DRAINED ASH SWAMP (*VERATRO ALBI-FRAXINETUM ANGUSTIFOLIAE*), A NEW ASSOCIATION IN THE NYÍRSÉG, NE HUNGARY

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This paper presents the phytosociological description of a drained swamp community, *Veratro albi-Fraxinetum angustifoliae*, so far found only in the Nyírség at Nyírábrány “Kiskőrises”, “Mogyorósi-erdő”; Vámospércs “Jónásrész-Kőrises”; and Vámospércs “Jónásrész-Buzita”. The habitat of the community is transitional between that of alder swamps (*Fraxino pannonicae-Alnetum glutinosae*), and hardwood riparian forests (*Fraxino pannonicae-Ulmetum*). The community is characterised by high proportions of character species of *Alnion glutinosae* and *Molinion coerulei* as well as *Quercetea pubescentis-petraeae* s. l., whereas character species of the order *Fagetalia* are almost completely absent. It hosts several rare, often threatened species, such as *Angelica palustris*, *Ophioglossum vulgatum*, *Trollius europaeus* and *Veratrum album*.

Key words: ash swamp, Great Hungarian Plain, Natura 2000, nature reserve, syntaxonomy

INTRODUCTION

Hardwood riparian forests have been the subject of our long-term research on the distribution, composition and geographical variation of the forest vegetation in Hungary. Hardwood riparian forests still occur in most lowland areas of Hungary under different environmental conditions and thus are particularly suitable for studying phytosociological differentiation and biogeographical relationships in the forest vegetation within the Carpathian Basin. During our work in the Nyírség, an extensive area in the northeastern part of Hungary covered with eolic sand, we found several *Fraxinus angustifolia* dominated forest stands that seemed to be different from all known forest communities described previously in the country (Figs 1–2). No similar forest community is known to exist in the European vegetation either (Braun-Blanquet 1964, Ellenberg 1986, Horvat 1938, Horvat *et al.* 1974, Mucina *et al.* 1993, Oberdorfer 1992a, b, Rodwell *et al.* 2002, Willner and Grabherr 2007a, b).

Because their species composition appeared to be substantially different from that of the *Fraxino pannonicae-Ulmetum* Soó in Aszód 1935 corr. Soó

1963, a community once widely distributed in similarly moist habitats across the country, and *Fraxino pannonicae-Alnetum* Soó et Járαι-Komlódi in Járαι-Komlódi 1958, we described it as a novel association under the name *Veratro albi-Fraxinetum angustifoliae* Kevey et Papp L. (Kevey 2008).

Unfortunately, this association has not been described in more detail, nor has a synoptic table of it been published since then. Here we are going to fill this gap by providing a detailed description of the community based on our sample material of ten relevés. Our primary goal is to substantiate the split of this new association from the rest of the hardwood riparian forests found in Hungary.

MATERIAL AND METHODS

Research area

The studied *Fraxinus angustifolia* dominated stands were found in four different forest areas in the Nyírség: the Mogyorósi-erdő and Kis-kőrises near the town of Nyírábrány, and the Jónásrész-Kőrises and Jónásrész-Buzita near the village of Nyírac nád. The stands were all found along the edge of local

Fig. 1. *Veratro albi-Fraxinetum angustifoliae*: Vámospéracs "Jónásrész" with *Veratrum album* in the foreground (photo: L. Papp)

depressions where the habitat is characterised by high groundwater levels, which rises above the ground surface only in very wet periods. They either grow at the fringe of genuine alder swamps (*Fraxino pannonicae-Alnetum*) in the deepest parts of local depressions, or form the transition zone between these swamps and oak-ash-elm forests (*Fraxino pannonicae-Ulmetum*) growing on higher ground (Fig. 3). Since the ground is normally not covered with water throughout most of the vegetative period in their habitats, the soil contains only small amounts of peat that is generally decaying.

The three studied forest areas are all parts of the Natura 2000 network, and are also protected by national law. The Jónásrészt “Kőrises” and “Buzita”, and “Kis-kőrises” are state reserves, whereas the “Mogyorósi-erdő” is under strict protection.

Methods

Our sampling procedure followed the traditional quadrat method of the Zürich-Montpellier phytosociological school (Becking 1957, Braun-Blanquet 1964). Sample plots were designated visually by selecting the parts of a stand that seemed to be the most homogeneous in habitat characteristics,

Fig. 2. *Veratro albi-Fraxinetum angustifoliae*: Vámospércs “Jónásrészt” with *Trollius europaeus* in the herb layer (photo: L. Papp)

vegetation structure and species composition, and showed no signs of human impact (including forest management). Because the traditionally used 400 m² plot size does not satisfy the requirement for minimal area (see Du Rietz 1921), our sample plots were 1600 m² in size except for one (1200 m²). This size suffices the requirement of representativity in temperate deciduous forests (Kevey 2008).

Because forests in similarly mesic habitats tend to exhibit large phenological changes during the vegetative period, we sampled each stand twice (spring and summer) using the same plots. During sampling, we recorded all species within the sample quadrat and estimated their projected cover. We also estimated the height of each vegetation layer, and the trunk diameter of trees.

The raw data were compiled and arranged in a synoptic table by the NS software program (Kevey and Hirmann 2002), which also was used to calculate constancy values of each species, and proportions of species characteristic of a particular syntaxon. To assess the syntaxonomic relationship of the studied stands, we compared them to a representative material of the spatially adjacent *Fraxino pannonicae-Alnetum* and *Fraxino pannonicae-Ulmetum*, and all previously described communities growing in similar habitats in Hungary: *Ophioglosso-Betuletum pubescentis* (Vértesszőlő: Riezing and Szollát 2008–2009: 6 relevés); *Molinio-Alnetum glutinosae* (Tengelici-homokvidék: Kevey 2008: 20 relevés); *Molinio-Salicetum cinereae* (Szigetköz: Kevey 2008: 25 relevés). In doing so, we performed pairwise comparisons between sample sets and deter-

Fig. 3. Vegetation diagram of the "Mogyorósi-erdő" at Nyírábrány. 1 = *Calamagrostio-Salicetum cinereae*; 2 = *Carici elatae-Salicetum albae*; 3 = *Fraxino pannonicae-Alnetum glutinosae*; 4 = *Veratro albi-Fraxinetum angustifoliae*; 5: *Fraxino pannonicae-Ulmetum*. (Kevey original)

mined the set of differential species (species that differed in their constancy value by at least two steps) and the proportions of character species. We also carried out binary cluster and principal coordinates analyses (PCoA) with the help of the Syntax 2000 package (Podani 2001). The method of grouping in the cluster analyses was complete link, and the similarity coefficient in both types of analyses was that of Baroni-Urbani and Buser.

The names of plants and syntaxonomic categories follow the nomenclature of Király (2009) and that of Borhidi and Kevey (1996), Borhidi *et al.* (2012), and Kevey (2008), respectively. Designation of species as character species of phytosociological taxa is primarily adopted from Soó (1964, 1966, 1968, 1970, 1973, 1980) with some modifications based on more recent literature (see Borhidi 1993, 1995, Horváth *et al.* 1995) and our own research experience (Kevey ined.).

The order of syntaxa in the synoptic and statistical tables follows the modified syntaxonomic system of Soó (1980) according to the suggestions and results of Borhidi *et al.* (2012), Kevey (2008), Mucina *et al.* (1993) and Oberdorfer (1992a, b).

RESULTS

Physiognomy and structure

In the studied stands, the forest canopy was structured into two distinct layers. The upper layer was situated at about 20–28 m height and was rather dense with high (60–80%) projected cover. The most abundant (A–D: 3–4) tree species in this layer were *Fraxinus angustifolia* subsp. *danubialis* and *Populus alba*. They were also constant species across the samples.

The lower canopy layer was at the height of 12–20 m. The projected cover was rather variable among samples. It was made up of mostly tree-sized shrubs and young individuals of trees. The most abundant species in this layer was *Fraxinus angustifolia* subsp. *danubialis*.

Shrubs in the samples were 1.5–3.5 m tall, and formed a moderately dense layer with 25–70% cover value. It was composed of *Cornus sanguinea*, *Crataegus monogyna*, *Frangula alnus*, *Fraxinus angustifolia* subsp. *danubialis*, and *Ligustrum vulgare*. Only *Cornus sanguinea* and *Ligustrum vulgare* had rather high cover values. The layer of saplings was greatly variable in projected cover (1–50%).

All samples had an apparent herbaceous layer, which greatly varied in cover (35–85%). The most frequent species include *Angelica sylvestris*, *Brachypodium sylvaticum*, *Cucubalus baccifer*, *Filipendula ulmaria*, *Geranium palustre*, *Listera ovata*, *Lychnis flos-cuculi*, *Lysimachia nummularia*, *Moehringia trinervia*, *Poa trivialis*, *Scrophularia nodosa*, *Valeriana officinalis*, *Veratrum album*. Only two species (*Brachypodium sylvaticum* and *Convallaria majalis*) were locally abundant at places (Table 1).

Table 1
Veratro albi-Fraxinetum angustifoliae

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
1. Querco-Fagea													
1.1. Salicetea purpureae													
1.1.1. Salicetalia purpureae													
1.1.1.1. Salicion albae													
<i>Cucubalus baccifer</i> (Cal,Ulm)	C	+	+	-	+	+	+	+	+	-	+	IV	70
<i>Salix fragilis</i> (Ai,Cal)	A1	+	-	2	-	-	-	1	+	-	+2	II	40
	A2	-	-	1	-	-	-	-	-	-	1	I	10
	S	+	-	2	-	-	-	1	+	-	+2	II	40
<i>Humulus lupulus</i> (Cal,Ate,Ai)	B1	-	-	+	-	-	-	-	-	-	+	I	10
	C	-	-	+	-	-	-	-	+	+	+	II	30
	S	-	-	+	-	-	-	-	+	+	+	II	30
1.2. Alnetea glutinosae													
1.2.1. Alnetalia glutinosae													
<i>Betula pubescens</i> (Qr,PQ)	A2	-	-	+	-	-	-	-	-	-	+	I	10
1.2.1.1. Alnion glutinosae													
<i>Angelica palustris</i>	C	-	-	+	-	+	+	+	-	-	+	II	40
<i>Calamagrostis canescens</i> (Pte)	C	-	-	-	-	-	-	-	+	-	+	I	10
1.3. Querco-Fagetea													
<i>Brachypodium sylvaticum</i> (Qpp)	C	3	3	2	3	2	4	2	3	3	2-5	V	100

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Cornus sanguinea</i> (Qpp)	B1	2	1	2	3	3	2	2	3	2	1-3	V	100
	B2	+	+	1	2	+	2	+	1	+	+2	V	100
	S	2	1	2	4	3	2	3	3	2	1-4	V	100
<i>Crataegus monogyna</i> (Qpp)	A2	+	+	-	-	-	-	-	-	2	+2	II	30
	B1	2	2	+	-	1	+	+	+	+	+2	V	90
	B2	+	+	+	+	+	+	+	+	+	+	V	100
	S	2	2	+	+	1	+	+	+	2	+2	V	100
<i>Geum urbanum</i> (Epa,Cp,Qpp)	C	+	+	+	+	+	+	+	+	+	+	V	100
<i>Ligustrum vulgare</i> (Cp,Qpp)	B1	+	+	+	2	2	2	2	1	3	+3	V	100
	B2	+	+	1	1	+	1	1	1	2	+2	V	100
	S	+	+	1	2	2	2	1	2	4	+4	V	100
<i>Euonymus europaeus</i> (Qpp)	B1	-	+	-	+	+	-	+	-	+	+	III	50
	B2	-	-	+	+	-	+	+	+	+	+	III	60
	S	-	+	+	+	+	+	+	+	+	+	V	90
<i>Rhamnus catharticus</i> (Qpp,Pru)	A2	-	-	-	-	+	-	-	-	-	+	I	10
	B1	-	-	-	+	+	+	-	+	+	+	III	50
	B2	+	+	+	+	+	+	-	+	+	+	V	90
	S	+	+	+	+	1	+	-	+	+	+1	V	90
<i>Scrophularia nodosa</i> (GA,Epa)	C	+	-	+	+	+	+	+	+	+	+	V	90
<i>Quercus robur</i> (Ai,Cp,Qpp)	A1	-	-	-	1	1	2	-	-	2	1-2	II	40
	A2	-	-	+	-	-	-	-	-	+	+	I	20
	B1	-	-	-	-	-	+	-	-	-	+	I	10

