					1	I			+-1	I		
Solanum dulcamara			+	III					+-1	I		
Solidago gigantea ssp. serotina	+	I	+	I	+	I	+-2	II				
Sonchus oleraceus			+	I								
Stachys palustris	+	I	+	III	+-1	II						
Stachys sylvatica	+	I	+	IV			+	I				
Stellaria media	+-3	I	+	I	1	I	+-3	III				
Stenactis annua	+	I	+	I			1	I				
Symphytum officinale			+	III					+-1	II		
Tanacetum vulgare					1	I	+	I				
Taraxacum officinale			+	I	+-1	II	+	I	+-1	II		
Torilis arvensis					1	I						
Torilis japonica s.str.			+	III	+	I	+	I	+-2	I		
Typha latifolia									+	I		
Urtica dioica	+-2	V	+-2	V	1-2	V	+-3	V	+-3	III	+	II
Urtica urens	+	I										
Veronica hederifolia			+	I	1	I						
Veronica officinalis					1	I						
Vicia angustifolia ssp. segetalis	+	I										
Vicia cracca					1	I			+	I		
Vicia dumetorum			+	I								
Vicia sepium			+	I	+	I						
Vincetoxicum hirundinaria			+	I								
Viola cyanea							2	I				
Viola odorata							+-1	II				
Viola sylvestris	+-1	II	+-2	IV	1	I	+	I			+	IV

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Kv1: area of the Körös rivers	71 (AD)		Máthé 1936
Kv2: area of the Körös rivers	50 (AD)		Kevey (unpublished)
Ny1: Nyírség	23 (AD)		Soó 1943
Ny2: Western Nyírség	22 (AD)		Kevey & Papp L. (unpublished)
Ny3: Eastern Nyírség	53 (AD)		Kevey, Lendvai & Papp L. (unpublished)
Sz1: Szatmár plain	45 (AD)		Balázs 1943; Simon 1959; Bodrogközy (unpublished)
Sz2: Szatmár plain	5 (AD)		Kevey (unpublished)
Bg1: Bereg plain	24 (AD)		Simon 1959; Bodrogközy (unpublished)
Bg2: Bereg plain	36 (AD)		Kevey (unpublished)
Bk1: Bodrogköz	11 (AD)		Tuba (unpublished); Cserhalmi, Czóbel, Gál, Nagy J., Szerdahelyi, Szirmai, Tuba & Ürmös (unpublished)
Bk2: Bodrogköz	10 (AD)		Kevey (unpublished)
TP1: section of the Tisza between Tokaj and Polgár	30 (AD)		Ujvárosi 1940; Bodrogközy (unpublished)
TP2: section of the Tisza between Tokaj and Polgár	22 (AD)		Molnár Zs. 1996
Lt: Lakitelek	23 (AD)		Bodrogközy (unpublished); Horváth & Margóczi 1979; Bancsó 1987
Mv: area of the Maros river	3 (AD)		Margóczi (unpublished)

X. 3 *Circaeo-Carpinetum*

	Kv		Ny1		Ny2		Sz1		Sz2		Bg1		Bg2		Bk1		Bk2	
	A-D	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**
Upper canopy layer (A1)																		
Acer campestre			1	I	+-1	II	1-2	III	2	I			+-2	II	2-3	III	+-1	I
Acer platanoides	1	I			1	I									2-4	II		
Acer pseudo-platanus	1	I																
Betula pendula					+-1	II												
Carpinus betulus	1-3	II	1-3	V	+-5	V	1-5	V	1-4	V	2-4	V	1-4	IV	1-3	IV	3-5	V
Celtis occidentalis															2	I		
Cerasus avium			1	II	+-2	II	1-2	III			+	I	+-1	I				
Fagus sylvatica											+	I	1-3	I			+-1	II
Fraxinus angustifolia ssp. pannonica	+-3	IV	1	I	+-4	III					+	I	+-3	III	3	I	+-1	III
Fraxinus excelsior							1	I							1	I		
Fraxinus pennsylvanica			1	I	+	I												
Hedera helix	+	I			+	I							+	I				
Juglans nigra	+	I			1	I												
Loranthus europaeus					+	I							+	I				
Populus alba	2	I			+-3	I									2	I	1	I
Populus tremula					+-2	I	+	I										
Pyrus pyraster					+	I	1	I					+	I				
Quercus cerris	2-4	I			+-2	I					2	I						
Quercus robur	1-4	V	3	V	+-5	V	+-5	IV	2-4	V	1-4	V	2-5	V	1-3	II	1-4	V
Quercus rubra	+	I			1	I												
Robinia pseudo-acacia			+-1	II	+-1	I							+	I	1-2	II	+	I
Sorbus torminalis									+	II								
Tilia cordata			1	I	+-3	I									3	I	1-2	III
Tilia platyphyllos					1	I											+	I
Tilia tomentosa			1-2	IV	+-3	I							1	I				
Ulmus glabra							1-2	I										
Ulmus laevis	+	I			+-1	II							+	I	2	I	+	I
Ulmus minor					+	I	1-2	I			+-1	II	+	I	4	I	1	I
Viscum album					+	I												
Lower canopy layer (A2)																		
Acer campestre	+-2	III	+-3	V	+-3	IV			+-2	V	+-1	II	+-2	V	2	I	+-2	IV

Acer negundo	+	I																
Acer platanoides	+	I			+	I												
Acer pseudo-platanus	+-3	I																
Acer tataricum	+	I			+-2	II			+	II			+	I				
Alnus glutinosa													+	I				
Betula pendula					+	I												
Carpinus betulus	1-4	V	2-3	V	1-4	V	+-1	I	2-3	V	1-2	V	2-5	V			2-3	V
Celtis occidentalis																		
Cerasus avium			+	III	+-1	I							+	I			+	I
Clematis vitalba					+	I												
Cornus sanguinea					+	I											+	I
Corylus avellana					1	I											+	I
Crataegus monogyna	+	I			+	I												
Fagus sylvatica													1	I				
Fraxinus angustifolia ssp. pannonica	+-2	IV			+-2	II			+	I			+-1	I			+-1	II
Fraxinus pennsylvanica			1	I	+	I												
Hedera helix	+-1	I			+	I											+	I
Malus sylvestris					+	I							+	I			+	I
Padus avium																		
Populus alba	+	I			+	I												
Pyrus pyraster					+-1	I					+	I	+	I				
Quercus cerris	+	I																
Quercus robur	1	I			+	I							+-1	I			+	I
Robinia pseudo-acacia	+	I			+	I							+	I			+	I
Salix caprea					+	I												
Sorbus torminalis									+	I								
Tilia cordata					+-3	I							+	I			+-1	II
Tilia platyphyllos	+-1	I			+-1	I												
Tilia tomentosa	+-1	I	1-3	V	+-2	I							+	I				
Ulmus glabra					+	I												
Ulmus laevis			+	I	+-2	II							+-1	I			+	I
Ulmus minor	+-2	III	+	II	+-1	II			+	III			+-1	II			+	I
Vitis sylvestris					+	I												
Shrub layer (B1)																		
Acer campestre	+-3	III	+-2	V	+-3	V	+	I	+-2	V	+-1	V	+-4	IV	1-2	III	+-2	IV
Acer negundo					+	I												
Acer platanoides	+	II			+	I									+	I		

Acer pseudo-platanus	+	I	+	I	+	I												
Acer tataricum	+	I			+-3	III	+-1	II	+	III	+	I	+-1	I				
Carpinus betulus	+-4	V	+-1	V	+-3	V	+	I	+-2	V	+-1	IV	+-2	IV	+	I	+-1	II
Celtis occidentalis	+	I											+	I	+	II		
Cerasus avium					+	I					+	I						
Cornus mas	+	I			+-2	I			+	I								
Cornus sanguinea	+-1	II	1	I	+-2	III	+-2	IV	+	III	+-1	V	+-3	III	+	I	+-3	V
Corylus avellana					+-2	III	1-2	III	2	I	+	I	+	I			+-1	II
Crataegus monogyna	+-2	IV	+-2	III	+-2	IV	+-2	IV	+	II	+	II	+	II	+-1	I	+	I
Crataegus oxyacantha	+	I			+	I			+	III	+	II	+-1	II			+	I
Euonymus europaea	+	II			+	II	1-2	IV			+	III	+	I	+	I	+	II
Euonymus verrucosa					+	I	1	I										
Fagus sylvatica											+	I			+	I		
Fallopia dumetorum					+	I												
Frangula alnus	+	I	+	I	+	I	1	I					+	I	+	I		
Fraxinus angustifolia ssp. pannonica	+-3	IV	1	I	+-2	III			+-1	IV	+	I	+-1	II	2	I	+-2	IV
Fraxinus pennsylvanica	1	I	+	I	+	I												
Hedera helix	+	II			+	I			+	I			+	I				
Humulus lupulus					+	I												
Juglans nigra	+	I																
Juglans regia																		
Ligustrum vulgare	+	II	1	I	+-1	III	+-2	III	+	I	+-1	III						
Malus sylvestris	+	I			+	I												
Padus avium	+	I			+	I												
Padus serotina			+	II														
Philadelphus coronarius					+	I												
Populus alba					+	I	1	I										
Populus tremula					+	I	1	I			+	I						
Prunus spinosa	+	II			+	I	1	I			+	II						
Pyrus pyraster					+	I									1	I		
Quercus robur											+	I	+	I	+-1	II		
Quercus rubra	+	I																
Rhamnus catharticus					+	I	1	I										
Ribes rubrum					+	I												
Robinia pseudo-acacia	+	I	+	I	+	I					+	I			+-2	II		
Rosa canina agg.											+	I						
Salix caprea							1	I										

Salix cinerea							1	I										
Sambucus nigra	+-3	III	+-2	IV	+-2	II	1	I	+	I			+	I	+-2	III		
Sorbus torminalis									+	I								
Staphylea pinnata					+-4	I	1-2	I										
Tilia cordata					+-2	II	2	I					+	I	1	I	+-2	III
Tilia platyphyllos	+	I			+-2	I	1-2	II									+	I
Tilia tomentosa	+	I	1-3	III	+-2	I							+	I				
Ulmus glabra					+	I												
Ulmus laevis	+	I			+-2	I							+	I			+	I
Ulmus minor	+-2	IV	+	III	+-2	IV			+	III	+-1	III	+	II	+-1	II	+	III
Viburnum opulus	+	I			+-1	I	1	I										
Vitis sylvestris					+	I												
Saplings (B2)																		
Acer campestre	+-1	IV	+	V	+-1	V	+	I	+-1	V	+-1	III	+-1	V	+-3	II	+	V
Acer negundo					+	I									+	I		
Acer platanoides	+	II			+	I									+-3	II	+	II
Acer pseudo-platanus	+	II			+	I									+	I	+	II
Acer tataricum	+	II			+-1	III			+	V	+	I	+	II			+	I
Aesculus hippocastanum	+	I																
Ailanthus altissima																		
Carpinus betulus	+-2	V	+-1	V	+-1	V	+	I	+	V	+-1	IV	+-1	IV	+	I	+	III
Celtis occidentalis	+	I	+	I	+	I									+	I		
Cerasus avium	+	I	+	I	+-1	IV			+	II	+	I	+	III				
Clematis vitalba	+	I			+	I												
Cornus mas					+	I			+	II								
Cornus sanguinea	+	V	1	I	+-1	III	+	I	+	V	+	II	+-1	IV			+-1	V
Corylus avellana	+	I			+	II			+	II			+	I	+	I		
Crataegus monogyna	+	IV	+	III	+	IV	+	I	+	V	+	I	+	IV			+	IV
Crataegus oxyacantha	+	I							+	IV	+	II	+	IV			+	III
Euonymus europaea	+	IV	+	V	+-1	V	+	I	+	V	+	II	+	V	+-1	II	+	V
Euonymus verrucosa					+	I												
Fagus sylvatica													+	I				
Frangula alnus			+	I	+	II	+	I	+	II	+	I	+	I			+	III
Fraxinus angustifolia ssp. pannonica	+-2	V	+	I	+-2	IV			+	V	+	III	+	IV			+-2	V
Fraxinus excelsior															+	I		
Fraxinus pennsylvanica			+	I	+	I									+	I	+	II
Gleditsia triacanthos	+	I			+	I												

Hedera helix	+-3	II			+-2	III			+	III			+-1	II			+	IV
Juglans nigra	+	I	+	I	+	I											+	I
Juglans regia																		
Ligustrum vulgare	+-1	IV	+	I	+-1	IV			+	III	+	I	+	I	+-2	II		
Malus sylvestris	+	I			+	I			+	I			+	I				
Padus avium	+	I			+	I												
Padus serotina			+	III	+	I												
Parthenocissus quinquefolia	+	I			+	I			+	I							+	II
Populus alba	+	I			+	I									+	I	+	I
Populus tremula					+	I	+	I	+	I	+	I	+	I				
Prunus spinosa	+	III			+	I	+	I	+	III	+	I	+	I				
Pyrus pyraster	+	II			+	I			+	I			+	I				
Quercus cerris	+-1	III			+-1	I												
Quercus robur	+	III	+	V	+	IV	+	I	+	III	+-1	V	+	III	+	I	+	IV
Quercus rubra	+	I			+	I							+	I				
Rhamnus catharticus	+	II	+	I	+	II			+	I								
Ribes rubrum	+	I	+	I	+	I												
Robinia pseudo-acacia	+	I			+	II			+	II			+	I			+	III
Rosa canina agg.	+	I	+	I	+	I			+	III			+	I			+	I
Rubus caesius	+-1	V	+	I	+	III	+-1	I	+	V	+	III	+-2	IV	+	I	+	V
Rubus hirtus											+	I						
Sambucus nigra	+	IV	+	V	+	IV			+	III			+	II	1	I		
Sorbus torminalis									+	III								
Staphylea pinnata					+-1	I												
Stellaria media															1	I		
Syringa vulgaris	+	I																
Tilia cordata			+	I	+-1	II							+	I	+-1	I	+-2	IV
Tilia platyphyllos	+	I			+	I											+	I
Tilia tomentosa	+	I	+-1	V	+	II							+	I				
Ulmus glabra					+	I			+	I			+	I				
Ulmus laevis			+	I	+	II							+	I	+	I	+	II
Ulmus minor	+	IV	+	III	+-1	IV	+	I	+	V	+	I	+	IV			+	III
Viburnum opulus	+	I	+	I	+-1	III	+	I	+	I	+	I	+	I			+	V
Vitis sylvestris					+	I							+	I				
Vitis vulpina	+	I																
Herbaceous layer (C)																		
Achillea millefolium s.str.							1	I										

Actaea spicata					+	II	1	I										
Aegopodium podagraria					+-4	I	+-2	II	+-1	II	+	I	+-2	III	1	I	+-2	V
Aethusa cynapium			+	I	+	I												
Agrimonia eupatoria					+	I	+	I										
Agropyron caninum	+-2	III	+-1	V	+-1	II	1	I					+	I				
Agropyron repens							1	I										
Agrostis stolonifera							1-2	I										
Ajuga reptans	+-1	III			+-1	III	+-2	III	+	V	+-1	IV	+	V	+	I	+	V
Alliaria petiolata	+-1	III	+	IV	+-2	V	1	I	+	V			+-3	V	+	III	+	V
Allium oleraceum	+	I			+	I												
Allium scorodoprasum	+	II																
Allium ursinum					+-5	I												
Anemone nemorosa	+	I							2-3	V	+-2	III	+-5	III				
Anemone ranunculoides	+-1	II			+-1	I	1-2	II	+	V			+-3	III	1	I	+-1	III
Angelica sylvestris			+	I													+	II
Anthriscus cerefolium ssp. trichosperma	+	I	+	III	+	I												
Anthriscus sylvestris							1	I							+-1	III		
Arctium minus	+	III	+	II	+	III											+	II
Arctium tomentosum							+-1	I										
Aristolochia clematitis	+	III	+	I									+	I			+	II
Arum orientale	+	IV					1	I							+-2	II		
Asarum europaeum	+	I			+	I	+-2	I	+	II	1	I	+-1	III				
Astragalus glycyphyllos	+	I			+	I	2	I			+	I	+	I				
Athyrium filix-femina	+	I			+-1	II	1	I	+	II	+	I	+	I			+	III
Atriplex tatarica							1	I										
Ballota nigra	+	I	+	I	+	I												
Berteroa incana							1	I										
Betonica officinalis					+	I	1	I										
Brachypodium pinnatum															+	I		
Brachypodium sylvaticum	+-3	V	+-1	V	+-2	V	+-2	III	+	V	+	IV	+-1	V	+-1	II	+	III
Bromus commutatus							1	I										
Bromus ramosus agg.	+-1	IV	+	V	+-1	IV	1	I										
Calystegia sepium							1	I										
Campanula patula					+	I	1	I										
Campanula persicifolia					+	I												
Campanula trachelium					+	I	1	I									+	III
Cannabis sativa																		

Cardamine impatiens			+	I	+	I							+	II			+	V
Cardamine pratensis													+	I				
Carduus acanthoides							1	I										
Carduus crispus					+	I	1	I										
Carduus hamulosus							1	I										
Carex brizoides	+	I			+-2	I	+	I	+	III	+	I	+-1	IV			+	I
Carex divulsa	+-1	V	+	IV	+	II	1	I	+	II			+	I				
Carex hirta							+-1	I										
Carex michelii			+	I														
Carex montana							1	I										
Carex pairae	+	I			+	I	+	I			+-5	III						
Carex pallescens							1	II										
Carex pilosa					+-1	I	1-5	I			1-3	I	+-2	II			+	II
Carex remota					+	II	1-2	II			+	I					+	V
Carex spicata					+	I												
Carex sylvatica	+	III	+	III	+-1	IV	+-3	III	+	V	+-1	III	+	III			+	V
Centaurea indurata							1	I										
Centaurea pannonica							1	I										
Cephalanthera damasonium			+	I	+	I												
Cephalanthera longifolia	+	I	+	I														
Cephalaria pilosa																		
Cerastium fontanum							1	I										
Cerastium sylvaticum									+	II			+	I				
Chaerophyllum aromaticum					+	I												
Chaerophyllum bulbosum													+	I				
Chaerophyllum temulum	+	IV	+	V	+-2	IV	1	I	+	V			+-1	IV			+	II
Chelidonium majus	+	I	+	V	+	III							+	I	+-2	IV		
Circaea lutetiana	+-4	V	+	V	+-2	V	1	II	+-1	IV			+-2	V			1-2	V
Cirsium pannonicum							2	I										
Cirsium vulgare							1	I										
Clinopodium vulgare	+	II	+	I	+	I	1-2	I										
Colchicum autumnale					+	I												
Convallaria majalis					+-3	V	+-2	II	+	III	1-2	I	+-1	III			+-2	V
Corydalis cava	+-5	IV	1-3	V	+-3	II	1-4	III	+-5	IV					1-5	III	+-4	V
Corydalis solida	+	I	+-2	III	+-1	I	1	I									+-1	IV
Crocus heuffelianus									+-2	V			1-2	I				
Cruciata glabra							1-2	II	+-1	V								

Cruciata laevipes	+	I			+	I	1-2	I								
Cucubalus baccifer	+	IV	+	IV	+	III			+	II			+	I				
Cystopteris fragilis							1	I								
Dactylis glomerata agg.	+-2	V	+-1	V	+-1	III	+-4	IV	+	V	+	I	+	III	+	III	+	II
Dentaria bulbifera	+	I			+-5	III	1-3	II	+	I	+	I						
Deschampsia caespitosa			+	I	+	I	1	I	+	I	+	I	+	I				
Digitalis grandiflora					+	I												
Dryopteris carthusiana s.str.					+	II							+	I				
Dryopteris expansa									+	I								
Dryopteris filix-mas s.str.			+	I	+-1	IV	1	I	+	II	+	I	+	II				
Echinocystis lobata					+	I												
Epilobium angustifolium							1	I										
Epilobium hirsutum							1	I										
Epilobium montanum					+	I	1	I										
Epipactis helleborine agg.	+	I			+	III	+-1	I			+	I					+	I
Epipactis purpurata							1	I					+	I				
Equisetum arvense					+	I	1	I										
Erodium cicutarium															+	I		
Eupatorium cannabinum					+	I												
Euphorbia amygdaloides					+	I	+	I	+	II	+	I	+	II			+	III
Euphorbia salicifolia							1	I										
Fallopia dumetorum	+	II	+	V	+-1	IV			+	III	+	I	+	III			+-1	III
Festuca drymeia							1-4	I										
Festuca gigantea	+	IV	+	III	+	II	1-2	I	+	III			+	III			+	I
Ficaria verna	+-3	V	1-2	V	+-4	V	1-3	III	1-3	V			+-3	V	+-4	II	+-2	V
Fragaria vesca	+	I			+	II	+-2	II	+	II	+	III	+	I				
Fritillaria meleagris													+	I				
Gagea lutea	+	II					1	I	+-1	V			+-2	III			+	I
Gagea minima													+-1	II				
Gagea pratensis			+	IV	+	I												
Gagea spathacea							+	I	+-1	V			+-3	IV				
Galanthus nivalis							2	I			+-1	I	+-1	I				
Galega officinalis							1	I										
Galeobdolon luteum	+-2	I			1-2	I			2	I	1-2	I	1-4	II				
Galeopsis bifida	+	II			+	I							+	II				
Galeopsis pubescens			+	V	+	IV	1	I	+	II	+	I	+	I				
Galeopsis speciosa	+	I	+	II	+	I	1	II					+	I			+	III

Galium aparine	+-2	V	+	V	+-2	V	1-2	I	+	V	+-1	II	+	IV	+-2	IV	+	V
Galium mollugo					+	I	1	I							+	I		
Galium odoratum					+-4	III	+-5	IV	+-2	V	+-3	V	+-3	V	1	I	+-1	V
Galium palustre					+	I												
Galium rubioides					+	I												
Galium schultesii							+-2	I			+-1	I	+	I				
Galium verum							+-1	I										
Geranium phaeum							1	I										
Geranium robertianum	+	III	+	V	+-2	V	1-3	III	+	III	+	I	+	IV	1	I	+	II
Geum urbanum	+-1	V	+	V	+	V	+-2	IV	+	V	+	II	+	IV	+	II	+-1	IV
Gladiolus imbricatus							1	I										
Glechoma hederacea s.str.	+	I	+	V	+	II	1-2	II	+	II			+-2	III			+-2	V
Glechoma hirsuta					+	I	1-2	I										
Hedera helix							+-5	II			+	I						
Heracleum sphondylium					+	I	+-2	II	+	I	+	I	+	I				
Hieracium sabaudum agg.							1	I										
Hieracium umbellatum agg.							+	I			+	I						
Humulus lupulus					+	I	2	I										
Hypericum hirsutum	+	I			+	I	1	I										
Hypericum perforatum							1	II										
Impatiens noli-tangere					+-1	I	1	I	+	I			+-1	II				
Impatiens parviflora			+-2	V														
Inula britannica							2	I										
Isopyrum thalictroides					+-1	I	2	I	+	IV	+	I	+-3	I				
Knautia arvensis							1	I										
Lactuca quercina ssp. quercina	+	I																
Lactuca quercina ssp. sagittata					+	I												
Lamium album															+	I		
Lamium maculatum	+-2	II			+	I							+-1	II				
Lamium purpureum	+	I			+	I									+	I		
Lapsana communis	+	IV	+	III	+	IV	1	III					+	I			+	I
Lathraea squamaria					+	I			+	I	+	I	+	I				
Lathyrus niger							1	III			+	I						
Lathyrus pratensis							1-2	I										
Lathyrus vernus					+	I	+	I	+	V	+	I	+-1	III				
Leontodon hispidus							1	I										
Leonurus cardiaca			+	II	+	I												