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Quercus robur</i> (Ai,Cp,Qpp)	B2	-	+	+	-	-	+	+	+	-	+	III	50
	S	-	+	+	1	1	2	+	+	2	+2	IV	80
<i>Ulmus minor</i> (Ai,Ulm,Qpp)	A2	1	1	2	-	-	+	1	-	1	+2	III	60
	B1	+	+	2	-	-	+	+	-	2	+2	III	60
	B2	+	+	+	-	+	+	+	-	+	+	IV	70
	S	1	1	3	-	+	1	1	-	2	+3	IV	70
<i>Corylus avellana</i> (Qpp)	A2	1	1	-	-	-	-	-	-	-	1	I	20
	B1	2	+	+	-	-	-	1	-	+	+2	III	50
	B2	+	+	+	+	-	-	+	-	+	+	III	60
	S	2	1	+	+	-	-	1	-	+	+2	III	60
<i>Dactylis polygama</i> (Qpp,Cp)	C	+	1	+	+	-	-	-	+	1	+1	III	60
<i>Geranium robertianum</i> (Epa)	C	+	+	1	-	-	-	-	+	+	+1	III	60
<i>Veronica chamaedrys</i> (Qpp,Ara)	C	-	-	-	+	+	+	+	+	-	+	III	60
<i>Convallaria majalis</i> (Qpp)	C	3	4	+	-	-	-	4	-	1	+4	III	50
<i>Populus tremula</i> (Qr,Qc,Ber)	A1	+	-	-	-	-	-	-	1	-	+1	I	20
	A2	1	-	+	-	-	-	-	-	-	+1	I	20
	B1	+	-	-	-	+	-	-	-	-	+	I	20
	B2	-	-	+	-	-	-	-	+	+	+	II	30
	S	1	-	+	-	+	-	-	1	+	+1	III	50
<i>Ajuga reptans</i> (MoA)	C	-	-	-	+	1	1	1	-	-	+1	II	40
<i>Campanula trachelium</i> (Epa,Cp)	C	+	1	1	+	-	-	-	-	-	+1	II	40

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Carex spicata</i> (Qpp,Epa)	C	-	+	+	-	-	+	-	+	-	+	II	40
<i>Heracleum sphondylium</i> (Qpp,Moa)	C	+	+	+	-	-	-	-	-	-	+	II	40
<i>Polygonatum latifolium</i> (Qpp)	C	+	+	-	-	-	-	-	+	+	+	II	40
<i>Cruciata glabra</i>	C	+	+	-	-	-	-	-	-	-	+	II	30
<i>Ranunculus auricomus</i> agg. (Moa)	C	-	-	-	-	-	+	+	-	+	+	II	30
<i>Carex divulsa</i>	C	-	-	-	-	-	-	+	-	+	+	I	20
<i>Fragaria vesca</i> (Qpp,Epa)	C	-	-	-	+	-	-	-	+	-	+	I	20
<i>Galeopsis pubescens</i> (Qpp,Epa)	C	-	-	-	+	-	-	-	+	-	+	I	20
<i>Veronica hederifolia</i> subsp. <i>luorum</i>	C	-	+	-	-	-	-	-	-	-	+	I	20
<i>Acer campestre</i> (Qpp)	A2	1	-	-	-	-	-	-	-	-	1	I	10
	B1	+	-	-	-	-	-	-	-	-	+	I	10
	B2	+	-	-	-	-	-	-	-	-	+	I	10
	S	1	-	-	-	-	-	-	-	-	1	I	10
<i>Cephalanthera damasonium</i> (Qpp)	C	-	-	-	+	-	-	-	-	-	+	I	10
<i>Cephalanthera longifolia</i>	C	-	-	-	+	-	-	-	-	-	+	I	10
<i>Lapsana communis</i> (Qpp,GA,Epa)	C	+	-	-	-	-	-	-	-	-	+	I	10
<i>Mycelis muralis</i>	C	-	-	-	+	-	-	-	-	-	+	I	10
<i>Platanthera bifolia</i> (Qpp,PQ,NC,Moa)	C	-	-	-	+	-	-	-	-	-	+	I	10
<i>Poa nemoralis</i> (Qpp)	C	+	-	-	-	-	-	-	-	-	+	I	10
<i>Vicia sepium</i> (Ara,Qpp)	C	-	-	-	-	-	+	-	-	-	+	I	10
<i>Viola mirabilis</i> (F,Qpp)	C	+	-	-	-	-	-	-	-	-	+	I	10

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
1.3.1. Fagetalia sylvaticae													
<i>Listera ovata</i> (Ate,Ai)	C	-	+	+	-	+	+	+	+	+	+	IV	80
<i>Moehringia trinervia</i>	C	+	+	+	-	+	-	+	-	+	+	IV	70
<i>Carex sylvatica</i>	C	1	1	+	+	-	-	-	-	-	+1	II	40
<i>Stachys sylvatica</i> (Epa)	C	+	1	+	+	-	-	-	-	-	+1	II	40
<i>Circaea lutetiana</i> (Ai)	C	-	+	+	+	-	-	-	-	-	+	II	30
<i>Milium effusum</i>	C	+	+	-	-	-	-	-	-	-	+	I	20
<i>Aegopodium podagraria</i> (Ai,Cp)	C	+	-	-	-	-	-	-	-	-	+	I	10
<i>Cardamine bulbifera</i>	C	-	-	+	-	-	-	-	-	-	+	I	10
<i>Carpinus betulus</i> (Cp)	B2	-	-	-	+	-	-	-	-	-	+	I	10
<i>Epipactis helleborine</i> agg.	C	-	-	-	+	-	-	-	-	-	+	I	10
<i>Galeopsis speciosa</i> (Epn,Ai)	C	-	-	-	-	-	-	+	-	-	+	I	10
<i>Polygonatum multiflorum</i> (QFt)	C	+	-	-	-	-	-	-	-	-	+	I	10
1.3.1.1. Alnion incanae													
<i>Fraxinus angustifolia</i> subsp. <i>danubialis</i> (Ate)	A1	4	4	3	3	4	4	4	4	2	2-4	V	100
	A2	2	3	3	2	3	2	2	2	2	2-3	V	100
	B1	1	-	2	1	1	2	2	1	+	+2	V	90
	B2	1	-	+	2	2	2	1	2	2	+2	V	90
	S	5	5	5	4	5	5	5	5	3	3-5	V	100
<i>Populus alba</i> (Sal,AQ)	A1	1	2	2	1	2	1	1	2	3	1-3	V	100
	A2	-	-	1	1	-	-	-	-	+	+1	II	30

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Populus alba</i> (SaI, AQ)	B1	+	-	-	-	-	-	-	-	+	+	I	20
	B2	+	-	+	-	+	+	+	+	+	+	IV	80
	S	1	2	2	2	1	1	1	2	3	1-3	V	100
<i>Viburnum opulus</i> (Ate)	B1	-	-	1	-	-	-	-	-	+	+1	I	20
	B2	+	+	1	+	+	+	+	+	1	+1	V	100
	S	+	+	2	+	+	+	+	+	1	+2	V	100
<i>Frangula alnus</i> (Ate, Qr, PQ)	B1	-	+	+	+	+	-	-	+	+	+	IV	70
	B2	-	-	-	+	+	+	+	+	+	+	IV	70
	S	-	+	+	+	+	+	+	+	+	+	V	90
<i>Elymus caninus</i> (Pna, Qpp)	C	+	+	+	+	-	-	-	-	+	+	III	60
<i>Festuca gigantea</i> (CaI, Epa)	C	-	+	-	-	-	1	-	-	+	+1	II	40
<i>Rumex sanguineus</i> (Epa, Pna)	C	+	-	-	-	-	-	-	-	+	+	II	30
<i>Carex remota</i>	C	+	-	-	-	-	-	-	-	+	+	I	20
<i>Equisetum hyemale</i> (F)	C	+	-	-	-	-	-	-	-	+	+	I	20
<i>Ribes rubrum</i>	B1	-	-	-	-	-	-	-	-	+	+	I	10
	B2	-	+	-	-	-	-	-	-	-	+	I	10
	S	-	+	-	-	-	-	-	-	+	+	I	20
<i>Ulmus laevis</i> (SaI, Ulm)	A1	-	-	-	-	+	-	-	-	2	+2	I	20
	A2	-	-	-	-	-	-	-	-	+	+	I	10
	B1	-	-	-	-	-	-	-	-	+	+	I	10
	B2	-	-	-	-	+	-	-	-	-	+	I	10
	S	-	-	-	-	+	-	-	-	2	+2	I	20

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Malus sylvestris</i> (Qpp)	B2	-	-	+	-	-	-	-	-	-	+	I	10
<i>Padus avium</i>	A2	-	-	-	-	-	-	-	-	+	+	I	10
	B1	-	-	-	-	-	-	-	-	+	+	I	10
	B2	-	-	-	-	-	-	-	-	+	+	I	10
	S	-	-	-	-	-	-	-	-	1	1	I	10
	C	-	-	-	-	-	+	-	-	-	+	I	10
<i>Viola elatior</i> (Moa)													
1.4. Quercetea pubescentis-petraeae													
<i>Prunus spinosa</i> (Pru,Prf)	B1	-	-	+	-	+	+	-	-	+	+	III	50
	B2	-	-	+	+	+	+	-	+	+	+	IV	70
	S	-	-	+	+	+	+	-	+	+	+	IV	70
	A1	-	-	-	-	-	1	-	-	-	1	I	10
	A2	-	-	-	-	1	2	+	+	-	+2	III	50
	B1	-	-	-	-	-	+	+	-	-	+	I	20
	B2	-	+	-	+	+	-	-	-	-	+	II	30
	S	-	+	-	+	1	2	+	+	-	+2	IV	70
	C	-	+	+	+	+	-	-	+	-	+	III	60
<i>Clinopodium vulgare</i>													
<i>Betonica officinalis</i> (MoA)	C	+	-	-	-	+	+	-	+	+	+	III	50
<i>Carex michelii</i>	C	+	-	-	+	-	-	-	+	-	+	II	30
<i>Pulmonaria mollissima</i>	C	-	-	+	+	-	-	-	-	-	+	II	30
<i>Rosa canina</i> agg. (Pru,Prf)	B1	-	-	-	-	-	-	-	-	-	+	I	10
	B2	-	+	+	-	-	-	-	-	-	+	II	30
	S	-	+	+	-	-	-	-	-	-	+	II	30