Leucojum vernum											+-1	I	+-1	II				
Lilium martagon					+	II	1-2	I										
Listera ovata			+	I	+	II	1	I										
Lithospermum purpureo-coeruleum	1	I																
Luzula pilosa											+	I						
Lychnis flos-cuculi							+-1	I										
Lycopus exaltatus							+-1	I										
Lysimachia nummularia	+-1	II			+	II	+-2	III	+	II	+-1	II	+	I			+	II
Lysimachia vulgaris																	+	II
Majanthemum bifolium					+	I	+	I			+	II	+	I			+	III
Malva sylvestris							1	I										
Melampyrum bihariense							1-2	I										
Melampyrum nemorosum					+	I	+-1	I	+-1	III	+	I	+	I				
Melampyrum nemorosum ssp. debreceniense							1-2	I										
Melica altissima	+	I																
Melica picta					+	I												
Melica uniflora	+	I											1	I	1	I		
Melissa officinalis	+	I																
Melittis carpatica					+	I	1	I										
Mentha longifolia							1	I										
Mercurialis perennis					+-1	I			+-3	IV								
Milium effusum	+	II	+	II	+	IV	+-2	IV	+	I	+	I	+	IV			+	III
Moehringia trinervia	+	V	+	V	+-1	V	+-2	II	+	III	+	I	+	IV			+	V
Monotropa hypopitys							+	I			+	I						
Muscari botryoides							1	I										
Muscari comosum					+	I												
Mycelis muralis	+	I	1	I	+	IV	1	II			+	I						
Myosotis sparsiflora	+	I																
Myosoton aquaticum							1	I										
Neottia nidus-avis					+	I					+	I	+	I			+	I
Oenanthe banatica							1	I	+	III			+	III				
Orchis militaris					+	I												
Origanum vulgare							1	I										
Ornithogalum boucheanum			+	II	+	I									+-1	II		
Ornithogalum umbellatum			+-1	V	+	I												
Oxalis fontana													+	I				
Paris quadrifolia					+	I							+	I				

Peucedanum oreoselinum							1	I										
Phleum pratense							+-1	I										
Pimpinella saxifraga							1	I										
Plantago major							1	I										
Platanthera bifolia	+	II			+	I	+-1	II	+	I	+	I	+	II			+	II
Platanthera chlorantha					+	I												
Poa nemoralis			+	I	+	II	1-3	II					+	I	+	I		
Poa pratensis s.str.							1	I							+	I		
Polygonatum latifolium	+-1	V	+-1	V	+-3	II	1	II										
Polygonatum multiflorum			+	II	+-1	V	+-1	III	+-1	V	+-1	III	+-1	V	+-1	II	+-1	V
Polygonatum odoratum					+	I	1-2	II										
Potentilla alba							1	I										
Potentilla argentea s.str.							1-2	I										
Prunella vulgaris					+	I	1-2	I										
Pteridium aquilinum					+	I												
Pulicaria vulgaris							1	I										
Pulmonaria mollis					+	I	1	II							+-1	II		
Pulmonaria officinalis agg.	+-1	II			+-2	II	+-1	I	+	V	+-1	III	+-1	IV	+-1	I	+	IV
Ranunculus auricomus agg.	+	I			+	I	+-2	II	+	III	+	I	+	II			+	I
Ranunculus cassubicus					+	I	1	II									+	V
Ranunculus repens					+	I	1-2	II										
Ranunculus strigulosus							1	I										
Rumex crispus							1	I										
Rumex sanguineus	+	V			+	II	1	II	+	I			+	I			+	II
Salvia glutinosa			+-1	V	+-2	II												
Sambucus ebulus					+	I									+	I		
Sanicula europaea	+	I			+	II	+-1	II	1	I	+-2	II	+	I				
Scabiosa ochroleuca							1	I										
Scilla kladnii					+-1	I	1	I	+	IV			+-1	III				
Scilla vindobonensis	+	I																
Scrophularia nodosa	+	III			+	III	1	I	+	II			+	II			+	V
Scutellaria hastifolia							1	I										
Sedum maximum							1	I										
Senecio erraticus ssp. barbaraeifolius							+-1	I										
Serratula tinctoria							1	I										
Silene nutans							1	I										
Solanum dulcamara					+	I							+	I				

Solidago gigantea					+	I												
Sonchus arvensis							1	I										
Stachys sylvatica	+	III	+	IV	+-2	V	1-2	II	+	I	1	I	+	II			+	V
Stellaria holostea	+-3	II			+	I			+-1	III			+	I				
Stellaria media	+	I	+	I	+-1	II							+	I	+-4	IV		
Stenactis annua					+	I									+	I		
Symphytum tuberosum ssp. angustifolium					+	I	1	I										
Tamus communis					+	I												
Tanacetum vulgare							1	I										
Taraxacum officinale			+	I	+	I	+-1	I							+	I		
Thalictrum aquilegiifolium					+	I												
Torilis japonica s.str.	+	II	+	I	+	III					+	I	+	I			+	II
Trifolium pratense							1	I										
Trifolium repens							2	I										
Tussilago farfara							+-1	I										
Urtica dioica	+-2	IV	+-2	V	+-1	IV			+	II	+	I	+	III	+-2	IV	+	V
Veratrum album					+	I												
Veronica chamaedrys	+	II	+	II	+	II	1-2	III			+	I						
Veronica hederifolia	+-2	IV	+	V	+-1	II	1-2	I	+	V			+-1	IV				
Veronica montana													+	I				
Veronica officinalis					+	I												
Veronica triphyllos							1	I										
Vicia dumetorum	+	I			+	I											+	I
Vicia sepium							1	II										
Vinca minor	+-3	I			+-4	I	1-2	II			+	I	+-4	I				
Vincetoxicum hirundinaria	+	I			+	I	1	I	+	I			+	I				
Viola alba	+	I			+	I												
Viola cyanea	+-2	IV	+-1	I	+-3	I	1	II	+	II			+	I				
Viola elatior					+	I												
Viola hirta	+	I			+	I	1	I										
Viola mirabilis			+	I	+-2	III	1-2	III							2	I		
Viola montana					1	I												
Viola odorata							1	I					+	I	2-3	I		
Viola sylvestris	+-1	IV	+	IV	+-1	V	+-3	IV	+-1	V	+-4	V	+-2	V	+-3	IV	+-1	V
Viscaria vulgaris							1	I										

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Kv: area of the Körös rivers	20 (AD)		Kevey 2003; Kevey (unpublished)
Ny1:Western Nyírség	6 (AD)		Kevey, Papp (unpublished)
Ny2: Eastern Nyírség	56 (AD)		Kevey (unpublished); Kevey, Lendvai, Papp L. (unpublished); Kevey, Papp L. (unpublished)
Sz1: Szatmár plain	25 (AD)		Balázs 1943; Simon 1957
Sz2: Szatmár plain	7 (AD)		Kevey (unpublished)
Bg1: Bereg plain	11 (AD)		Simon 1957
Bg2: Bereg plain	32 (AD)		Kevey (unpublished); Papp M., Lesku (unpublished)
Bk1: Bodrogköz	11 (AD)		Tuba (unpublished).; Nagy J., Szerdahelyi, Czóbel, Szirmai, Gál, Cserhalmi (unpublished)
Bk2: Bodrogköz	11 (AD)		Kevey (unpublished)

XI.1 *Convallario-Quercetum roboris*

		Ny 1		Ny 2		Ny 3		Sz		Bg		Bk		Sv
	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K	A-D	K
Upper canopy layer (A1)														
Acer campestre	1-3	III	+	III	+-1	I	1-4	III	2	I				
Acer platanoides					2	I								
Betula pendula	1-4	I												
Carpinus betulus	1	I					1	I						
Cerasus avium	1	I	+	V	+-1	II	1	II						
Fraxinus angustifolia ssp. pannonica	1	I											1-4	III
Fraxinus pennsylvanica					1	I								
Loranthus europaeus	+	I	+	II	+	I								
Populus alba	1	I			1-2	I							1-3	I
Populus nigra	+	I									1	I		
Populus tremula	1	I												
Populus × canescens	+	I	+	I										
Pyrus pyraster	1	I			1	I	1	I			4	V		
Quercus cerris					1	I								
Quercus robur	1-5	V	4-5	V	3-5	V	1-5	V	4	V	1	III	2-5	V
Robinia pseudo-acacia	+	I	+	II	+	II	1	I						
Tilia cordata	+	I	+	I										
Tilia platyphyllos			+	I										
Tilia tomentosa	1-4	I	+	I	1	II								
Ulmus glabra	1	I					+	I						
Ulmus laevis	+	I	+	II	+	I					1	III		
Ulmus minor	1-2	III	+	III			1-2	III						
Viscum album	+	I												
Lower canopy layer (A2)														
Acer campestre					1-4	III			2-3	V			1	II
Acer platanoides					+-1	III								
Acer tataricum									1-2	IV			1	I
Celtis occidentalis					+-2	II								
Cerasus avium					+	II								
Crataegus monogyna					+	II								
Fraxinus angustifolia ssp. pannonica					+	I								

Fraxinus pennsylvanica					+-1	I			1	I	1	III		
Hedera helix					+	I								
Malus sylvestris	1	I			+	II			2	I				
Padus avium					1	I								
Padus serotina					+	I								
Pyrus pyraster					+-2	III			+-2	III	1	I		
Quercus robur					+-1	III					2	I		
Robinia pseudo-acacia					+	I								
Salix caprea	+	I												
Tilia cordata					+	I								
Tilia tomentosa					+-3	III								
Ulmus laevis					+-2	II								
Ulmus minor					+-2	V			1	I				
Shrub layer (B1)														
Acer campestre			+-2	III	+-3	V			+-2	IV				
Acer negundo					+	I								
Acer platanoides					+	III								
Acer pseudo-platanus			+	I	+	I								
Acer tataricum	1-2	II					1-2	V	+-2	V				
Berberis vulgaris	+	I												
Celtis occidentalis					+-2	III								
Cerasus avium			+-1	II	+	II								
Clematis vitalba	+	I												
Cornus mas	+	I	+	I										
Cornus sanguinea	+-1	III	+-2	III	+	II	1-2	III	+-2	IV	+	IV	1	I
Corylus avellana	1-3	III	+-2	II	+-4	III	1-3	V					2	I
Crataegus monogyna	1	IV	+-2	V	1-3	IV	1-3	IV	+-1	III			1-2	III
Crataegus oxyacantha							1	I	1	I	+	III		
Euonymus europaea	+-1	II			+	IV	1	III					1	I
Euonymus verrucosa	1	II					1	II						
Frangula alnus	1	II			+	I	1	III					1	I
Fraxinus angustifolia ssp. pannonica					+	I							1-2	III
Fraxinus pennsylvanica									+	I				
Hedera helix					+	I								
Humulus lupulus					+	I							1	I
Juglans regia					+	I								
Ligustrum vulgare	1-2	V			+-1	III	1-2	V					1-2	IV

Malus sylvestris			+	I	+	I					+	I	1	I
Padus avium	+	I			+-1	II								
Padus serotina			+	I	+-2	II								
Populus alba					+	I								
Populus tremula					+	I	1	I						
Prunus spinosa	+-1	II			+	II	1	I					1	I
Pyrus pyraster			+	I	+	I							1	I
Quercus robur											+	V	1-2	I
Rhamnus catharticus	1	I			+	I	1	I					1	I
Robinia pseudo-acacia			+-2	II	+	I								
Rosa canina agg.							1	I						
Rosa corymbifera s.str.	+	I												
Rosa gallica											+	I		
Rosa livescens													+	I
Sambucus nigra	1	II	+-3	IV	+-2	V	1	I	+-1	II			1	I
Staphylea pinnata	+	I					1-2	I						
Tilia tomentosa					+-1	III								
Ulmus laevis			+	III	+	II					+	IV		
Ulmus minor			+	III	+-1	V							1-2	II
Viburnum lantana											+	I		
Viburnum opulus	1	I			+	I	1	I					1	I
Vitis sylvestris													1	I
Saplings (B2)														
Acer campestre			+	II	+-1	V			+-1	V			+	II
Acer platanoides					+	III								
Acer pseudo-platanus			+	I	+	II								
Acer tataricum									+	II	+	I	+	I
Ailanthus altissima					+	I								
Carpinus betulus									+	III				
Celtis occidentalis					+	II								
Cerasus avium			+	II	+	III			+	I				
Cornus sanguinea			+	I	+	II			+-2	V	1	III		
Corylus avellana			+	I	+	III			+	I				
Crataegus monogyna			+	II	+	III			+	IV				
Euonymus europaea			+	IV	+-1	V								
Fraxinus pennsylvanica			+	I	+	I			+-1	II	2	III		
Gleditsia triacanthos					+	I								

Hedera helix	1	I			+-3	I								
Juglans nigra					+	II								
Juglans regia					+	I								
Ligustrum vulgare			+	I	+-2	IV			+	IV				
Padus avium					+	I								
Padus serotina			+	I	+	III								
Populus alba					+	I								
Prunus spinosa					+	I								
Pyrus pyraster					+	I			+	I				
Quercus robur			+	II	+	IV			+	III				
Quercus rubra					+	I								
Rhamnus catharticus					+	I			+	I				
Ribes rubrum					+	I								
Robinia pseudo-acacia			+	II	+	II								
Rosa canina agg.									+	I				
Rosa gallica							1	I						
Rubus caesius	1	II	+-2	I	+	II	1	III	1-2	IV	3	V	1	II
Sambucus nigra			+	IV	+	V								
Tilia tomentosa					+	III								
Ulmus laevis					+	I					+	III		
Ulmus minor			+	III	+-1	V			+	I				
Viburnum opulus			+	I	+	I								
Vitis vulpina											+	II		
Herbaceous layer (C)														
Achillea millefolium s.str.	+	I					1-2	III					1	I
Actaea spicata	+	I	+	I										
Aethusa cynapium	+	I	+	I	+	I							1	I
Agrimonia eupatoria	+	I					1	I					1	I
Agropyron caninum	1-2	III	+	III	+-1	V	1	II					1-2	III
Agropyron repens							2	I						
Agrostis capillaris							1-3	III						
Agrostis stolonifera													1	I
Ajuga genevensis	+	I											1	I
Ajuga reptans	+	I					1-2	III			+	II	1	II
Alliaria petiolata	1	III	+	IV	+	V	1	III	+	II			1	I
Allium oleraceum	1	I												
Allium scorodoprasum	+	I					1	I					1	II

Alopecurus pratensis							1	I					1	I
Alyssum montanum ssp. montanum	1	I												
Anemone ranunculoides	2	I			+-1	II	1-2	III					1	I
Angelica sylvestris	+	I							+	I	+	I	1	I
Anthoxanthum odoratum	1	I					1	I						
Anthriscus cerefolium ssp. trichosperma	+	I	+	I	+	I							1	I
Anthriscus sylvestris	+	I	+	I	+	III			+	II				
Arabis turrita													1	III
Arctium lappa	1	II	+	II									1	I
Arctium minus					+	IV								
Arctium nemorosum													1	I
Arctium tomentosum	+	I					1	I						
Aristolochia clematitis	+	I			+	I			+	I	1	II	1	I
Arrhenatherum elatius	+	I												
Artemisia campestris	+	I												
Artemisia pontica	+	I												
Artemisia vulgaris													1	I
Arum maculatum s.str.			+	I	+-1	III								
Arum orientale ssp. besseranum	1	II			+-1	II								
Asparagus officinalis	1	I											1	I
Asperugo procumbens	+	I												
Asplenium trichomanes	1	I												
Astragalus cicer	+	I												
Astragalus glycyphyllos	1	III	+	I	+	II	1-2	III					1-2	III
Athyrium filix-femina	1	I	+	II	+	I								
Ballota nigra	+	I			+	I								
Berteroa incana							1	I						
Betonica officinalis	1	I					1-2	II						
Brachypodium sylvaticum	1-2	IV	+-2	III	+-1	V	1	III	+-2	V			1-5	III
Bromus inermis	+	I											1	I
Bromus mollis							2	I						
Bromus ramosus agg.	1	I	+	I	+-1	III	1	I					1	I
Bromus sterilis	+	I	+	I			2	I					1	I
Bulbocodium versicolor	1-2	I												
Bupleurum affine													1	I
Campanula bononiensis	+	I											1	I
Campanula cervicaria	+	I					1	I						

Campanula glomerata	+	I												
Campanula patula	+	I	+	I			1	III	+	I				
Campanula persicifolia	+	I												
Campanula rapunculoides	+	I												
Campanula rapunculus	1	I												
Campanula rotundifolia s.str.	1	I												
Campanula trachelium													1	I
Cannabis sativa	+	I			+	I								
Cardamine impatiens	1	I											1	II
Carduus acanthoides							1	I						
Carduus crispus	1	I					1	I					1	II
Carex brizoides					+	I								
Carex caryophyllea	+	I												
Carex divulsa	+-1	II			+	IV	1	III					1	I
Carex gracilis											2	III		
Carex leporina							1	I						
Carex michelii	1	I												
Carex pairae	1	II					1	I					1	II
Carex pallescens	1	I					1	III						
Carex praecox	+	I					1	I						
Carex remota							1	II						
Carex spicata	1	II	+	I									1	I
Carex sylvatica			+	I	+	II	1	I					1-5	II
Carlina vulgaris	+	I					+	I						
Centaurea indurata	1	I					1	II						
Centaurea pannonica	+	I					1	III					1	I
Centaurea scabiosa s.str.	1	I												
Centaurea spinulosa	1	I												
Centaurea triumfetti	+	I												
Centaurium erythraea	1	I							+	I			1	I
Centaurium pulchellum	+	I					1	I						
Cephalanthera rubra	+	I												
Cephalaria pilosa	1	I			+	I							1	II
Cerastium fontanum	+	I												
Cerasus vulgaris ssp. acida							1	I						
Cerinthe minor	+	I												
Chaerophyllum bulbosum	+	I												

Chaerophyllum temulum	1	II	+-2	V	+	V	1	III					1-2	IV
Chamaecytisus albus							1	I						
Chamaecytisus ratisbonensis	1	I												
Chamaecytisus supinus ssp. pseudorochellii	+	I												
Chelidonium majus	1	II	+	III	+	IV								
Chrysanthemum leucanthemum agg.	1	I					1	I			+	I	1	I
Circaea lutetiana	1	II	+-1	V	+-1	IV	1-2	II	+-1	V			1-2	II
Cirsium arvense							1	II						
Cirsium pannonicum							2	I						
Cirsium vulgare	+	I					1	I						
Clematis recta	+	I												
Clinopodium vulgare	1	II	+	I	+	I	1	I	+	I			1	II
Cnidium dubium													1-2	I
Colchicum autumnale	1	I					1-2	II						
Conium maculatum	1	II												
Convallaria majalis	1-3	IV	+	I	+-1	II	1-4	III	+	II	4	V	1	I
Coronilla varia	+	I											1	I
Corydalis cava	3	I			+-4	II	2	I					1-5	III
Crepis setosa	+	I												
Crepis tectorum							1	I						
Crocus reticulatus	1	I												
Cruciata glabra	+	I	+	I			1-2	V						
Cruciata laevipes	1	II	+	I										
Cucubalus baccifer	1	I			+	V			+	I			1	II
Cuscuta europaea	+	I												
Cynoglossum hungaricum	1	I												
Cynosurus cristatus							1	I						
Cystopteris fragilis	1	I												
Dactylis glomerata s.str.	1	III					1-2	III					1	I
Dactylis polygama			+	III	+-1	IV	1	II	1	I				
Dentaria bulbifera							1	I						
Deschampsia caespitosa							1	II						
Dianthus armeria	1	I					1	I					1	I
Dianthus collinus ssp. glabriusculus	1	I					1	I					1	I
Dianthus pontederae	+	I												
Dictamnus albus	+	I												
Digitalis grandiflora	1	I					1	I						

Draba nemorosa	+	I												
Dryopteris carthusiana s.str.	1	I	+	I										
Dryopteris filix-mas s.str.	1	II	+	II			1	I						
Echinops sphaerocephalus	1	I												
Epilobium angustifolium	1	I												
Epilobium lanceolatum	+	I												
Epilobium montanum	+	I					1	I						
Epilobium obscurum							1	I						
Epilobium tetragonum							1	I						
Epipactis helleborine agg.	1	I									+	I	1	I
Equisetum arvense	+	I	+	I	+	I							1	I
Equisetum x moorei	1	I												
Erechtites hieraciifolia							1	I						
Erigeron canadensis	+	I					1	I						
Erodium cicutarium													1	I
Erophila verna s.str.	1-2	I											1-2	I
Eryngium planum							1-2	I						
Euphorbia angulata	+	I												
Euphorbia cyparissias	+	I	+	I									1	I
Euphorbia lucida							1	I			+	I		
Euphorbia platyphyllos													1	I
Euphorbia salicifolia	+	I												
Euphorbia villosa	+	I					1	I						
Fallopia dumetorum	1	II	+	III	+	V			+	I			1	I
Festuca gigantea	1	II	+	II	+	III	1	II	+-1	II			1-2	I
Festuca heterophylla							1	I						
Festuca pratensis							1	I						
Festuca rupicola	+	I					1-2	II						
Festuca valesiaca							1	I						
Ficaria verna	1-2	II			+-4	V	1-3	IV					1-3	III
Filipendula vulgaris	+	I												
Fragaria moschata	+	I												
Fragaria vesca	1	III	+	I	+	I	1-2	V					1	II
Gagea lutea							1	I					1	II
Gagea minima													1	I
Gagea pratensis	1	I			+	IV							1-2	III
Gagea pusilla	1	I												