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Astragalus glycyphyllos</i>	C	+	-	-	-	+	-	-	-	-	+	I	20
<i>Lactuca quercina</i> subsp. <i>sagittata</i>	C	+	-	-	-	+	-	-	-	-	+	I	20
<i>Euonymus verrucosus</i> (Pru)	B1	+	-	-	-	-	-	-	-	-	+	I	10
	B2	+	-	-	-	-	-	-	-	-	+	I	10
	S	+	-	-	-	-	-	-	-	-	+	I	10
<i>Inula salicina</i> (MoA,Fvg)	C	-	-	+	-	-	-	-	-	-	+	I	10
<i>Melampyrum cristatum</i> (Fvl)	C	-	-	-	-	-	-	-	-	+	+	I	10
<i>Polygonatum odoratum</i> (Fvl)	C	-	-	-	-	-	-	-	-	+	+	I	10
1.4.1. Quercetalia cerridis													
<i>Gagea pratensis</i> (Sea)	C	-	-	-	-	+	-	-	-	-	+	I	10
<i>Trifolium medium</i>	C	-	-	-	-	-	+	-	-	-	+	I	10
1.4.1.1. Aceri tatarici-Quercion													
<i>Acer tataricum</i> (Qpp)	B1	+	+	-	-	-	-	-	-	-	+	II	30
	B2	+	+	-	-	-	-	-	-	-	+	II	30
	S	+	+	-	-	-	-	-	-	-	+	II	30
2. Cypero-Phragmitea													
2.1. Phragmitetea													
<i>Eupatorium cannabinum</i> (Epa,Sal,Ate,Ai)	C	+	+	+	+	+	+	+	+	-	+	V	90
<i>Carex acutiformis</i> (Mag,Cgr,MoJ,Sal,Ate)	C	-	+	1	-	+	-	+	+	1	+1	III	60
<i>Iris pseudacorus</i> (Sal,Ate,Ai)	C	-	+	-	-	+	+	+	-	-	+	III	50
<i>Hypericum tetrapterum</i> (FiC)	C	-	+	+	-	-	-	-	-	-	+	II	30
<i>Lycopus europaeus</i> (Moa,Cal,Bia,Spu,Ate)	C	-	-	-	-	-	-	+	+	+	+	II	30

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Sium latifolium</i> (Sal,Ate)	C	-	-	+	-	-	-	-	1	+	+ -1	II	30
<i>Solanum dulcamara</i> (Cal,Bia,Spu)	C	+	-	+	1	-	-	-	-	-	+ -1	II	30
<i>Galium palustre</i> (Mag,Moj,FPi,Spu,Ate)	C	-	-	-	+	-	-	-	+	-	+	I	20
<i>Carex riparia</i> (Mag,Cgr,Moj,Sal,Ate)	C	-	-	-	-	-	-	-	+	-	+	I	10
<i>Epilobium parviflorum</i> (NG,Moj,Moa,Ate)	C	-	-	-	-	-	-	-	+	-	+	I	10
<i>Euphorbia palustris</i> (Mag,Des,FiC,Bec,Ate)	C	-	-	-	-	-	-	-	-	+	+	I	10
<i>Stachys palustris</i> (Moa,Cal,Bin,Spu,Ate)	C	-	-	-	+	-	-	-	-	-	+	I	10
2.1.1. Nasturtio-Glycerietalia													
2.1.1.1. Glycerio-Sparganion													
<i>Scrophularia umbrosa</i> (Ai)	C	-	-	-	+	-	-	-	-	-	+	I	10
2.1.2. Magnocaricetalia													
2.1.2.1. Magnocaricion													
<i>Carex otrubae</i> (Cgr,Moj,FPi,Ai)	C	-	-	+	-	-	-	+	+	-	+	II	30
3. Molinio-Arrhenathera													
<i>Lynchnis flos-cuculi</i> (Mag,Ate)	C	-	+	+	+	+	+	+	+	+	+	V	90
<i>Poa trivialis</i> (Pte,Spu,Ate,Ai)	C	+	+	+	+	+	+	+	-	-	+	IV	70
<i>Cardamine pratensis</i> (Mag,Des,Sal,Ate,Ai)	C	-	-	+	-	-	+	+	+	-	+	II	40
<i>Vicia cracca</i> (Mag,Sea,Aon,Qpp)	C	-	-	+	+	-	+	-	-	-	+	II	30
<i>Lathyrus pratensis</i> (Mag,Qpp)	C	-	-	-	-	-	+	-	+	-	+	I	20
<i>Ranunculus acris</i>	C	-	-	-	-	+	-	-	-	-	+	I	20
<i>Pastinaca sativa</i> (Arr)	C	-	-	-	-	-	-	-	-	+	+	I	10

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
3.1. Molinio-Juncetea													
<i>Veratrum album</i> (Ate,Ai)	C	+	+	-	+	2	+	2	1	1	+2	V	90
<i>Cirsium canum</i> (Mag,Ate,Ai)	C	-	+	+	+	-	+	-	+	+	+	III	60
<i>Deschampsia caespitosa</i> (Des,Sal,Ate,Ai)	C	-	-	-	+	2	1	1	+	+	+2	III	60
<i>Cirsium rivulare</i> (Mag,Ate,Ai)	C	-	+	+	-	-	-	-	+	-	+	II	40
<i>Symphytum officinale</i> (Pte,Cal,Spu,Ate,Ai)	C	-	-	+	-	-	+	-	+	+	+	II	40
<i>Selinum carvifolia</i> (Mon,Ate,PQ)	C	-	-	-	+	-	-	-	+	-	+	I	20
<i>Succisa pratensis</i> (Mon,Tof,NC)	C	-	-	-	-	-	-	-	-	+	+	I	10
3.1.1. Molinietalia coeruleae													
<i>Angelica sylvestris</i> (Mag,Ate,Ai)	C	+	+	+	+	+	+	+	+	+	+1	V	100
<i>Valeriana officinalis</i> (Mag,FiC)	C	-	-	+	+	+	+	+	+	+	+	IV	70
<i>Ophioglossum vulgatum</i> (NC,Arn)	C	-	-	-	+	+	+	+	+	+	+	III	60
<i>Trollius europaeus</i> (Ate)	C	-	+	+	-	+	+	+	+	-	+	III	60
<i>Orchis militaris</i> (FBt,Qpp)	C	-	-	-	+	+	-	-	-	-	+	I	20
3.1.1.1. Filipendulo-Cirsion oleracei													
<i>Filipendula ulmaria</i> (Moa,Sal,Ate,Ai)	C	+	+	1	+	+	+	+	+	+	+1	V	100
<i>Geranium palustre</i> (Ate)	C	+	+	1	+	+	+	+	-	-	+1	IV	80
4. Festuco-Bromea													
<i>Campanula glomerata</i> (Qpp)	C	-	-	+	-	-	+	-	+	-	+	II	30
5. Chenopodio-Scleranthea													
5.1. Secalietea													
<i>Muscari comosum</i> (FBt)	C	-	-	-	-	-	-	-	+	-	+	I	10

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
5.2. Chenopodietea													
<i>Arctium minus</i> (Ar,Bia,Pla)	C	+	-	+	-	+	-	+	+	-	+	III	50
5.3. Galio-Urticetea													
5.3.1. Calystegietalia sepium													
5.3.1.1. Galio-Alliarion													
<i>Chaerophyllum temulum</i>	C	+	+	-	+	1	-	+	+	-	+1	III	60
<i>Alliaria petiolata</i> (Epa)	C	-	-	-	+	+	-	+	-	-	+	II	30
5.3.1.2. Calystegion sepium													
<i>Myosoton aquaticum</i> (Pte,Spu,Ate,Ai)	C	-	+	-	+	-	-	-	-	-	+	I	20
<i>Bryonia alba</i> (Ar,GA)	C	-	-	+	-	-	-	-	-	-	+	I	10
<i>Calystegia sepium</i> (Pte,Bia,Pla,Spu,Ate)	C	-	-	-	-	-	-	-	-	+	+	I	10
5.4. Epilobietea angustifolii													
5.4.1. Epilobietalia													
<i>Galeopsis bifida</i> (Cal)	C	-	-	+	-	-	-	-	-	-	+	I	10
<i>Salix caprea</i> (US,QFt)	A2	-	-	-	-	-	-	-	-	+	+	I	10
6. Indifferens													
<i>Equisetum arvense</i> (MoA,Sea,SaI,Ate,Ai)	C	+	+	+	+	+	+	+	+	+	+	V	100
<i>Galium aparine</i> (Sea,Epa,QFt)	C	+	1	+	+	+	+	+	1	+	+1	V	100
<i>Lysimachia nummularia</i> (Pte,MoJ,Bia)	C	+	+	+	+	+	+	+	1	+	+1	V	100
<i>Rubus caesius</i> (Spu)	B2	+	+	1	1	1	1	+	+	1	+1	V	90
<i>Torilis japonica</i> (Ar,GA,Epa,QFt)	C	+	+	+	+	+	+	+	+	-	+	V	90
<i>Glechoma hederacea</i> (MoA,QFt,SaI,Ai)	C	+	+	1	1	+	+	+	+	-	+1	IV	80

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	A-D	K	%
<i>Taraxacum officinale</i> agg. (MoA,ChS)	C	+	-	+	-	+	+	+	+	-	+	IV	70
<i>Urtica dioica</i> (Ar,GA,Epa,Spu)	C	-	-	+	+	+	+	+	+	-	+	III	60
<i>Sambucus nigra</i> (Epa,US,QFt)	B2	-	-	+	-	+	-	+	+	+	+	III	50
<i>Calthia palustris</i> (Mag,MoJ,Spu,Ate,Ai)	C	-	+	+	-	-	-	-	+	+	+	II	40
<i>Galium mollugo</i> (MoA,FBt,Qrp,Qpp)	C	-	-	+	-	-	+	-	-	+	+	II	40
<i>Ranunculus repens</i> (Pte,MoA,ChS,Spu,Ate)	C	-	-	+	-	-	-	+	+	+	+	II	40
<i>Serratula tinctoria</i> (MoA,MoJ,Qrp,Qpp,PQ)	C	-	-	-	-	+	-	-	+	-	+	I	20
<i>Stellaria media</i> (ChS,QFt,Spu)	C	-	+	-	-	-	-	-	-	-	+	I	20
<i>Carex hirta</i> (Pte,MoA,Pla)	C	-	-	+	-	-	-	-	-	-	+	I	10
<i>Lanium album</i> (Ar,GA,Cal)	C	-	-	-	-	-	-	+	-	-	+	I	10
<i>Lysimachia vulgaris</i> (Ai,Pte,SCn,MoJ,Sal)	C	-	-	-	-	-	-	-	-	+	+	I	10
<i>Mentha aquatica</i> (Pte,Moa,Spu,Ate,Ai)	C	-	-	-	-	-	-	-	-	+	+	I	10
<i>Prunella vulgaris</i> (Pte,MoA,ChS,QFt)	C	-	-	-	-	-	-	-	+	-	+	I	10
<i>Pseudolysimachion longifolium</i> (Des,FiC)	C	-	-	-	-	-	-	-	+	-	+	I	10
7. Adventiva													
<i>Fraxinus pennsylvanica</i>	A2	-	-	-	+	2	-	1	-	-	+2	II	30
	B1	-	-	-	1	1	+	-	-	-	+1	II	30
	B2	-	-	-	+	+	+	+	-	-	+	II	40
	S	-	-	-	1	2	+	1	-	-	+2	II	40
<i>Acer negundo</i>	B1	-	+	-	-	-	-	-	-	-	+	I	10
	B2	-	+	-	-	-	-	-	-	-	+	I	20
	S	-	+	+	-	-	-	-	-	-	+	I	20

Table 2
Data of the relevés

	1	2	3	4	5	6	7	8	9	10
Number of sample plot	5932	5935	15808	15809	5921	5924	5927	5928	5930	15807
Year of first sampling	2004	2004	2005	2007	2004	2004	2004	2004	2004	2007
Month and day of first sampling	1	04.26	08.20	04.22	04.26	04.26	04.26	04.26	06.25	04.22
Year of first sampling	2	2004	2007	2007	2004	2004	2004	2004	2007	2007
Month and day of first sampling	2	06.26	04.22	08.12	06.25	06.25	06.25	06.25	04.22	08.12
Altitude above sea level (m)	137	137	137	137	130	130	130	130	133	133
Exposition	0	0	0	0	0	0	0	0	0	0
Cover of upper canopy layer (%)	75	80	60	65	75	70	65	70	70	65
Cover of lower canopy layer (%)	30	40	60	25	40	40	40	25	20	40
Cover of shrub layer (%)	50	25	50	70	50	60	40	60	50	70
Cover of saplings (%)	3	1	15	50	25	25	40	5	30	40
Cover of understorey (%)	80	85	85	35	60	65	60	80	70	50
Height of upper canopy layer (m)	28	28	22	25	25	22	20	25	27	25
Height of lower canopy layer (m)	16	15	15	15	18	16	15	18	20	12
Height of shrub layer (m)	3	3,5	2,5	3	3	3	1,5	3	2,5	3
Mean trunk diameter (cm)	55	60	40	50	45	40	35	40	45	50
Area of sample plot (m ²)	1600	1600	1600	1600	1600	1600	1200	1600	1600	1600

Location: 1–4: Nyírábrány “Mogyorósi-erdő”; 5–8: Nyíracsaád “Jónásrész-Kőrises”; 9: Nyíracsaád; “Jónásrész-Buzita”; 10: Nyírábrány “Kis-kőrises”

Type of baserock: 1–10: sand. Soil type: peaty soil with decaying peat.