Galega officinalis									+	I				
Galeopsis pubescens	1	II	+	II	+	V	1	I	+	I			1	II
Galeopsis speciosa			+-2	II	+	I	1-2	IV	+	I				
Galinsoga parviflora	+	I												
Galium aparine	1	III	+-2	V	+	V	1	III					1-3	III
Galium boreale	+	I												
Galium mollugo	1	II					1-2	IV						
Galium odoratum	1	I			+-1	I			1-2	V				
Galium palustre													1	I
Galium rubioides	+	I												
Galium verum							1-2	III						
Genista tinctoria ssp. elatior	1	I												
Genista tinctoria ssp. tinctoria							1-2	III						
Geranium divaricatum	+	I												
Geranium phaeum	1	I	+	I										
Geranium robertianum	1	III	+-1	V	+-1	V	1	II	+	I			1-2	IV
Geranium sanguineum	+	I					1-2	III						
Geum urbanum	1	V	+	IV	+-1	V	1-2	IV	+	IV			1	V
Gladiolus imbricatus							1	I						
Glechoma hederacea s.str.	1	IV	+	II	+	II	1-2	III	+-3	III	3	III	1-3	III
Glechoma hirsuta					+-2	III								
Gymnocarpium dryopteris	1	I												
Gypsophila muralis							1	I						
Heracleum sphondylium	1	I	+	I			1	I					1-2	I
Hieracium bauhinii agg.	+	I												
Hieracium caespitosum agg.	+	I												
Hieracium cymosum agg.	+	I												
Hieracium lachenalii agg.							1-2	I						
Hieracium pilosella agg.	+	I											1	I
Hieracium sabaudum agg.	+	I					1	II						
Hieracium umbellatum agg.	1	I												
Holcus lanatus	+	I					1	I						
Holosteum umbellatum	+	I											1	II
Humulus lupulus	+-1	III			+	III								
Hypericum hirsutum							1	III						
Hypericum perforatum	1	I					1-2	II	1	I			1	I
Hypericum tetrapterum							1	I						

Hypochoeris maculata	+	I												
Impatiens noli-tangere							1	I						
Impatiens parviflora			+-3	II	1-3	V								
Inula britannica							1	II					1	I
Inula hirta	+	I												
Inula salicina	1	I												
Iris aphylla ssp. hungarica	1	I												
Iris arenaria	+	I												
Isatis tinctoria	+	I												
Isopyrum thalictroides							2	I						
Juncus effusus							1	I	+	I				
Knautia arvensis	1	I					1	II						
Knautia drymeia							1	I						
Lactuca quercina ssp. quercina	+	I			+	I	+-1	II					1	II
Lactuca quercina ssp. sagittata	1	I											1	II
Lactuca serriola									+	I				
Lamium album	+	I											1	I
Lamium maculatum	+	I												
Lamium purpureum	+	I											1	I
Lapsana communis	1	II	+	I	+	III	1-2	III	+	III			1	III
Laserpitium prutenicum	+	I												
Lathraea squamaria							1	I						
Lathyrus niger	1	I					1	II						
Lathyrus pallescens	+	I												
Lathyrus pratensis	+	I					1	II					1	I
Lathyrus sylvestris	1	I												
Lavatera thuringiaca	+	I					1	I					1	I
Lembotropis nigricans	+	I					1	I						
Leontodon autumnalis							1	I						
Leontodon hispidus	+	I					1	II					1	I
Leonurus cardiaca	+-1	II	+	I	+	II								
Leonurus marrubiastrum											+	I	1	I
Lilium martagon					+	I								
Linaria vulgaris							1-2	II						
Listera ovata	+	I					1	I	+	II				
Lithospermum officinale	+	I												
Lithospermum purpureo-coeruleum	2-4	I					3	I						

Lotus corniculatus	+	I					1-2	I						
Luzula campestris	1	I					1	I					1	I
Luzula pallescens	1	I												
Lychnis coronaria	1	I												
Lychnis flos-cuculi							1	II					1	I
Lycopus europaeus									+	I	+	II		
Lycopus exaltatus							1	II						
Lysimachia nummularia	+	I	+	I			1-2	IV	+	II	1	II	1	II
Lysimachia vulgaris											+	II		
Majanthemum bifolium	+	I												
Malva sylvestris							1-2	II						
Melampyrum bihariense	+	I					1-2	II						
Melampyrum cristatum	+	I												
Melampyrum nemorosum	1	II			+	I			+	I				
Melandrium album	1	I	+	I	+	I	1	I						
Melica picta	+	I												
Mentha arvensis													1	I
Milium effusum	1-2	II	+	IV	+	II	1	III					1-2	II
Moehringia trinervia	1	III	+	I	+	V							1	II
Molinia coerulea	+	I												
Monotropa hypopitys	+	I												
Muscari botryoides	1	I					1	I						
Mycelis muralis	1	I			+	I	1	II					1	I
Myosotis arvensis	+	I											1	I
Myosotis caespitosa							1	I						
Myosotis sparsiflora	1	I	+	I	+	I	1	III						
Myosoton aquaticum	+	I	+	II										
Neottia nidus-avis	+	I					1	I					1	I
Nepeta cataria	+	I												
Nepeta pannonica	+	I												
Odontites vulgaris							1-2	II						
Oenanthe banatica							1-2	III						
Oenothera biennis	+	I											1	I
Ononis arvensis							+	I						
Ophioglossum vulgatum	+	I												
Origanum vulgare	1	II												
Ornithogalum boucheanum	+	I			+-1	V								

Ornithogalum umbellatum	1	I			+-1	III								
Orobanche ramosa	+	I												
Pastinaca sativa	+	I											1	I
Peucedanum alsaticum	+	I												
Peucedanum cervaria	+	I												
Peucedanum officinale							1	I						
Peucedanum oreoselinum	1	I					1	I						
Phleum pratense							1	I						
Phlomis tuberosa													1	I
Physalis alkekengi													1-2	I
Phytolacca americana					+	I								
Picris hieracioides							1	I						
Pimpinella saxifraga													1	I
Plantago major							1	II						
Platanthera bifolia	1	I					1	I						
Platanthera chlorantha	+	I					1	I					+	I
Poa nemoralis	1-4	III	+	I	+	III	1-5	V					1-5	IV
Poa palustris													1-2	II
Poa pratensis s.str.	1	I					1-2	III					1-2	II
Poa trivialis	+	I					1	II						
Polygala comosa	1	I												
Polygonatum latifolium	1-2	III	+	II	+-2	IV	1-2	II					1	I
Polygonatum multiflorum	1	III			+	III	1	III	+	IV				
Polygonatum odoratum	1	I			+	I	1	I					1	I
Polygonum hydropiper	+	I											1	I
Polygonum minus	+	I												
Polypodium vulgare	+	I												
Polystichum aculeatum	+	I												
Potentilla alba	1	I												
Potentilla argentea s.str.	+	I					1	I					1	I
Potentilla erecta							1	I						
Potentilla recta	+	I												
Potentilla reptans									+	I			1	I
Primula veris	1-2	I					1	I						
Prunella laciniata							1	I						
Prunella vulgaris	1	I					1-2	III	+-1	III			1	II
Pteridium aquilinum	1	I	+-2	I										

Pulmonaria mollis	1-2	IV			+	I	1	II					1	I
Pulmonaria officinalis s.str.							1	II					1-2	II
Pulsatilla pratensis ssp. hungarica	+-1	I												
Pyrola rotundifolia	+	I												
Ranunculus acris							1	I						
Ranunculus arvensis							1	I						
Ranunculus auricomus agg.	+	I					1	I					1	I
Ranunculus polyanthemos	1	I					1	I					1	I
Ranunculus repens							1-2	I						
Ranunculus strigulosus							1	II						
Rumex acetosa	+	I					2	I					1	I
Rumex crispus	+	I					1	I						
Rumex obtusifolius	+	I												
Rumex sanguineus	+	I			+	I	1-2	III					1	III
Sagina procumbens	+	I												
Salvia glutinosa	1-3	II	+-3	V	+-3	V								
Salvia pratensis	1	I												
Sambucus ebulus	+	I									+	II	1	I
Saponaria officinalis							1	I						
Saxifraga bulbifera	+	I												
Scabiosa ochroleuca							1	II						
Scilla kladnii	2	I												
Scilla vindobonensis					+-1	IV								
Scrophularia nodosa	1	I			+	I	1	II	+-1	II			1	I
Scutellaria galericulata							1	II			+	I		
Scutellaria hastifolia	1	I					1	I						
Sedum maximum	1	I			+	I	1	I						
Selinum carvifolia							1	II						
Senecio erraticus ssp. barbaraeifolius							1	III					1	I
Senecio erucifolius ssp. tenuifolius	1	I												
Senecio integrifolius	1	I												
Senecio jakobea	+	I												
Senecio nemorensis ssp. nemorensis	2	I											1-2	I
Serratula tinctoria	+	I					1	III						
Seseli annuum	+	I												
Silene nutans	1	I					1	I						
Silene vulgaris	1	I											1	II

Solanum dulcamara											+	II		
Solidago virga-aurea	+	I	+	I			1	I						
Stachys germanica	+	I												
Stachys sylvatica	1-2	III	+-2	V	+-1	V	1-2	III					1	II
Stellaria graminea	1	I					1	III						
Stellaria holostea	2	I												
Stellaria media	1	II	+	III	+-1	III	1	I					1	I
Stenactis annua	+	I					1	I	+	I				
Succisa pratensis							1	I						
Symphytum officinale	+	I									+	II	1	I
Symphytum tuberosum ssp. angustifolium							1	I						
Tanacetum vulgare							1	II						
Taraxacum officinale	+	I					1-2	II					1	I
Teucrium chamaedrys	+	I												
Thalictrum aquilegiifolium	1	II											1	I
Thalictrum lucidum	+	I												
Thalictrum minus	+	I	+	I										
Thalictrum simplex	+	I												
Thymus serpyllum	+	I												
Torilis arvensis													1	IV
Torilis japonica s.str.	1	II			+	I								
Tragopogon orientalis							1	I						
Trifolium alpestre	+	I					1	I						
Trifolium campestre	+	I											1	I
Trifolium diffusum	+	I												
Trifolium medium	1	I												
Trifolium montanum	+	I												
Trifolium ochroleucon							1	I						
Trifolium pratense	+	I												
Trifolium repens							1-2	II						
Turritis glabra	+	I											1	II
Urtica dioica	1	III	+-5	V	+-2	V	1-3	II			+	I	1	II
Valeriana officinalis s.str.	1	I					1	I					1	I
Valerianella locusta	+	I											1	I
Verbascum blattaria	+	I											1	I
Verbascum densiflorum	1	I												
Verbascum lychnitis	1	II												