Authors: 1–3, 5–10, Kevey and Papp L. ined.; 4 : Kevey ined.

Fig. 6. Proportion of *Salicetea purpureae* s. l. character species. Fr-A = *Fraxino pannonicæ-Alnetum*, Nyírség (Kevey and Papp L. ined.: 5 relevés); V-Fr = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.: 10 relevés); Fr-U = *Fraxino pannonicæ-Ulmetum*, Nyírség (Kevey et al. 2017: 20 relevés)

Fig. 7. Proportion of *Alnion incanae* s. l. character species. Fr-A = *Fraxino pannonicæ-Alnetum*, Nyírség (Kevey and Papp L. ined.: 5 relevés); V-Fr = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.: 10 relevés); Fr-U = *Fraxino pannonicæ-Ulmetum*, Nyírség (Kevey et al. 2017: 20 relevés)

Fig. 8. Proportion of *Fagetalia* character species. Fr-A = *Fraxino pannonicæ-Alnetum*, Nyírség (Kevey and Papp L. ined.: 5 relevés); V-Fr = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.: 10 relevés); Fr-U = *Fraxino pannonicæ-Ulmetum*, Nyírség (Kevey et al. 2017: 20 relevés)

Fig. 9. Proportion of *Phragmitetea* s. l. character species. Fr-A = *Fraxino pannonicæ-Alnetum*, Nyírség (Kevey and Papp L. ined.: 5 relevés); V-Fr = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.: 10 relevés); Fr-U = *Fraxino pannonicæ-Ulmetum*, Nyírség (Kevey et al. 2017: 20 relevés)

Table 3
Percentages of characteristic species in *Veratro albi-Fraxinetum angustifoliae* and five similar associations selected for comparison

	Percentage of characteristic species in K%					Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Quercu-Fagea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salicetea purpureae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salicetalia purpureae	8.2	2.0	1.5	3.6	3.8	1.3	2.2	0.5	0.2	2.5	4.6	0.3
Salicion triandrae	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0	0.0	1.8	0.0
Salicion albae	6.6	3.3	1.9	3.0	3.7	1.6	8.0	2.7	1.3	3.9	2.2	1.9
Populenion nigro-albae	0.0	0.5	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Salicion albae s. l.	6.6	3.8	1.9	3.0	3.7	1.8	8.0	2.8	1.3	3.9	2.2	1.9
Salicetalia purpureae s. l.	14.8	5.8	3.4	6.7	8.0	3.1	10.2	3.3	1.5	6.4	8.6	2.2
Salicetea purpureae s. l.	14.8	5.8	3.4	6.7	8.0	3.1	10.2	3.3	1.5	6.4	8.6	2.2
Alnetea glutinosae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alnetalia glutinosae	13.9	8.2	5.0	7.4	7.6	2.3	25.4	17.7	13.0	18.5	15.5	5.6
Alnion glutinosae	1.1	0.8	0.0	0.7	1.0	0.0	1.7	0.1	0.0	0.8	11.7	0.0
Alnetalia glutinosae s. l.	15.0	9.0	5.0	8.1	8.6	2.3	27.1	17.8	13.0	19.3	27.2	5.6
Alnetea glutinosae s. l.	15.0	9.0	5.0	8.1	8.6	2.3	27.1	17.8	13.0	19.3	27.2	5.6
Quercu-Fagetea	2.7	13.0	9.8	4.9	2.1	20.7	0.2	21.9	12.8	6.0	0.8	25.4
Fagetalia sylvaticae	0.3	3.9	7.0	0.2	0.3	19.9	0.0	0.7	1.2	0.0	0.0	17.2
Alnion incanae	12.9	9.8	5.2	6.0	5.1	8.1	21.0	20.8	1.5	17.1	13.4	13.8
Alnenion glutinosae-incanae	0.9	0.0	0.0	0.5	0.0	0.0	6.2	0.0	0.0	12.8	0.0	0.0
Ulmenion	0.0	0.8	0.3	0.4	0.3	1.1	0.0	0.9	0.0	0.1	0.1	1.2
Alnion incanae s. l.	13.8	10.6	5.5	6.9	5.4	9.2	27.2	21.7	1.5	30.0	13.5	15.0

Table 3 (continued)

	Percentage of characteristic species in K%							Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U		
Fagion sylvaticae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Eu-Fagenion	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0		
Carpinenion betuli	0.1	2.5	1.8	1.1	0.4	4.1	0.0	2.7	0.2	0.2	0.1	5.6		
Tilio-Acerenion	0.0	0.0	0.6	0.1	0.0	0.5	0.0	0.0	0.1	0.0	0.0	0.4		
Fagion sylvaticae s. l.	0.1	2.5	2.4	1.2	0.4	4.9	0.0	2.7	0.3	0.2	0.1	6.0		
Aremonio-Fagion	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	1.1		
Fagetalia sylvaticae s. l.	14.2	17.0	14.9	8.3	6.1	34.4	27.2	25.1	3.0	30.2	13.6	39.3		
Quercetalia roboris	0.6	0.6	1.3	0.5	0.2	0.5	0.1	0.1	11.4	0.1	0.1	0.1		
Quercion robori-petraeae	0.0	0.2	0.4	0.4	0.3	0.0	0.0	0.0	0.1	0.1	0.1	0.0		
Quercetalia roboris s. l.	0.6	0.8	1.7	0.9	0.5	0.5	0.1	0.1	11.5	0.2	0.2	0.1		
Querco-Fagetea s. l.	17.5	30.8	26.4	14.1	8.7	55.6	27.5	47.1	27.3	36.4	14.6	64.8		
Quercetea pubescentis-petraeae	1.1	14.1	11.3	9.0	6.9	13.5	0.1	21.9	12.4	6.6	1.6	20.4		
Orno-Cotinetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Orno-Cotinon	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0		
Orno-Cotinetalia s. l.	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0		
Quercetalia cerridis	0.1	0.4	0.0	0.2	0.2	0.3	0.0	0.1	0.0	0.1	0.0	0.0		
Quercion farnetto	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	1.1		
Quercion petraeae	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0		
Aceri tatarici-Quercion	0.5	0.8	0.1	0.2	0.3	0.7	0.1	1.7	0.0	0.0	0.2	0.9		
Quercetalia cerridis s. l.	0.6	1.2	0.1	0.4	0.5	1.6	0.1	1.8	0.0	0.1	0.2	2.0		

Table 3 (continued)

	Percentage of characteristic species in K%					Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Prunetalia spinosae	0.0	1.1	1.1	1.2	0.5	0.4	0.0	0.2	0.1	0.6	0.1	0.0
Berberidion	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Prunion fruticosae	0.0	0.5	0.7	0.8	0.3	0.2	0.0	0.1	0.1	0.2	0.0	0.0
Prunetalia spinosae s. l.	0.1	1.8	1.8	2.1	0.8	0.7	0.0	0.4	0.2	0.8	0.1	0.0
Quercetea pubescentis-petraeae s. l.	1.8	17.1	13.2	11.5	8.2	15.9	0.2	24.1	12.6	7.5	1.9	22.4
Querceto-Fagea s. l.	49.1	62.7	48.0	40.4	33.5	76.9	65.0	92.3	54.4	69.6	52.3	95.0
Abieti-Piceea	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinio-Piceetea	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Pino-Quercetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pino-Quercion	0.4	0.6	2.0	0.9	0.6	0.2	0.0	0.1	11.5	0.2	0.1	0.0
Pino-Quercetalia s. l.	0.4	0.6	2.0	0.9	0.6	0.2	0.0	0.1	11.5	0.2	0.1	0.0
Vaccinio-Piceetea s. l.	0.5	0.6	2.0	0.9	0.6	0.3	0.0	0.1	11.5	0.2	0.1	0.0
Abieti-Piceea s. l.	0.5	0.6	2.0	1.0	0.6	0.4	0.0	0.1	11.5	0.2	0.1	0.0
Lemno-Potamea	1.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Hydrochari-Lemnetea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrocharietalia	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Lemnion minoris	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Hydrocharietalia s. l.	1.6	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Hydrochari-Lemnetea s. l.	1.6	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Potametea	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lemno-Potamea s. l.	3.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0

Table 3 (continued)

	Percentage of characteristic species in K%					Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Cybero-Phragmitea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phragmitetea	11.6	2.6	1.4	5.2	7.5	0.4	8.8	0.4	0.5	3.4	16.6	0.0
Phragmitetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phragmitum	1.3	0.0	0.0	0.2	0.1	0.0	0.6	0.0	0.0	0.1	0.0	0.0
Phragmitetalia s. l.	1.3	0.0	0.0	0.2	0.1	0.0	0.6	0.0	0.0	0.1	0.0	0.0
Nasturtio-Glycerietalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Glycerio-Sparganion	1.0	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Nasturtio-Glycerietalia s. l.	1.0	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Magnocaricetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnocaricion	3.6	2.5	1.6	3.6	5.7	0.1	7.0	0.4	0.7	1.4	2.2	0.0
Caricenion rostratae	0.0	0.0	0.0	0.5	1.9	0.0	0.0	0.0	0.0	0.1	0.8	0.0
Caricenion gracilis	1.5	0.3	0.2	0.3	1.3	0.0	6.0	0.1	0.4	0.7	0.9	0.0
Magnocaricion s. l.	5.1	2.8	1.8	4.4	8.9	0.1	13.0	0.5	1.1	2.2	3.9	0.0
Magnocaricetalia s. l.	5.1	2.8	1.8	4.4	8.9	0.1	13.0	0.5	1.1	2.2	3.9	0.0
Phragmitetea s. l.	19.0	5.5	3.2	10.1	16.5	0.5	22.5	0.9	1.6	5.7	20.5	0.0
Isoëto-Nanojuncetea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nanocyperetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nanocyperion flavescentis	0.7	0.0	0.1	0.3	0.7	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Nanocyperetalia s. l.	0.7	0.0	0.1	0.3	0.7	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Isoëto-Nanojuncetea s. l.	0.7	0.0	0.1	0.3	0.7	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Cybero-Phragmitea s. l.	19.7	5.5	3.3	10.4	17.2	0.5	22.6	0.9	1.6	5.8	20.6	0.0

Table 3 (continued)

	Percentage of characteristic species in K%					Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Oxycocco-Caricea nigrae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scheuchzerio-Caricetea nigrae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scheuchzerio-Caricetalia nigrae	0.3	0.0	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.0
Scheuchzerio-Caricetea nigrae s. l.	0.3	0.0	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.0
Oxycocco-Caricea nigrae s. l.	0.3	0.0	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.0
Molinio-Arrhenathera	1.4	4.0	5.4	4.9	8.3	1.5	0.1	0.7	0.7	0.8	1.8	0.3
Molinio-Juncetea	3.8	2.3	4.7	8.3	10.8	0.4	5.8	0.9	22.6	11.8	7.5	0.0
Tofieldietalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Caricion davallianae	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tofieldietalia s. l.	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Molinietaalia coeruleae	1.7	2.2	2.0	2.3	3.2	0.3	0.3	0.3	0.3	0.5	1.1	0.0
Molinion coeruleae	0.0	0.1	0.4	0.4	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Deschampsion caespitosae	0.9	0.4	0.4	1.2	3.5	0.1	0.2	0.2	0.7	2.4	2.8	0.0
Filipendulo-Cirsion oleracei	0.0	1.7	0.6	1.1	0.9	0.3	0.0	0.3	0.1	0.2	0.3	0.0
Alopecurion pratensis	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Molinietaalia coeruleae s. l.	2.7	4.4	3.4	5.0	7.7	0.7	0.5	0.8	1.2	3.2	4.2	0.0
Molinio-Juncetea s. l.	6.5	6.7	8.2	13.5	18.5	1.1	6.3	1.7	23.8	15.0	11.7	0.0
Arrhenatheretea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arrhenatheretalia	0.0	0.4	0.6	0.3	0.3	0.3	0.0	0.0	0.1	0.0	0.0	0.0
Arrhenatherion elatioris	0.0	0.4	0.6	0.4	0.4	0.0	0.0	0.0	0.2	0.1	0.1	0.0
Cynosurion cristati	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3 (continued)

	Percentage of characteristic species in K%						Percentage of characteristic species in A-D					
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Arrhenatheretalia s. l.	0.0	0.8	1.5	0.8	0.7	0.3	0.0	0.0	0.3	0.1	0.1	0.0
Arrhenatheretea s. l.	0.0	0.8	1.5	0.8	0.7	0.3	0.0	0.0	0.3	0.1	0.1	0.0
Nardo-Callunetea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nardetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nardo-Agrostion tenuis	0.0	0.4	0.5	0.5	0.0	0.2	0.0	0.0	0.1	0.1	0.0	0.3
Nardetalia s. l.	0.0	0.4	0.5	0.5	0.0	0.2	0.0	0.0	0.1	0.1	0.0	0.3
Nardo-Callunetea s. l.	0.0	0.4	0.5	0.5	0.0	0.2	0.0	0.0	0.1	0.1	0.0	0.3
Calluno-Ulicetea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinio-Genistetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calluno-Geniston	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3
Vaccinio-Genistetalia s. l.	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3
Calluno-Ulicetea s. l.	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3
Molinio-Arrhenathera s. l.	7.9	11.9	15.6	19.8	27.5	3.3	6.4	2.4	24.9	16.0	13.6	0.9
Puccinellio-Salicornea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuco-Puccinellietea	0.1	0.0	0.4	0.2	0.8	0.0	0.1	0.0	0.0	0.7	1.1	0.0
Festuco-Puccinellietalia	0.6	0.2	0.3	0.5	0.8	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Juncion gerardi	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Beckmannion eruciformis	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Festuco-Puccinellietalia s. l.	0.7	0.2	0.4	0.7	1.3	0.0	0.2	0.0	0.0	0.1	0.3	0.0
Artemisio-Festucetalia pseudovinae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festucion pseudovinae	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3 (continued)

	Percentage of characteristic species in K%						Percentage of characteristic species in A-D					
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Artemisio-Festucetalia pseudovinae s. l.	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuco-Puccinellietea s. l.	0.0	0.2	0.8	0.9	2.2	0.0	0.0	0.0	0.0	0.8	1.4	0.0
Puccinellio-Salicornea s. l.	0.7	0.2	0.8	0.9	2.2	0.0	0.2	0.0	0.0	0.8	1.4	0.0
Festuco-Bromea	0.0	0.2	0.5	0.3	0.5	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Festucetea vaginatae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festucetalia vaginatae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festucion vaginatae	0.0	0.1	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.1	0.4	0.0
Festucetalia vaginatae s. l.	0.0	0.1	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.1	0.4	0.0
Festucetea vaginatae s. l.	0.0	0.1	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.1	0.4	0.0
Festuco-Brometea	0.0	0.4	1.7	1.2	0.8	0.1	0.0	0.1	0.4	0.2	0.1	0.0
Festucetalia valesiacae	0.0	0.2	0.2	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Festucion rupicolae	0.0	0.0	0.9	0.6	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Cynodonto-Festucionion	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festucion rupicolae s. l.	0.0	0.0	1.2	0.7	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Festucetalia valesiacae s. l.	0.0	0.2	1.4	0.9	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.0
Brometalia erecti	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cirsio-Brachypodium	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Brometalia erecti s. l.	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Festuco-Brometea s. l.	0.0	0.6	3.1	2.1	1.3	0.2	0.0	0.1	0.5	0.3	0.2	0.0
Festuco-Bromea s. l.	0.0	0.9	3.6	3.3	2.7	0.2	0.0	0.1	0.6	0.4	0.7	0.0

Table 3 (continued)

	Percentage of characteristic species in K%						Percentage of characteristic species in A-D					
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Chenopodio-Scleranthea	0.5	0.6	1.0	1.1	0.9	0.2	0.0	0.1	0.1	0.2	0.2	0.0
Secalietea	0.5	0.9	0.3	0.9	0.8	0.6	0.0	0.2	0.0	0.1	0.1	0.1
Oryzetea sativae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oryzetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oryzion sativae	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oryzetalia s. l.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oryzetea sativae s. l.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chenopodietea	0.1	0.2	1.0	0.7	0.1	0.5	0.0	0.0	0.1	0.1	0.0	0.1
Onopordetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Onopordion acanthii	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Onopordetalia s. l.	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Chenopodietea s. l.	0.0	0.2	1.7	0.7	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0
Artemisietea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemisietalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arction lappae	0.5	0.8	1.6	1.0	0.0	1.1	0.1	0.1	0.2	0.2	0.0	0.1
Artemisietalia s. l.	0.5	0.8	1.6	1.0	0.0	1.1	0.1	0.1	0.2	0.2	0.0	0.1
Artemisietea s. l.	0.5	0.8	1.6	1.0	0.0	1.1	0.1	0.1	0.2	0.2	0.0	0.1
Galio-Urticetea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calystegietalia sepium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Galio-Alliarion	0.4	2.3	3.6	1.8	0.0	3.9	0.1	0.4	0.6	0.4	0.0	0.6

Table 3 (continued)

	Percentage of characteristic species in K%						Percentage of characteristic species in A-D					
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
<i>Calystegion sepium</i>	5.0	1.5	1.2	2.5	1.9	0.9	3.1	0.5	0.2	0.8	2.3	0.1
<i>Calystegietalia sepium</i> s. l.	5.4	3.8	4.8	4.3	1.9	4.8	3.2	0.9	0.8	1.2	2.3	0.7
<i>Galio-Urticetea</i> s. l.	5.4	3.8	4.8	4.3	1.9	4.8	3.2	0.9	0.8	1.2	2.3	0.7
<i>Bidentetea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bidentetalia</i>	3.1	0.8	0.4	1.8	1.7	0.5	0.9	0.2	0.1	0.5	0.6	0.0
<i>Bidenton tripartiti</i>	0.7	0.0	0.0	0.2	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
<i>Chenopodion rubri</i>	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Bidentetalia</i> s. l.	4.1	0.8	0.4	2.0	1.8	0.5	1.1	0.2	0.1	0.5	0.6	0.0
<i>Bidentetea</i> s. l.	4.1	0.8	0.4	2.0	1.8	0.5	1.1	0.2	0.1	0.5	0.6	0.0
<i>Plantaginetea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plantaginetalia majoris</i>	0.5	0.3	0.9	1.0	1.0	0.2	0.1	0.0	0.1	0.3	0.3	0.0
<i>Agropyro-Rumicion crispi</i>	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plantaginetalia majoris</i> s. l.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Plantaginetea</i> s. l.	0.5	0.3	0.9	1.2	1.1	0.2	0.1	0.0	0.1	0.3	0.3	0.0
<i>Epilobietea angustifolii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Epilobietalia</i>	1.8	4.5	5.7	2.3	0.9	6.1	0.2	0.8	1.6	0.7	0.2	1.4
<i>Epilobion angustifolii</i>	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Epilobietalia</i> s. l.	1.8	4.6	5.7	2.3	0.9	6.3	0.2	0.8	1.6	0.7	0.2	1.4
<i>Epilobietea angustifolii</i> s. l.	1.8	4.6	5.7	2.3	0.9	6.3	0.2	0.8	1.6	0.7	0.2	1.4
<i>Urtico-Sambucetea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3 (continued)

	Percentage of characteristic species in K%					Percentage of characteristic species in A-D						
	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U	Fr-A	V-Fr	O-B	M-A	M-S	Fr-U
Sambucetalia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sambuco-Salicion capreae	0.1	0.3	0.6	0.3	0.0	0.4	0.0	0.0	0.9	0.1	0.0	0.3
Sambucetalia s. l.	0.1	0.3	0.6	0.3	0.0	0.4	0.0	0.0	0.9	0.1	0.0	0.3
Urtico-Sambucetea s. l.	0.1	0.3	0.6	0.3	0.0	0.4	0.0	0.0	0.9	0.1	0.0	0.3
Chenopodio-Scleranthea s. l.	13.8	12.3	17.0	13.8	7.5	14.6	4.7	2.3	4.0	3.4	3.7	2.7
Indifferens	3.6	3.8	4.7	4.9	5.9	2.9	0.4	0.8	1.6	1.9	4.3	0.8
Adventiva	0.5	1.9	4.9	5.3	2.4	1.0	0.0	1.1	1.0	1.6	3.0	0.2
Fr-A: <i>Fraxino pannonicae-Alnetum</i> , Nyírség (Kevey, Papp L. et Lendvai ined.: 5 rel.); V-Fr: <i>Veratro albi-Fraxinetum angustifoliae</i> , Nyírség (Kevey et Papp L. ined.: 10 rel.); O-B: <i>Ophioglossa-Betuletum pubescentis</i> , Vértessalja (Riezinger et. al. 2009; 6 rel.); M-A: <i>Molinio-Alnetum glutinosae</i> , Mezőföld (Kevey 2008; 20 rel.); M-S: <i>Molinio-Salicetum cinereae</i> , Szigetköz (Kevey 2008; 20 rel.) Fr-U: <i>Fraxino pannonicae-Ulmetum</i> , Nyírség (Kevey et Papp L. ined.: 20 rel.)												

The frequency distribution of species in the five constancy categories, from I to V, follows a characteristic pattern. The highest frequency value at I steeply drops to II, then decreases further with diminishing increments to IV, where it reaches its minimum. At V, its value is again higher (Fig. 4). This patterns is only typical of phytosociological samples that are representative of the sampled vegetation unit (see Kevey 2008).

Proportion of character species

As usual in temperate deciduous forests in Central Europe, the species characteristic of the *Querco-Fagetea* class or syntaxa within it play a substantial role (30.8%) in the species composition of these *Fraxinus angustifolia* dominated stands. They are followed by the character species of SE European dry oak woods, *Quercetea pubescentis-petraeae* s. l. (17.1%) despite the rather mesic habitat, and *Alnetea glutinosae* s. l., *Molinio-Juncetea* s. l., *Salicetea* s. l., and *Phragmitetea* s. l. in decreasing order. Within the *Querco-Fagetea* class, *Fagetalia* s. l. and *Alnion incanae* species attain the highest proportions.