Verbascum nigrum	+	I												
Verbascum phlomoides	+	I												
Verbascum phoeniceum	+	I												
Veronica austriaca s.str.	+	I												
Veronica chamaedrys	1	II	+	I	+	I	1-2	V					1	III
Veronica hederifolia	1	I			+-2	V	1-2	III					1	II
Veronica longifolia	1	I											1	I
Veronica officinalis	1	I												
Veronica orchidea	+	I											1	I
Veronica paniculata ssp. foliosa	+	I												
Veronica serpyllifolia	+	I					1	I						
Veronica spicata s.str.	+	I												
Veronica teucrium	+	I												
Vicia cassubica	+	I												
Vicia cracca	+	I											1	II
Vicia hirsuta	+	I												
Vicia lathyroides	+	I											1	I
Vicia pisiformis	1	I											1	II
Vicia sepium	1	II	+	I	+	I	1	III					1	II
Vicia tetrasperma	+	I					1	I					1	I
Vinca minor	1	I			4	I	1-4	III						
Vincetoxicum hirundinaria	1	I					1	I	+	I			1	I
Viola canina	+	I												
Viola cyanea	1	II	+	II	+-2	V	1	II	+	I			1-2	III
Viola elatior	+	I												
Viola hirta	1	I											1	II
Viola mirabilis	1	II			+	I	1	I						
Viola montana	1	I												
Viola odorata			+	II	+	I								
Viola riviniana	1-2	I					1	I						
Viola suavis	1	I												
Viola sylvestris	1	I			+	I	1	III					1-2	V
Viola tricolor	1	I											1	I
Viscaria vulgaris	1	I					1	I						

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Ny 1: Nyírség	24 (AD)		Soó 1943
Ny 2: Nyírség	15 (AD)		Horánszky 1998
Ny 3: Nyírség	12 (AD)		Kevey (unpublished).; Kevey & Papp L. (unpublished)
Sz: Szatmár plain	12 (AD)		Balázs 1943
Bg: Bereg plain	5 (AD)		Margóczi & Makra (unpublished)
Bk: Bodrogköz	5 (AD)		Tuba (unpublished)
Sv: area of the Sajó river	22 (AD)		Ujvárosi 1941

XI.2 *Galatello-Quercetum roboris*

	Tiszántúl1		Tiszántúl2		Újszentmargita		Bélmegyer		Körös-valley		altogether	
	A-D	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**	**A-D**	**K**
Upper canopy layer (A1)												
Acer campestre			1	I			+-2	I	1	I	+-2	I
Acer tataricum			2	I							2	I
Fraxinus angustifolia ssp. pannonica			2	I					1-2	II	1-2	I
Juglans nigra									1	I	1	I
Loranthus europaeus							+-2	I	+-1	I	+-2	I
Pyrus pyraster			1-2	II			1-5	II	1-2	II	1-5	II
Quercus cerris	+-3	III	2	I	1-3	II	3-4	I	1	I	+-4	II
Quercus petraea agg.	+-2	I			+-2	I					+-2	I
Quercus pubescens	+-2	I	1	I							+-2	I
Quercus robur	2-4	V	2-4	III	2-4	V	1-5	III	1-3	V	1-5	V
Ulmus minor			+	I	+-2	I	+-3	I			+-3	I
Lower canopy layer (A2)												
Acer campestre	+-2	II			2	I			+-2	III	+-2	I
Acer pseudo-platanus									+	I	+	I
Acer tataricum	1-4	IV	+	I	1-4	III					+-4	I
Crataegus monogyna					1	I	+-2	I	1	I	+-2	I
Elaeagnus angustifolia									+	I	+	I
Fraxinus angustifolia ssp. pannonica					1	I			+-2	III	+-2	I
Malus sylvestris					+	I			+	I	+	I
Prunus spinosa					+	I	1-2	I	-	-	+-2	I
Pyrus pyraster	1-2	IV	1-2	I	+-2	III			+-3	IV	+-3	III
Quercus cerris	+-3	III	2	I					2	I	+-3	I
Quercus petraea agg.	+-2	I									+-2	I
Quercus pubescens	2	I	1	I							1-2	I
Quercus robur			3-5	II					1-3	IV	1-5	II
Rhamnus catharticus					+	I					+	I
Robinia pseudo-acacia					1	I					1	I
Ulmus minor	+-3	II	1	I	2-4	I			+-3	III	+-4	II
shrub layer (B1)												
Acer campestre	+-2	III	+-1	II	+-1	I	+	I	+-1	IV	+-2	II
Acer platanoides									+	I	+	I

Acer pseudo-platanus							+	I	+	I	+	I
Acer tataricum	+-2	V	+-3	IV	+-2	III			+-1	I	+-3	II
Amygdalus nana	+	I									+	I
Bryonia alba									+	I	+	I
Cerasus fruticosa	+	I			+	I					+	I
Cornus sanguinea	+-2	I	1	I			+	I	+-2	II	+-2	I
Crataegus monogyna	+-2	V	+-3	V	+-2	IV	+-3	IV	+-3	V	+-3	V
Elaeagnus angustifolia									+	I	+	I
Euonymus europaea	+	III	+	III	+-1	I	+-2	II	+	I	+-2	II
Frangula alnus							+-1	I	-	-	+-1	I
Fraxinus angustifolia ssp. pannonica			+	I	+	I			+-3	II	+-3	I
Humulus lupulus									+	I	+	I
Ligustrum vulgare	+-4	V	1-2	IV	+-4	IV	+-2	II	+-1	II	+-4	III
Malus sylvestris			+	I							+	I
Padus serotina			+	I							+	I
Prunus spinosa	+-3	IV	+-3	V	+-3	III	1-5	IV	+-5	V	+-5	V
Pyrus pyraster	2	IV	+-1	III	+-1	II	+-1	I	+-2	V	+-2	IV
Quercus cerris	+-1	I	+	I	+	I	+-1	I	+	II	+-1	I
Quercus pubescens	+-2	I									+-2	I
Quercus robur	+	I	1	I	+-1	I	+	II	+	III	+-1	II
Rhamnus catharticus	+	II	+	I	+	I			+	II	+	II
Rosa canina agg.	+-1	II	+	III	+-1	III	+-2	II	+	V	+-2	IV
Rubus caesius					-	-	-	-	+	I	+	I
Sambucus nigra					+	I	+-2	I	+-1	II	+-2	I
Solanum dulcamara									+	I	+	I
Ulmus glabra							+	I			+	I
Ulmus minor	+-3	II	+-2	II	+-2	II	+-2	II	+-2	IV	+-3	III
Saplings (B2)												
Acer campestre			+	II	+-1	I	+-1	II	+-1	IV	+-1	II
Acer platanoides									+	I	+	I
Acer pseudo-platanus									+	I	+	I
Acer tataricum			+-2	IV	+-2	V			+	II	+-2	II
Clematis vitalba									+	I	+	I
Cornus sanguinea			+	I					+	II	+	I
Crataegus monogyna			+-1	IV	+	II	+-2	II	+	V	+-2	III
Euonymus europaea			+-2	IV	+	III	+-2	I	+	IV	+-2	II
Frangula alnus							+	I			+	I

Fraxinus angustifolia ssp. pannonica			+	I					+-2	III	+-2	II
Fraxinus pennsylvanica									+	I	+	I
Hedera helix			1	I							1	I
Ligustrum vulgare			+-2	IV	+	I	+-1	I	+	II	+-2	II
Prunus spinosa			+-2	IV	+-1	I	+-2	II	+-2	V	+-2	III
Pyrus pyraster			+	II	+	II	+-1	I	+	V	+-1	III
Quercus cerris			+	I	+	I			+	II	+	I
Quercus robur			+	II	+	III	+	I	+	V	+	III
Rhamnus catharticus			+	I	+	I	+	I	+	IV	+	II
Robinia pseudo-acacia					+	I	+	I			+	I
Rosa canina agg.					+	II	+	I	+	III	+	II
Rosa gallica	+	II	1	I	+	I					+-1	I
Rubus caesius									+-1	IV	+-1	II
Rubus fruticosus agg.					+	I			-	-	+	I
Sambucus nigra			+	II	+	I	+	II	+	I	+	I
Ulmus glabra							+	I	-	-	+	I
Ulmus laevis									+	I	+	I
Ulmus minor			2	I	+-2	I	+-1	I	+-1	V	+-2	II
Vitis sylvestris					+	I					+	I
Herbaceous layer (C)												
Achillea collina			+	I							+	I
Achillea millefolium s.str.					+	I	+-1	I	+	I	+-1	I
Achillea pannonica					+	I	-	-	+-1	V	+-1	II
Achillea setacea			+	I			+-2	II			+-2	I
Agrimonia eupatoria									+-1	IV	+-1	II
Agropyron caninum	+-2	II	+	II	1-2	I			+	II	+-2	I
Agropyron repens	+	II	+-2	V	1-4	II	1-3	II	+-1	V	+-4	IV
Agrostis stolonifera			+	I	+	I			+	I	+	I
Ajuga genevensis			+	II	+	I			+	II	+	I
Ajuga reptans									+	I	+	I
Alliaria petiolata	+-3	III	+	III	+-3	III			+-1	V	+-1	II
Allium oleraceum									+	I	+	I
Allium scorodoprasum									+-1	III	+-1	I
Allium vineale							+-1	I	+	III	+-1	I
Alopecurus pratensis	+-4	III	+-2	IV	1-5	III	+-2	II	+-1	V	+-5	V
Amaranthus deflexus					+	I					+	I
Ambrosia artemisiifolia									+	I	+	I

Anthoxanthum odoratum			+	I							+	I
Anthriscus cerefolium ssp. trichosperma			+	II					+-1	II	+-1	I
Anthriscus sylvestris			+	I							+	I
Arabidopsis thaliana									+	I	+	I
Arctium lappa			+	I	+	II			+	I	+	I
Arctium minus									+	II	+	I
Aristolochia clematitis									+	I	+	I
Arrhenatherum elatius									+	I	+	I
Artemisia pontica	1	II	+	II	+-1	I	+-1	I	+	III	+-1	III
Artemisia santonicum					+	I			+	III	+	I
Artemisia vulgaris									+	I	+	I
Arum orientale ssp. besseranum			+	I	+-1	I	+	I	+	I	+	I
Asparagus officinalis	+	III	+	II	+	I			+	II	+	II
Asperugo procumbens									+	I	+	I
Aster linosyris	+	II									+	I
Aster sedifolius	+-1	III	+	III	+-1	III	+-2	II	+-2	V	+-2	V
Astragalus glycyphyllos	+	III	+	III	+	III	+-1	I	+	IV	+-1	III
Atriplex oblongifolia							+-2	I	-	-	+-2	I
Ballota nigra			+	II	+-1	I	+-3	I	+-1	IV	+-3	II
Betonica officinalis	+-1	II	+	II	+	I	+	I			+-1	II
Brachypodium pinnatum	+	I									+	I
Brachypodium sylvaticum	+-2	III	+	III	+-1	II	+-2	II	+	III	+-2	II
Bromus commutatus									+	II	+	I
Bromus inermis			+-1	II					+	II	+-1	I
Bromus ramosus agg.			-	-					+	I	+	I
Bromus sterilis			+	I					+-1	III	+-1	I
Bryonia alba			-	-					+	I	+	I
Calamagrostis epigeios			+-2	II	+	I			+	II	+-2	I
Calystegia sepium							+-2	IV	-	-	+-2	I
Campanula glomerata									+	I	+	I
Campanula macrostachya			+	I					-	-	+	I
Campanula rapunculus					+	I			+	I	+	I
Capsella bursa-pastoris									+	I	+	I
Cardaria draba									+	II	+	I
Carduus acanthoides									+	II	+	I
Carduus crispus			+	I					+	III	+	II