In comparison to other communities, it is noteworthy that character species proportions in all but two syntaxa were typically intermediate between those in *Fraxino pannonicae-Alnetum* and

Table 4
Differential species in *Veratro albi-Fraxinetum angustifoliae* and *Fraxino pannonicae-Alnetum*

	V-Fr	Fr-A		V-Fr	Fr-A
Constant species			<i>Geranium palustre</i>	IV	–
<i>Crataegus monogyna</i>	V	–	<i>Moehringia trinervia</i>	IV	–
<i>Euonymus europaeus</i>	V	–	<i>Prunus spinosa</i>	IV	–
<i>Filipendula ulmaria</i>	V	–	<i>Pyrus pyrastrer</i>	IV	–
<i>Geum urbanum</i>	V	–	<i>Taraxacum officinale</i> agg.	IV	–
<i>Ligustrum vulgare</i>	V	–	<i>Ulmus minor</i>	IV	–
<i>Lychnis flos-cuculi</i>	V	–	<i>Valeriana officinalis</i>	IV	–
<i>Rhamnus catharticus</i>	V	–	<i>Listera ovata</i>	IV	I
<i>Scrophularia nodosa</i>	V	–	<i>Quercus robur</i>	IV	I
<i>Torilis japonica</i>	V	–	<i>Glechoma hederacea</i>	IV	II
<i>Veratrum album</i>	V	–	<i>Alisma plantago-aquatica</i>	–	IV
<i>Angelica sylvestris</i>	V	I	<i>Sparganium erectum</i>	–	IV
<i>Equisetum arvense</i>	V	I	<i>Calystegia sepium</i>	I	IV
<i>Galium aparine</i>	V	I	<i>Lysimachia vulgaris</i>	I	IV
<i>Brachypodium sylvaticum</i>	V	II	<i>Mentha aquatica</i>	I	IV
<i>Cornus sanguinea</i>	V	II	<i>Stachys palustris</i>	I	IV
<i>Lysimachia nummularia</i>	V	II	<i>Sium latifolium</i>	II	IV
<i>Viburnum opulus</i>	V	II	Accessory species		
<i>Frangula alnus</i>	V	III	<i>Betonica officinalis</i>	III	–
<i>Populus alba</i>	V	III	<i>Chaerophyllum temulum</i>	III	–
<i>Alnus glutinosa</i>	–	V	<i>Cirsium canum</i>	III	–
<i>Lemna minor</i>	–	V	<i>Clinopodium vulgare</i>	III	–
<i>Oenanthe aquatica</i>	–	V	<i>Convallaria majalis</i>	III	–
<i>Salix cinerea</i>	–	V	<i>Corylus avellana</i>	III	–
<i>Carex riparia</i>	I	V	<i>Dactylis polygama</i>	III	–
<i>Galium palustre</i>	I	V	<i>Elymus caninus</i>	III	–
<i>Lycopus europaeus</i>	II	V	<i>Geranium robertianum</i>	III	–
<i>Salix fragilis</i>	II	V	<i>Ophioglossum vulgatum</i>	III	–
<i>Solanum dulcamara</i>	II	V	<i>Trollius europaeus</i>	III	–
<i>Symphytum officinale</i>	II	V	<i>Veronica chamaedrys</i>	III	–
<i>Carex acutiformis</i>	III	V	<i>Arctium minus</i>	III	I
Sub-constant species			<i>Deschampsia caespitosa</i>	III	I
<i>Cucubalus baccifer</i>	IV	–	<i>Populus tremula</i>	III	I

Table 4 (continued)

	V-Fr	Fr-A		V-Fr	Fr-A
<i>Sambucus nigra</i>	III	I	<i>Hypericum tetrapterum</i>	II	–
<i>Bidens tripartita</i>	–	III	<i>Polygonatum latifolium</i>	II	–
<i>Carex vesicaria</i>	–	III	<i>Pulmonaria mollissima</i>	II	–
<i>Glyceria maxima</i>	–	III	<i>Ranunculus auricomus</i> agg.	II	–
<i>Impatiens noli-tangere</i>	–	III	<i>Rosa canina</i> agg.	II	–
<i>Lythrum salicaria</i>	–	III	<i>Rumex sanguineus</i>	II	–
<i>Salix alba</i>	–	III	<i>Stachys sylvatica</i>	II	–
Sub-accessorial species			<i>Vicia cracca</i>	II	–
<i>Acer tataricum</i>	II	–	<i>Chenopodium polyspermum</i>	–	II
<i>Alliaria petiolata</i>	II	–	<i>Myosotis nemorosa</i>	–	II
<i>Angelica palustris</i>	II	–	<i>Persicaria hydropiper</i>	–	II
<i>Campanula glomerata</i>	II	–	<i>Poa palustris</i>	–	II
<i>Campanula trachelium</i>	II	–	<i>Scutellaria galericulata</i>	–	II
<i>Carex michelii</i>	II	–	<i>Teucrium scordium</i>	–	II
<i>Carex spicata</i>	II	–	<i>Thelypteris palustris</i>	–	II
<i>Carex sylvatica</i>	II	–	<i>Typha latifolia</i>	–	II
<i>Circaea lutetiana</i>	II	–	Number of differential species	68	32
<i>Cirsium rivulare</i>	II	–	V-Fr = <i>Veratro albi-Fraxinetum angustifoliae</i> (Kevey and Papp L. ined.: 10 rel.); Fr-A = <i>Fraxino pannonicae-Alnetum</i> (Kevey, Papp L. and Lendvai ined.: 5 rel.)		
<i>Cruciata glabra</i>	II	–			
<i>Fraxinus pennsylvanica</i>	II	–			
<i>Galium mollugo</i>	II	–			
<i>Heracleum sphondylium</i>	II	–			

Fig. 10. Proportion of Molinio-Juncetea s. l. character species. Fr-A = *Fraxino pannonicae-Alnetum*, Nyírség (Kevey and Papp L. ined.: 5 relevés); V-Fr = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.: 10 relevés); Fr-U = *Fraxino pannonicae-Ulmetum*, Nyírség (Kevey et al. 2017: 20 relevés)

Table 5

Differential species in *Veratro albi-Fraxinetum angustifoliae* and *Fraxino pannonicæ-Ulmetum*

	V-Fr	Fr-U		V-Fr	Fr-U
Constant species			<i>Taraxacum officinale</i> agg.	IV	I
<i>Angelica sylvestris</i>	V	–	<i>Chelidonium majus</i>	–	IV
<i>Equisetum arvense</i>	V	–	<i>Pulmonaria officinalis</i>	–	IV
<i>Filipendula ulmaria</i>	V	–	<i>Carpinus betulus</i>	I	IV
<i>Lychnis flos-cuculi</i>	V	–	<i>Lapsana communis</i>	I	IV
<i>Eupatorium cannabinum</i>	V	I	<i>Ulmus laevis</i>	I	IV
<i>Frangula alnus</i>	V	I	<i>Veronica hederifolia</i> subsp.	I	IV
<i>Veratrum album</i>	V	I	<i>lucorum</i>		
<i>Rhamnus catharticus</i>	V	II	<i>Viola mirabilis</i>	I	IV
<i>Lysimachia nummularia</i>	V	III	<i>Alliaria petiolata</i>	II	IV
<i>Populus alba</i>	V	III	<i>Carex sylvatica</i>	II	IV
<i>Viburnum opulus</i>	V	III	<i>Festuca gigantea</i>	II	IV
<i>Ranunculus ficaria</i>	–	V	Accessory species		
<i>Viola reichenbachiana</i>	–	V	<i>Betonica officinalis</i>	III	–
<i>Acer campestre</i>	I	V	<i>Carex acutiformis</i>	III	–
<i>Milium effusum</i>	I	V	<i>Cirsium canum</i>	III	–
<i>Polygonatum multiflorum</i>	I	V	<i>Iris pseudacorus</i>	III	–
<i>Ajuga reptans</i>	II	V	<i>Ophioglossum vulgatum</i>	III	–
<i>Circaea lutetiana</i>	II	V	<i>Trollius europaeus</i>	III	–
<i>Stachys sylvatica</i>	II	V	<i>Clinopodium vulgare</i>	III	I
<i>Chaerophyllum temulum</i>	III	V	<i>Deschampsia caespitosa</i>	III	I
<i>Convallaria majalis</i>	III	V	<i>Elymus caninus</i>	III	I
<i>Corylus avellana</i>	III	V	<i>Populus tremula</i>	III	I
<i>Geranium robertianum</i>	III	V	<i>Actaea spicata</i>	–	III
<i>Sambucus nigra</i>	III	V	<i>Bromus ramosus</i> agg.	–	III
Sub-constant species			<i>Fallopia dumetorum</i>	–	III
<i>Geranium palustre</i>	IV	–	<i>Hedera helix</i>	–	III
<i>Valeriana officinalis</i>	IV	–	<i>Lilium martagon</i>	–	III
<i>Glechoma hederacea</i>	IV	I	<i>Tilia cordata</i>	–	III
<i>Poa trivialis</i>	IV	I	<i>Tilia tomentosa</i>	–	III
<i>Prunus spinosa</i>	IV	I	<i>Carex divulsa</i>	I	III
<i>Pyrus pyraister</i>	IV	I	<i>Carex remota</i>	I	III

Table 5 (continued)

	V-Fr	Fr-U		V-Fr	Fr-U
Sub-accessorial species			<i>Chaerophyllum aromaticum</i>	–	II
<i>Angelica palustris</i>	II	–	<i>Colchicum autumnale</i>	–	II
<i>Campanula glomerata</i>	II	–	<i>Corydalis cava</i>	–	II
<i>Carex michelii</i>	II	–	<i>Dryopteris filix-mas</i>	–	II
<i>Carex otrubae</i>	II	–	<i>Euphorbia amygdaloides</i>	–	II
<i>Carex spicata</i>	II	–	<i>Galeobdolon luteum</i>	–	II
<i>Cirsium rivulare</i>	II	–	<i>Galium odoratum</i>	–	II
<i>Galium mollugo</i>	II	–	<i>Impatiens noli-tangere</i>	–	II
<i>Hypericum tetrapterum</i>	II	–	<i>Lathraea squamaria</i>	–	II
<i>Lycopus europaeus</i>	II	–	<i>Sanicula europaea</i>	–	II
<i>Pulmonaria mollissima</i>	II	–	<i>Scilla vindobonensis</i>	–	II
<i>Sium latifolium</i>	II	–	<i>Viola suavis</i> s. l.	–	II
<i>Symphytum officinale</i>	II	–	Number of differential species	41	47
<i>Vicia cracca</i>	II	–	V-Fr = <i>Veratro albi-Fraxinetum angustifoliae</i> (Kevey and Papp L. ined.: 10 rel.); Fr-U = <i>Fraxino pannonicae-Ulmetum</i> , Nyírség (Kevey and Papp L. ined.: 20 rel.)		
<i>Allium ursinum</i>	–	II			
<i>Anemone ranunculoides</i>	–	II			
<i>Cerasus avium</i>	–	II			

Table 6

Differential species in *Veratro albi-Fraxinetum angustifoliae* and *Ophioglosso-Betuletum*