Carex acutiformis			+	I							+	I
Carex distans									+	I	+	I
Carex divulsa			+-1	II	+-3	IV			+	I	+-1	I
Carex elata			-	-			+	I			+	I
Carex melanostachya			+-1	III					+-2	IV	+-2	II
Carex pairae	+-2	III	-	-							+-2	I
Carex pallescens			-	-					+	I	+	I
Carex praecox			+	II	+	I			+-1	II	+-1	I
Carex spicata									+	IV	+	II
Carex tomentosa	+	I							+	I	+	I
Carex vulpina			+	I			2-3	II			+-3	I
Centaurea jacea s.str.			+	I	+	I			+	IV	+	II
Centaurea pannonica	+-1	III					+-1	I			+-1	I
Centaurea scabiosa agg.					+-1	I					+-1	I
Centaurea triumfetti					+	I					+	I
Centaurium pulchellum									+	I	+	I
Cerastium brachypetalum									+	I	+	I
Chaerophyllum bulbosum					+	I			+	I	+	I
Chaerophyllum temulum			+	I					+	I	+	I
Chenopodium album			+	I	+	I	+-1	II	+	IV	+-1	II
Chenopodium hybridum			+	I			+-2	I	+	I	+-2	I
Cichorium intybus							+-1	II	+	I	+-1	I
Circaea lutetiana									+	I	+	I
Cirsium arvense							+	I	+	III	+	II
Cirsium vulgare									+	III	+	I
Clinopodium vulgare	+	III	+	I	+-1	II	+-1	I	+	III	+-1	II
Conium maculatum					+	I			+	I	+	I
Consolida regalis									+	I	+	I
Convolvulus arvensis							1	I	+	III	+-1	I
Corydalis cava	+-4	II	+-1	I					+	I	+-4	I
Cruciata glabra			-	-			+	I			+	I
Cruciata laevipes			1	I					+	III	+-1	I
Cruciata pedemontana			+	I					+	I	+	I
Cucubalus baccifer			+	II			+-1	II	+	IV	+-1	II
Cuscuta epithymum ssp. kotschyi							+	I	+	I	+	I
Cuscuta europaea							+	I			+	I
Cuscuta trifolii									+	I	+	I

Cynoglossum officinale									+	I	+	I
Dactylis glomerata s.str.	+-2	IV	+-1	IV	+-3	IV			+	II	+-3	III
Dactylis polygama									+	II	+	I
Daucus carota ssp. carota							+-1	I	+	I	+-1	I
Dianthus armeria					+	I	+	I	+	I	+	I
Dianthus pontederae			+	I	+	I					+	I
Dipsacus laciniatus									+	II	+	I
Doronicum hungaricum	+-2	III	+-1	II	+-2	III					+-2	II
Echinops sphaerocephalus									+	I	+	I
Epilobium tetragonum									+	I	+	I
Erigeron canadensis			+	I					+	I	+	I
Eryngium campestre			+	I	+	I	+-1	I	+	III	+-1	II
Euphorbia cyparissias	+	II	+	II	+-1	II	+	II	+	II	+-1	II
Euphorbia palustris									+	I	+	I
Euphorbia virgata			+	I			1	I	+	II	+-1	I
Falcaria vulgaris							+	I	+	I	+	I
Fallopia dumetorum	+-1	IV	+	III	+-1	III			+	IV	+-1	III
Festuca pratensis							2-4	II			2-4	I
Festuca pseudovina			+	III	+-1	I	1	I	+	I	+-1	I
Festuca rubra s.str.									+	I	+	I
Festuca rupicola (incl. F. valesiaca)	3	III	1	I	+-4	II	2	I	+-1	IV	+-4	III
Ficaria verna	+-2	IV	+-1	IV	+-4	II	+	II	+-2	II	+-2	III
Filipendula vulgaris	+	II	+-1	III	+	I	1	I	+	II	+-1	II
Fragaria vesca									+	III	+	I
Fragaria viridis			+	I			+-2	III	+-1	V	+-2	III
Fumaria schleicheri									+	I	+	I
Gagea pratensis									+	I	+	I
Galeopsis bifida									+	I	+	I
Galeopsis pubescens	+-1	II									+-1	I
Galeopsis speciosa					1	I					1	I
Galium aparine	+-2	III	+-1	V	+-2	III	1-2	II	+-1	IV	+-2	III
Galium mollugo	+-1	III	+	II	+-1	II	+-2	I	+	III	+-2	II
Galium palustre					+	I					+	I
Galium rubioides									+	I	+	I
Galium verum	+-1	II	+	III	+-1	I	+-2	II	+-2	V	+-2	IV
Geranium columbinum							+	I			+	I
Geranium robertianum	+-2	III	+	I	+-3	I	+	III	+	I	+-2	II

Geum urbanum	+-1	IV	+	IV	+-1	IV	+-2	IV	+-1	V	+-2	IV
Glechoma hederacea s.l.	+	I			+	I			+-2	III	+-2	II
Gypsophila muralis							+	I	+	II	+	I
Heracleum sphondylium	+	I									+	I
Hesperis sylvestris									+	I	+	I
Hieracium auriculoides agg.			+	I							+	I
Hieracium bauhinii agg.					+	I			+	I	+	I
Hieracium pilosella agg.					+	I					+	I
Hieracium umbellatum agg.			+	II	+	I					+	I
Humulus lupulus									+	I	+	I
Hypericum hirsutum									+	I	+	I
Hypericum perforatum	+	I			+	I	+	I	+	III	+	II
Hypericum tetrapterum	-	-							+	I	+	I
Inula britannica	-	-					+	I	+	III	+	I
Inula salicina	+-2	III	+-1	II	+-1	I	-	-	+-1	II	+-2	II
Iris spuria			+	I			1-2	I	+	III	+-2	II
Juncus compressus									+	II	+	I
Juncus conglomeratus			+	I							+	I
Juncus gerardii									+	I	+	I
Lactuca perennis			+	I							+	I
Lactuca quercina ssp. quercina	+	III	+	I	+	II					+	I
Lactuca serriola									+	II	+	I
Lamium album							+	I			+	I
Lamium purpureum			+-1	IV	+	I	+-2	IV	+-1	III	+-2	III
Lapsana communis	+	III	+	III	+-2	II	+-1	II	+	II	+-2	II
Lathyrus hirsutus									+	I	+	I
Lathyrus niger			+	I							+	I
Lathyrus pratensis			+	I	+	I					+	I
Lathyrus sylvestris									+	I	+	I
Lathyrus tuberosus									+	II	+	I
Lavatera thuringiaca									+	I	+	I
Leonurus cardiaca			+	I	+	I	+	II	+-1	III	+-1	II
Leonurus marrubiastrum									+	II	+	I
Limonium gmelinii ssp. hungaricum	+	II	+	I	+	I	+-1	I	+	IV	+-1	III
Linaria vulgaris							+-1	I	+	I	+-1	I
Lithospermum arvense									+	I	+	I
Lithospermum officinale					+	I			+	I	+	I

Lithospermum purpureo-coeruleum	+	I	+-1	I			2-3	II	+-1	III	+-3	II
Lotus angustissimus			+	I							+	I
Lotus corniculatus					+	I	+-2	II	+	I	+-2	I
Luzula campestris			+	I							+	I
Luzula multiflora			+	I							+	I
Lychnis flos-cuculi					+	I			+	II	+	I
Lycopus exaltatus									+	III	+	I
Lysimachia nummularia			+	I			+-2	II	+	III	+-2	II
Lysimachia vulgaris					+	I					+	I
Lythrum salicaria									+	I	+	I
Lythrum virgatum									+	I	+	I
Matricaria maritima ssp. inodora					+	I					+	I
Medicago falcata									+	I	+	I
Melampyrum cristatum	+	II	+	II	+	I					+	II
Melampyrum nemorosum			2-3	I							2-3	I
Melandrium album			+	I	+	II	+	I	+	III	+	II
Melandrium noctiflorum									+	I	+	I
Melandrium viscosum					+	I					+	I
Melica altissima	+-1	III	+	I	1	I	+	I	+	I	+-1	I
Melica transsilvanica									+	I	+	I
Melilotus albus									+	I	+	I
Mentha aquatica									+	I	+	I
Moehringia trinervia			+	I	+-2	II			+	I	+	I
Myosotis arvensis									+	I	+	I
Myosotis ramosissima									+	III	+	I
Myosotis sparsiflora							1	I	+	II	+	I
Myosotis stricta					+	I					+	I
Myosoton aquaticum					+	I			+	I	+	I
Nepeta pannonica	+	I									+	I
Odontites vulgaris							+	I	+	I	+	I
Onopordum acantium									+	I	+	I
Orchis morio					+	I					+	I
Ornithogalum orthophyllum	+	II			+	I					+	I
Ornithogalum umbellatum			+	IV					+	III	+	II
Pastinaca sativa							+	I	+	I	+	I
Peucedanum alsaticum	+	II	+	II	+	II			+	III	+	III
Peucedanum officinale	+-2	III	+	IV	+-4	III	+-2	II	+-1	V	+-4	IV

Phlomis tuberosa	+	I									+	I
Phragmites australis			+-1	II	+-2	III	+-1	I	1-2	I	+-2	II
Picris hieracioides									+	I	+	I
Pimpinella saxifraga									+	III	+	I
Plantago lanceolata							+	I			+	I
Plantago major									+	I	+	I
Poa angustifolia	+-2	IV	2	I	+-1	I					1-2	I
Poa annua							+-1	I			+-1	I
Poa bulbosa			+	I							+	I
Poa compressa			+	I							+	I
Poa nemoralis	+-4	III	+-1	II	+-4	IV					+-4	I
Poa palustris					+	I			+	I	+	I
Poa pratensis s.str.			+-2	IV	+-4	III	1-4	II	+-3	V	+-4	IV
Poa trivialis			1	I					+-1	V	+-1	II
Podospermum canum			+	I							+	I
Polygonatum latifolium	+-4	IV	+-1	III	+-2	III	+-2	III	+	I	+-4	II
Polygonum hydropiper									+	I	+	I
Potentilla argentea s.str.					+	I					+	I
Potentilla impolita									+-2	II	+-2	I
Potentilla leucopolitana					+	I					+	I
Potentilla recta									+	I	+	I
Potentilla reptans									+	I	+	I
Prunella vulgaris									+	I	+	I
Pulmonaria mollis	+-1	III	+	II	+-1	II					+-1	I
Pulmonaria officinalis s.str.							+	I			+	I
Ranunculus acris			+	I							+	I
Ranunculus pedatus					+	I					+	I
Ranunculus polyanthemos	+	II			+	I	+	I	+	IV	+	III
Ranunculus repens									+	I	+	I
Rumex acetosa			+	I					+	I	+	I
Rumex conglomeratus							+	I			+	I
Rumex crispus									+	IV	+	II
Rumex patientia									+	I	+	I
Rumex pseudonatronatus									+	I	+	I
Rumex sanguineus					+	I			+	III	+	I
Salvia nemorosa									+	I	+	I
Saxifraga bulbifera			+	I	+	I					+	I