	V-Fr	O-B		V-Fr	O-B
Constant species			<i>Carex flacca</i>	–	V
<i>Cornus sanguinea</i>	V	–	<i>Chelidonium majus</i>	–	V
<i>Filipendula ulmaria</i>	V	–	<i>Cirsium oleraceum</i>	–	V
<i>Fraxinus angustifolia</i> subsp. <i>danubialis</i>	V	–	<i>Clematis vitalba</i>	–	V
<i>Lychnis flos-cuculi</i>	V	–	<i>Cynoglossum officinale</i>	–	V
<i>Lysimachia nummularia</i>	V	–	<i>Dactylis glomerata</i>	–	V
<i>Scrophularia nodosa</i>	V	–	<i>Fallopia dumetorum</i>	–	V
<i>Populus alba</i>	V	I	<i>Galium odoratum</i>	–	V
<i>Equisetum arvense</i>	V	II	<i>Molinia coerulea</i>	–	V
<i>Galium aparine</i>	V	II	<i>Phragmites australis</i>	–	V
<i>Acer pseudo-platanus</i>	–	V	<i>Quercus cerris</i>	–	V
<i>Arctium lappa</i>	–	V	<i>Ranunculus polyanthemos</i>	–	V
			<i>Sanguisorba officinalis</i>	–	V

Table 6 (continued)

	V-Fr	O-B		V-Fr	O-B
<i>Solidago gigantea</i>	–	V	<i>Achillea millefolium</i>	–	IV
<i>Acer campestre</i>	I	V	<i>Cardamine impatiens</i>	–	IV
<i>Acer negundo</i>	I	V	<i>Cerasus avium</i>	–	IV
<i>Betula pubescens</i>	I	V	<i>Festuca rubra</i>	–	IV
<i>Galeopsis pubescens</i>	I	V	<i>Alliaria petiolata</i>	II	IV
<i>Lapsana communis</i>	I	V	Accessory species		
<i>Lysimachia vulgaris</i>	I	V	<i>Arctium minus</i>	III	–
<i>Mycelis muralis</i>	I	V	<i>Betonica officinalis</i>	III	–
<i>Ranunculus acris</i>	I	V	<i>Cirsium canum</i>	III	–
<i>Selinum carvifolia</i>	I	V	<i>Clinopodium vulgare</i>	III	–
<i>Serratula tinctoria</i>	I	V	<i>Convallaria majalis</i>	III	–
<i>Circaea lutetiana</i>	II	V	<i>Corylus avellana</i>	III	–
<i>Festuca gigantea</i>	II	V	<i>Dactylis polygama</i>	III	–
<i>Fraxinus pennsylvanica</i>	II	V	<i>Elymus caninus</i>	III	–
<i>Galium mollugo</i>	II	V	<i>Iris pseudacorus</i>	III	–
<i>Humulus lupulus</i>	II	V	<i>Populus tremula</i>	III	–
<i>Rosa canina</i> agg.	II	V	<i>Trollius europaeus</i>	III	–
<i>Stachys sylvatica</i>	II	V	<i>Veronica chamaedrys</i>	III	–
<i>Carex acutiformis</i>	III	V	<i>Agrimonia eupatoria</i>	–	III
<i>Chaerophyllum temulum</i>	III	V	<i>Colchicum autumnale</i>	–	III
<i>Deschampsia caespitosa</i>	III	V	<i>Dianthus superbus</i>	–	III
<i>Geranium robertianum</i>	III	V	<i>Mentha pulegium</i>	–	III
<i>Ophioglossum vulgatum</i>	III	V	<i>Poa angustifolia</i>	–	III
<i>Sambucus nigra</i>	III	V	<i>Rubus fruticosus</i> agg.	–	III
<i>Urtica dioica</i>	III	V	<i>Tussilago farfara</i>	–	III
Sub-constant species			<i>Lathyrus pratensis</i>	I	III
<i>Geranium palustre</i>	IV	–	Sub-accessory species		
<i>Glechoma hederacea</i>	IV	–	<i>Acer tataricum</i>	II	–
<i>Listera ovata</i>	IV	–	<i>Ajuga reptans</i>	II	–
<i>Ulmus minor</i>	IV	–	<i>Angelica palustris</i>	II	–
<i>Valeriana officinalis</i>	IV	–	<i>Caltha palustris</i>	II	–
<i>Poa trivialis</i>	IV	I	<i>Campanula glomerata</i>	II	–
<i>Quercus robur</i>	IV	I	<i>Campanula trachelium</i>	II	–
<i>Prunus spinosa</i>	IV	II	<i>Cardamine pratensis</i>	II	–

Table 6 (continued)

	V-Fr	O-B		V-Fr	O-B
<i>Carex michelii</i>	II	–	<i>Sium latifolium</i>	II	–
<i>Carex otrubae</i>	II	–	<i>Symphytum officinale</i>	II	–
<i>Carex spicata</i>	II	–	<i>Vicia cracca</i>	II	–
<i>Carex sylvatica</i>	II	–	<i>Agrostis stolonifera</i>	–	II
<i>Cirsium rivulare</i>	II	–	<i>Bromus ramosus</i> agg.	–	II
<i>Cruciata glabra</i>	II	–	<i>Euphorbia cyparissias</i>	–	II
<i>Heracleum sphondylium</i>	II	–	<i>Phleum pratense</i>	–	II
<i>Hypericum tetrapterum</i>	II	–	<i>Valeriana dioica</i>	–	II
<i>Lycopus europaeus</i>	II	–	<i>Viola reichenbachiana</i>	–	II
<i>Pulmonaria mollissima</i>	II	–	Number of differential species	52	59
<i>Ranunculus auricomus</i> agg.	II	–	V-Fr = <i>Veratro albi-Fraxinetum angustifoliae</i> (Kevey and Papp L. ined.: 10 rel.);		
<i>Rumex sanguineus</i>	II	–	O-B = <i>Ophioglossa-Betuletum</i>		
<i>Salix fragilis</i>	II	–			

Fraxino pannonicae-Ulmetum, which reflects the transitional habitat of *Veratro albi-Fraxinetum angustifoliae* between the former two (Table 3, Figs 5–10). The two exceptions are the *Quercetea pubescentis-petraeae* s. l. and *Molinio-Juncetea* s. l. species. The proportion of the former is the highest not only among the three, but among all six communities, whereas that of the latter is the highest among the three hardwood riparian forest associations, but is the smallest among all drained swamp communities. The distribution of character species proportions in *Veratro albi-Fraxinetum pannonicae* are rather different from the latter communities. The largest differences are found in the character species of *Phragmitetea* s. l., *Molinio-Juncetea* s. l., *Galio-Urticetea* s. l., *Epilobietea* s. l., *Salicetea purpureae* s. l., *Alnetea glutinosae* s. l., *Querco-Fagetea* s. l., *Fagetalia*, *Alnion incanae* s. l. and *Quercetea pubescentis-petraeae* s. l. (Table 4).

The occurrence of introduced aliens (*Fraxinus pennsylvanica*, *Acer negundo*, *Celtis occidentalis*, *Echinocystis lobata*, *Parthenocissus inserta*, *Robinia pseudoacacia*, *Vitis riparia*) in the association is apparent (Table 1), but compared to other associations in the region, their proportion is low (1.9%).

Number of differentiating species

The number of differentiating species (species for which the difference between their constancy values in the compared two communities equals or exceeds two) in *Veratro albi-Fraxinetum angustifoliae* is greater than 40 in all pairwise comparisons. The highest number of differentiating species (68) was

Table 7

Differential species in *Veratro albi-Fraxinetum angustifoliae* and *Molinio-Alnetum glutinosae*

	V-Fr	M-A		V-Fr	M-A
Constant species			Sub-constant species		
<i>Filipendula ulmaria</i>	V	–	<i>Geranium palustre</i>	IV	–
<i>Fraxinus angustifolia</i>	V	–	<i>Listera ovata</i>	IV	–
subsp. <i>danubialis</i>			<i>Moehringia trinervia</i>	IV	–
<i>Scrophularia nodosa</i>	V	–	<i>Glechoma hederacea</i>	IV	I
<i>Lychnis flos-cuculi</i>	V	I	<i>Ulmus minor</i>	IV	II
<i>Torilis japonica</i>	V	I	<i>Pyrus pyrastrer</i>	IV	III
<i>Veratrum album</i>	V	I	<i>Asclepias syriaca</i>	–	IV
<i>Euonymus europaeus</i>	V	II	<i>Carex flacca</i>	–	IV
<i>Populus alba</i>	V	II	<i>Cynoglossum hungaricum</i>	–	IV
<i>Geum urbanum</i>	V	III	<i>Equisetum palustre</i>	–	IV
<i>Ligustrum vulgare</i>	V	III	<i>Lythrum salicaria</i>	–	IV
<i>Lysimachia nummularia</i>	V	III	<i>Phragmites australis</i>	–	IV
<i>Viburnum opulus</i>	V	III	<i>Potentilla reptans</i>	–	IV
<i>Alnus glutinosa</i>	–	V	<i>Ranunculus polyanthemus</i>	–	IV
<i>Molinia coerulea</i>	–	V	<i>Sonchus palustris</i>	–	IV
<i>Poa pratensis</i>	–	V	<i>Galium palustre</i>	I	IV
<i>Salix cinerea</i>	–	V	<i>Mentha aquatica</i>	I	IV
<i>Sanguisorba officinalis</i>	–	V	<i>Selinum carvifolia</i>	I	IV
<i>Solidago gigantea</i>	–	V	<i>Stachys palustris</i>	I	IV
<i>Valeriana dioica</i>	–	V	<i>Caltha palustris</i>	II	IV
<i>Calystegia sepium</i>	I	V	<i>Rosa canina</i> agg.	II	IV
<i>Celtis occidentalis</i>	I	V	Accessory species		
<i>Lysimachia vulgaris</i>	I	V	<i>Clinopodium vulgare</i>	III	–
<i>Ranunculus acris</i>	I	V	<i>Convallaria majalis</i>	III	–
<i>Lycopus europaeus</i>	II	V	<i>Corylus avellana</i>	III	–
<i>Ranunculus repens</i>	II	V	<i>Trollius europaeus</i>	III	–
<i>Solanum dulcamara</i>	II	V	<i>Betonica officinalis</i>	III	I
<i>Vicia cracca</i>	II	V	<i>Dactylis polygama</i>	III	I
<i>Carex acutiformis</i>	III	V	<i>Elymus caninus</i>	III	I
<i>Cirsium canum</i>	III	V	<i>Ophioglossum vulgatum</i>	III	I
<i>Deschampsia caespitosa</i>	III	V	<i>Veronica chamaedrys</i>	III	I
<i>Iris pseudacorus</i>	III	V	<i>Carex elata</i>	–	III
<i>Sambucus nigra</i>	III	V			

Table 7 (continued)

	V-Fr	M-A		V-Fr	M-A
<i>Galium boreale</i>	–	III	<i>Allium angulosum</i>	–	II
<i>Galium verum</i>	–	III	<i>Bromus sterilis</i>	–	II
<i>Genista tinctoria</i> subsp. <i>elata</i>	–	III	<i>Carex paniculata</i>	–	II
<i>Phalaris arundinacea</i>	–	III	<i>Cirsium arvense</i>	–	II
<i>Euphorbia palustris</i>	I	III	<i>Cirsium vulgare</i>	–	II
<i>Succisa pratensis</i>	I	III	<i>Dactylis glomerata</i>	–	II
Sub-accessorial species			<i>Festuca pratensis</i>	–	II
<i>Acer tataricum</i>	II	–	<i>Gentiana pneumonanthe</i>	–	II
<i>Ajuga reptans</i>	II	–	<i>Iris sibirica</i>	–	II
<i>Angelica palustris</i>	II	–	<i>Leucojum aestivum</i>	–	II
<i>Campanula glomerata</i>	II	–	<i>Morus alba</i>	–	II
<i>Campanula trachelium</i>	II	–	<i>Padus serotina</i>	–	II
<i>Cardamine pratensis</i>	II	–	<i>Phytolacca americana</i>	–	II
<i>Carex otrubae</i>	II	–	<i>Pulicaria dysenterica</i>	–	II
<i>Carex spicata</i>	II	–	<i>Salix alba</i>	–	II
<i>Carex sylvatica</i>	II	–	<i>Salix rosmarinifolia</i>	–	II
<i>Cirsium rivulare</i>	II	–	<i>Scirpoides holoschoenus</i>	–	II
<i>Cruciata glabra</i>	II	–	<i>Scutellaria galericulata</i>	–	II
<i>Heracleum sphondylium</i>	II	–	<i>Thalictrum flavum</i>	–	II
<i>Pulmonaria mollissima</i>	II	–	<i>Trifolium montanum</i>	–	II
<i>Ranunculus auricomus</i> agg.	II	–	Number of differential species	43	63
<i>Rumex sanguineus</i>	II	–	V-Fr = <i>Veratro albi-Fraxinetum angustifoliae</i> (Kevey and Papp L. ined.: 10 rel.); M-A = <i>Molinio-Alnetum glutinosae</i> , Mezőföld (Kevey 2008: 20 rel.)		
<i>Stachys sylvatica</i>	II	–			
<i>Agrimonia eupatoria</i>	–	II			

found in the comparison to the alder swamp (*Fraxino-Alnetum glutinosae*), whereas the smallest number (41) occurred in relation to *Fraxino pannonicae-Ulmetum* (Tables 5–8).

Number of protected species

The stands of *Veratro albi-Fraxinetum angustifoliae* host numerous rare, threatened, or otherwise protected plant species. These are: *Veratrum album* (K: V), *Listera ovata* (K: IV) *Ophioglossum vulgatum*, *Trollius europaeus* (both

K: III), *Betula pubescens*, *Cephalanthera damasonium*, *C. longifolia*, *Epipactis hel-leborine* agg., *Equisetum hyemale* (incl. *Equisetum* × *moorei*), *Orchis militaris*, *Plan-tanthera bifolia* (all K: I).

Similarity relations in multivariate analyses

In the cluster analysis with complete linkage algorithm, the ten samples of *Veratro albi-Fraxinetum angustifoliae* grouped with the samples of *Fraxino pannonicae-Ulmetum*. The rest of the samples formed the sister cluster of this group. In this cluster, samples of the alder swamp (*Fraxino pannonicae-Alnetum*) were the sister cluster of the three drained swamp communities (*Ophioglosso-Betuletum pubescentis*, *Molinio-Alnetum*, *Molinio-Salicetum cinereae*) (Fig. 11). The result in the analysis with the group-average algorithm differed only in the placement of one of the drained swamp communities (*Ophioglosso-Betuletum*

Fig. 11. Binary dendrogram of alder swamp, hardwood riparian forest and drained swamp communities I (method: complete link; coefficient: Baroni-Urbani and Buser). 1/1–5 = *Fraxino pannonicae-Alnetum*, Nyírség (Kevey and Papp L. ined.); 2/1–10 = *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.); 3/1–6 = *Ophioglosso-Betuletum pubescentis*, Vértessalja (Riezinger and Szollát 2008–2009); 4/1–25 = *Molinio-Salicetum cinereae*, Szigetköz (Kevey 2008); 5/1–20 = *Molinio-Alnetum glutinosae*, Mezőföld (Kevey 2008); 6/1–20 = *Fraxino pannonicae-Ulmetum*, Nyírség (Kevey et al. 2017)

pubescentis) as a sister group of the *Veratro albi-Fraxinetum* and *Fraxino pannonicae-Ulmetum* cluster (Fig. 12). The dissimilarity level of the *Veratro albi-Fraxinetum* and *Fraxino pannonicae-Ulmetum* was very similar, though slightly smaller than those between the *Ophioglosso-Betuletum* and *Molinio-Alnetum* (complete linkage), and *Molinio-Alnetum* and *Molinio-Salicetum cinereae* (group average).

The result of the PCoA is in agreement with the above. In the plane of axes one and two, the samples of *Veratro albi-Fraxinetum* were adjacent to both, *Fraxino pannonicae-Ulmetum* and *Ophioglosso-Betuletum pubescentis* (Fig. 13). However, the position of the latter changed substantially in the plane of axes one and three, while the spatial relation of the samples of *Veratro albi-Fraxinetum* and *Fraxino pannonicae-Ulmetum* essentially did not change (Fig. 14).

Fig. 12. Binary dendrogram of alder swamp, hardwood riparian forest and drained swamp communities II (method: group average; coefficient: Baroni-Urbani and Buser). 1/1–5: *Fraxino pannonicae-Alnetum*, Nyírség (Kevey and Papp L. ined.); 2/1–10: *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.); 3/1–6: *Ophioglosso-Betuletum pubescentis*, Vértessalja (Riezing and Szollát 2008–2009); 4/1–25: *Molinio-Salicetum cinereae*, Szigetköz (Kevey 2008); 5/1–20: *Molinio-Alnetum glutinosae*, Mezőföld (Kevey 2008); 6/1–20: *Fraxino pannonicae-Ulmetum*, Nyírség (Kevey et al. 2017)

DISCUSSION

Field observations on habitat characteristics of *Veratro albi-Fraxinetum angustifoliae* suggested its transitional nature between *Fraxino pannonicae-Alnetum* and *Fraxino pannonicae-Ulmetum*. It is likely that this community develops from *Fraxino pannonicae-Alnetum* as organic and inorganic deposits accumulate and the habitat gradually dries out. During this process, most species of the Lemno-Potametea s. l. class, and also many Phragmitetea s. l. and Alnetea glutinosae s. l. species disappear or are replaced by Molinietales s. l., Quercetalia and Quercetalia pubescenti-petraeae species. This genealogic relationship would manifest itself in similarities in species composition and character species proportions to both associations.

It also seemed reasonable to assume that this association may be closely related to drained swamp communities based on their similarities in habitat conditions. The habitat of these communities may be covered with water in wet periods, but the soil is typically not saturated with water most of the time. This allows the establishment of Molinietales and Quercetalia species in relatively high proportions. These communities also share a number of additional

Fig. 13. Ordination diagram (axes 1 and 2) of alder swamp, hardwood riparian forest and drained swamp communities I (method: principal coordinates analysis; coefficient: Baroni-Urbani and Buser). 1/1–5: *Fraxino pannonicae-Alnetum*, Nyírség (Kevey and Papp L. ined.); 2/1–10: *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevey and Papp L. ined.); 3/1–6: *Ophioglossa-Betuletum pubescentis*, Vértesszőlő (Riezing and Szollát 2008–2009); 4/1–25: *Molinio-Salicetum cinereae*, Szigetköz (Kevey 2008); 5/1–20: *Molinio-Alnetum glutinosae*, Mezőföld (Kevey 2008); 6/1–20: *Fraxino pannonicae-Ulmetum*, Nyírség (Kevey et al. 2017)

features including the relatively high proportions of *Phragmitetea* and *Alnetalia glutinosae*, and the low proportion of *Fagetalia* elements.

Despite these similarities, the *Veratro albi-Fraxinetum angustifoliae* cannot be identified with any of the studied associations, but is best recognised as a novel association. Its distinctiveness is supported by a suite of evidence, including the number of differentiating species, the distribution of character species proportions, and the dissimilarity in floristical composition. In our

Fig. 14. Ordination diagram (axes 1 and 3) of alder swamp, hardwood riparian forest and drained swamp communities II (method: principal coordinates analysis; coefficient: Baroni-Urbani and Buser). 1/1–5: *Fraxino pannonicae-Alnetum*, Nyírség (Kevéy and Papp L. ined.); 2/1–10: *Veratro albi-Fraxinetum angustifoliae*, Nyírség (Kevéy and Papp L. ined.); 3/1–6: *Ophioglossa-Betuletum pubescentis*, Vértesszőlő (Riezing and Szollát 2008–2009); 4/1–25: *Molinio-Salicetum cinereae*, Szigetköz (Kevéy 2008); 5/1–20: *Molinio-Alnetum glutinosae*, Mezőföld (Kevéy 2008); 6/1–20: *Fraxino pannonicae-Ulmetum*, Nyírség (Kevéy et al. 2017)

opinion, the amount of differences in these features are sufficiently high to designate this community as a distinct association.

Whereas the *Veratro albi-Fraxinetum angustifoliae* is best treated as a new association, its syntaxonomic affinity is rather difficult to ascertain. Owing to its intermediate characteristics in many respects, it could be placed either in the Alnetea or the Querco-Fagetea class. The Molinio-Betuletea class by Pasmarge and Hofmann (1968), which includes strongly acidophilic communities distributed over the more humid western and northern parts of Europe, may be excluded for this reason. Based on preliminary data, Kevey (2008) placed the *Veratro albi-Fraxinetum angustifoliae* in the class Alnetea glutinosae, within an alliance Molinio-Alnion glutinosae, established for basiphilic drained swamp communities.

*

Abbreviations: A1 = upper forest canopy layer; A2 = lower forest canopy layer; Ai = Alnion incanae; Aon = Alnion glutinosae; AQ = Aceri tatarici-Quercion; Ar = Artemisietea; Ara = Arrhenatheretea; Arn = Arrhenatherion elatioris; Ate = Alnetea glutinosae; B1 = shrub layer; B2 = saplings; Bec = Beckmannion eruciformis; Ber = Berberidion; Bia = Bidentetea; Bin = Bidention tripartiti; C = herbaceous layer; Cal = Calystegion sepium; Cgr = Caricion gracilis; ChS = Chenopodio-Scleranthea; Cp = Carpinion betuli; Des = Deschampsion caespitosae; Epa = Epilobietea angustifolii; Epn = Epilobion angustifolii; F = Fagetalia sylvaticae; FBt = Festuco-Brometea; FiC = Filipendulo-Cirsion oleracei; FPi = Festuco-Puccinellietalia; Fr-A = alder swamp (*Fraxino pannonicae-Alnetum*); Fr-U = hardwood riparian forest (*Fraxino pannonicae-Ulmetum*); Fvg = Festucetea vaginatae; Fvl = Festucetalia valesiacae; GA = Galio-Alliarion; incl. = inclusive; ined. = ineditum (unpublished); M-A = drained alder swamp (*Molinio-Alnetum glutinosae*); M-S = drained willow swamp (*Molinio-Salicetum cinereae*); Mag = Magnocaricetalia; Moa = Molinietaalia coeruleae; MoA = Molinio-Arrhenatheretea; MoJ = Molinio-Juncetea; Mon = Molinion coeruleae; NC = Nardo-Callunetea; NG = Nasturtio-Glycerietalia; O-B = drained birch swamp (*Ophioglosso-Betuletum pubescentis*); Pla = Plantaginetea; Pna = Populenion nigro-albae; PQ = Pino-Quercetalia; Prf = Prunion fruticosae; Pru = Prunetalia spinosae; Pte = Phragmitetea; Qc = Quercetalia cerridis; QFt = Querco-Fagetea; Qpp = Quercetea pubescentis-petraeae; Qr = Quercetalia roboris; Qrp = Quercion robori-petraeae; S = summa (sum); Sal = Salicion albae; SCn = Scheuchzerio-Caricetea nigrae; Sea = Secalietea; s. l. = sensu lato (in the broad sense); Spu = Salicetea purpureae; s. str. = sensu stricto (in the narrow sense); ToF = Tofieldietalia; Ulm = Ulmenion; US = Urtico-Sambucetea; V-Fr = drained ash swamp (*Veratro albi-Fraxinetum angustifoliae*).

*

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