Scilla vindobonensis	+-3	II	1	I	1-3	I			+	I	+-3	I
Scrophularia nodosa	+	II	+	II	+	II					+	I
Scutellaria hastifolia			+	II	+	I			+	I	+	I
Sedum maximum	+	I	+	III	+	I			+	I	+	I
Senecio erraticus ssp. barbaraeifolius					+	I			+	I	+	I
Senecio erucifolius ssp. tenuifolius									+	I	+	I
Serratula tinctoria	+-2	III	+	V	+-1	III	+-1	I	+-1	IV	+-2	IV
Sisymbrium strictissimum	+	I									+	I
Solanum dulcamara									+	I	+	I
Sonchus oleraceus							+	I			+	I
Stachys annua									+	I	+	I
Stachys germanica							+	I	+	I	+	I
Stachys recta							-	-	+	I	+	I
Stellaria graminea	+	II	+	II	+	I	+	II	+-1	III	+-1	II
Stellaria media			+-4	IV	+-2	II	1-2	II	+-1	IV	+-4	III
Stenactis annua									+	II	+	I
Symphytum officinale									+-1	I	+-1	I
Tanacetum vulgare					+	I			+	II	+	I
Taraxacum officinale			+	I	+	II			+	I	+	I
Thalictrum lucidum									+	I	+	I
Thlaspi perfoliatum									+	I	+	I
Thymus pannonicus							+	I	+	I	+	I
Tordylium maximum									+	I	+	I
Torilis japonica s.str.					+	I			+	II	+	I
Trinia ramosissima	+	I							+	I	+	I
Urtica dioica			+	I	+	I	+-2	IV	+-2	IV	+-2	III
Valerianella locusta									+	IV	+	II
Ventenata dubia			+	I							+	I
Verbascum blattaria			-	-					+	I	+	I
Verbascum phoeniceum	+	I	+	I	+	I					+	I
Veronica anagallis-aquatica									+	I	+	I
Veronica chamaedrys	+	I	+	II	+	I	+-2	II	+	III	+-2	II
Veronica hederifolia	+-1	III	+-1	III	+-1	I			+-1	V	+-1	III
Veronica longifolia					+	II					+	I
Veronica officinalis			+	I							+	I
Veronica praecox									+	I	+	I

Veronica serpyllifolia									+	I	+	I
Veronica spicata s.str.			+	I			+	I	+	II	+	I
Vicia cracca			+	I	+	I			+	III	+	II
Vicia hirsuta							+	I	+	I	+	I
Vicia pisiformis					+	I					+	I
Vicia sepium					+	I					+	I
Vicia tenuifolia							+	I			+	I
Vicia tetrasperma									+	I	+	I
Vincetoxicum hirundinaria	+-1	II	+-1	II	+-1	I			+	I	+-1	I
Viola arvensis							+-1	I	+	I	+-1	I
Viola cyanea	+-3	IV	+-1	III	+-3	IV	1-2	IV	+-2	V	+-3	IV
Viola hirta									+	IV	+	II
Viola montana									+	I	+	I
Viola odorata			+-3	II	+	I	+	I			+-3	I
Viola riviniana	+-1	II			+	I					+-1	I
Viscaria vulgaris	1	II	+	III	+-1	II					+-1	II

locality of the stands	**number of the relevés and the sampling methods**	**date of survey**	**informants**
Tiszántúl1: Kerecsend, Mezőcsát, Ohat, Újszentmargita	20 (AD)		Zólyomi, Tallós 1967
Tiszántúl2: Újszentmargita, Ohat, Hencida, Bélmegyer	10 (AD)		Molnár Zs. (unpublished)
Újszentmargita	20 (AD)		Tallós, Tóth 1968
Bélmegyer	30 (AD)		Molnár A. 1989
Körös-valley: Bélmegyer, Gyula	20 (AD)		Kevey (unpublished)

XII.1 *Fraxino pannonicaea-Alnetum*

total number of the stands: 10	north-eastern border - Tokaj	north-eastern border - Tokaj	Lake -Tisza	Szolnok - southern border	Szolnok - southern border	Kraszna	
number of the relevés: 10 (AD) + 61 (%) = 71	**average cover (%)**	**range of the AD values**	**AD**	**average cover (%)**	**range of the AD values**	**AD**	**K**
Upper canopy layer (A1)							
Alnus glutinosa	41.80	3	4		+-4	1	III
Fraxinus angustifolia ssp. pannonica	14.00	4				3	II
Fraxinus excelsior		1-3					I
Fraxinus pennsylvanica	6.60				+		I
Populus alba			2				I
Salix alba		1	2			1	II
Salix fragilis						1	I
Lower canopy layer (A2)							
Alnus glutinosa						2	I
Fraxinus angustifolia ssp. pannonica		2				1	I
Fraxinus pennsylvanica		1					I
Salix alba		+				1	I
Salix fragilis						1	I
Upper shrub layer (B1)							
Alnus glutinosa	5.04					+	I
Amorpha fruticosa			1				I
Cornus sanguinea	0.004						I
Frangula alnus	0.04	+				+	II
Fraxinus angustifolia ssp. pannonica	2.10	2				+	I
Fraxinus excelsior		+					I
Fraxinus pennsylvanica	7.00	2					I
Prunus spinosa	0.02						I
Quercus robur		+					I
Salix cinerea		1	1		+	2	II
Solanum dulcamara						+	I
Ulmus laevis	0.30						I
Ulmus minor		+					I

Lower shrub layer (B2)							
Alnus glutinosa							I
Calystegia sepium	0.20						I
Frangula alnus		+					I
Fraxinus angustifolia ssp. pannonica		+					I
Fraxinus pennsylvanica		1					I
Prunus spinosa							I
Quercus robur		+					I
Rubus caesius		+				+	I
Salix cinerea		+					I
Viburnum opulus						+	I
Herbaceous layer (C)							
Acer campestre	0.002						I
Acer negundo				0.53			II
Agrostis alba		+		8.18			I
Agrostis sp.					1		I
Alisma plantago-aquatica				0.12		+	II
Allaria petiolata				0.002			I
Alnus glutinosa	0.04			0.004			II
Alopecurus pratensis		+-2					I
Amorpha fruticosa				0.02			I
Angelica sylvestris				0.35	+		I
Ballota nigra				0.02			I
Bidens tripartitus				1.38	+	+	III
Bolboschoenus maritimus			+				I
Brachypodium sylvaticum	0.42			0.20			I
Calystegia sepium		+	1		1	1	III
Cardamine amara				0.06			I
Cardamine pratensis		+					I
Carex acutiformis		2	1			2	II
Carex appropinquata	0.02						I
Carex cuprina						+	I
Carex gracilis		1			2		I
Carex pseudocyperus				1.68			II
Carex riparia	52.00	2				3	II
Carex vesicaria						2	I
Carex vulpina		1					I

Chenopodium polyspermum	0.002						I
Circaea lutetiana				0.11			I
Clinopodium vulgare	0.10						I
Convallaria majalis		+-1					I
Convolvulus arvensis				0.002			I
Cornus sanguinea				0.04			I
Dryopteris carthusiana		+-1					I
Echinocystis lobata				0.04			I
Epilobium lanceolatum		+					I
Epilobium parviflorum			+				I
Epilobium tetragonum		+					I
Equisetum arvense			2				I
Equisetum fluviatile					+-1		I
Equisetum palustre				0.52			I
Eupatorium cannabinum				0.41	+-1	+	III
Euphorbia palustris		+					I
Fallopia convolvulus	0.20						I
Fallopia dumetorum		+					I
Festuca gigantea	0.02						I
Fraxinus angustifolia	12.60			1.63			II
Fraxinus pennsylvanica	11.40			0.84			II
Galium aparine	0.004			0.99	2		III
Galium boreale	0.60						I
Galium palustre	0.04	2	1	0.35		1	III
Galium rotundifolium	0.02						I
Geranium robertianum				0.20			II
Geum urbanum				0.12			II
Glechoma hederacea	10.60		1	4.09			II
Glyceria maxima	0.34	2	1			2	II
Hottonia palustris				0.07			I
Humulus lupulus	0.02		+				I
Impatiens noli-tangere		1-5				+	I
Iris pseudacorus		+		0.06	+-1		III
Lamium purpureum				0.002			I
Lapsana communis				0.04			I
Leersia orisoides		+	+	1.69	1		II
Lemna minor		+				+	I

Lycopus europeus	0.26	+	1	3.56	1-2	+	IV
Lycopus exaltatus				0.12			I
Lysimachia nummularia			1	0.61			II
Lysimachia vulgaris		+		0.06	+	+	II
Lythrum salicaria	0.002	+	+	0.004	2	+	III
Lythrum virgatum				0.02			I
Mentha aquatica				4.42			II
Mentha arvensis			1				I
Miosotis palustris				0.04			I
Moehringia trinervia		2-4					I
moss	0.20						I
Myosoton aquaticum	0.10			1.54	1		III
Oenanthe aquatica	0.004	+				+	II
Peucedanum palustre	0.20						I
Phalaris arundinacea		+					I
Phragmites australis					+		I
Poa palustris	0.00	+					I
Poa sp.					1		II
Poa trivialis		+		0.33			I
Polygonatum latifolium	0.002						I
Polygonatum multiflorum		1					I
Polygonum hydropiper		2				1	I
Polygonum lapathifolium			1				I
Polygonum mite				1.24			II
Populus alba			+				I
Ranunculus auricomus		+					I
Ranunculus repens	0.002	+	2	0.93			III
Robinia pseudo-acatia				0.02			I
Rubus caesius	1.00	+-1	1	0.04			II
Rumex hydrolapathum				0.72			II
Rumex sanguineus				0.01			I
Salix alba			1				I
Sambucus nigra				0.43			I
Schrophularia nodosa				0.04			I
Scutellaria galericulata				0.02			I
Sium erectum				0.86			I
Sium latifolium				0.61		+	II

Solanum dulcamara	0.02	+	1	1.11	3	1	IV
Solanum nigrum				0.002			I
Solidago gigantea			2				I
Sparganium erectum	0.002	+		1.15		1	III
Stachys palustris	1.92	1					I
Stellaria media				0.61			I
Stenactis strigosa				0.97			I
Symphytum officinale	3.42	1	+	0.56	+-1	1	IV
Tanacetum vulgare			1				I
Teucrium scoridum						1	I
Thalictrum flavum					+		I
Thelipteris palustris				0.02	4		II
Thypha angustifolia				0.004			I
Torylis japonica				0.43			I
Typha latifolia				0.22		+	II
Ulmus laevis	0.002						I
Urtica dioica	0.21	+		2.63	+-1		IV
Urtica kioviensis				0.16	3		II
Urtica urens	0.22						I
Valeriana officinalis					1		I
Vitis riparia				0.07			I

locality of the stands	number of the relevés and the sampling methods	date of survey	informants
Tisza from the north-eastern border to Tokaj			
Dámóci-erdő, Dámóc	5 (%)	October 2006	Nagy János et al. (in Gál et al., 2006)
Dusa-hát, Márokpapi	1 (AD)	June 2004	Balázs Kevey (unpublished)
Bockerek-forest, Gelénes	5 (AD)	1950	Tibor Simon (Simon, 1950)
Lake -Tisza			
Abádszalók cestion no.: 153	1 (AD)	August 1989	Mihály Vas, Zoltán Tuba (Vas, Tuba 1989)
Tisza from Szolnok to the southern border			
Tőserdő, Tiszaalpár	28 (%)	August 1987	Sándor Bancsó (Bancsó, 1987)
Tőserdő, Tiszaalpár	21 (%)	August 1987	Sándor Bancsó (Bancsó, 1987)
Tőserdő, Tiszaalpár	7 (%)	August 1987	Sándor Bancsó (Bancsó, 1987)
Tiszaalpár	1 (AD)	October 1962	György Bodrogközy (unpublished)
Tőserdő, Tiszaalpár	1 (AD)	October 1962	György Bodrogközy (unpublished)
Kraszna			
Vadaskerti-erdő, Tiborszállás	1 (AD)	June 2004	Balázs Kevey (unpublished)