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A syntaxonomic revision of floodplain forest communities in Romania

Syntaxonomische Überarbeitung der Auwälder in Rumänien

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Abstract

This paper compares the floodplain forests from Romania to those described from Central and Southeastern Europe from syntaxonomical and ecological perspectives and proposes a clear and adequate vegetation classification system that was needed for the Romanian floodplain forests. We performed a syntaxonomical analysis and classification of 473 vegetation relevés published from all nine Romanian provinces, between the years 1968 and 2015. The plant communities, established on the basis of character and differential species, were grouped within the alliance *Alnion incanae* Pawłowski 1928, according to current phytosociological consensus. The floristic structure of each syntaxon is presented in a synoptic table with species constancy expressed as a percentage. Since plant communities specific to intramontane river floodplains are notably different from those in the plains, we grouped the associations within two different suballiances. Within the suballiance *Alnenion glutinosae-incanae* Oberdorfer 1953, we included the associations *Stellario nemorum-Alnetum glutionosae* Lohmeyer 1957, *Telekio speciosae-Alnetum incanae* Coldea 1990, and *Carici remotae-Fraxinetum excelsioris* Koch ex Faber 1936. In the suballiance *Ulmenion* Oberdorfer 1953, we included the associations *Fraxino pannonicae-Ulmetum glabrae* Aszód 1935 corr. Soó 1963, *Ulmo campestris-Fraxinetum holotrichae* Borza ex Sanda 1970 and *Fraxino pallisae-Quercetum pedunculiflorae* Oprea 1997. In order to show the distribution of these associations within the territory of Romania, we have generated two maps displaying the provenance of the analyzed relevés. The proposed classification system will facilitate the phytosociological and ecological investigation of floodplain forests and support the activities aiming at their conservation.

Keywords: *Alnion incanae*, floristic structure, forest plant communities, phytosociology, Southeastern Europe, synchorology, synecology

Erweiterte deutsche Zusammenfassung am Ende des Artikels

1. Introduction

In the past century, the floodplains of Romania have been subject to extensive changes, both in the plains and in the hill and mountain areas. At the beginning of the 19th century, these forests covered a large area of about 1,500,000 ha (GIURESCU 1975, CHIRIŢĂ 1981). With the increase in the human population, the plain forests were largely clearcut and turned

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into agricultural fields, while in the hills and mountains floodplain forests were cleared to increase the area of meadows. Currently, the surface area of the floodplain forests in the plains is below 50,000 ha, while the floodplain forest area from the colline and montane belts barely reaches 10,000 ha (DONIȚĂ et al. 2005). Since the areas of both forest types, currently being included within Natura 2000 habitats 91E0* and 91F0, are on the decrease, they can both be considered endangered.

These forest communities are comprised of tree species with a wide distribution in Central Europe (*Quercus robur*, *Fraxinus excelsior*, *Ulmus glabra*, *Ulmus minor*, *Ulmus laevis*, *Fraxinus angustifolia* subsp. *oxycarpa* (*F. angustifolia* subsp. *pannonica* Soó et Simon), but also species with Southeastern European distribution such as *Quercus pedunculiflora*, *Ulmus procera* and *Fraxinus pallisae*.

The shrub and herb layer of these communities also contain certain regional species (*Telekia speciosa*, *Symphytum cordatum*, *Pulmonaria rubra*, *Petasites kablikianus*, *Euonymus nanus*), which, together with the above mentioned Southeastern European tree species, differentiate these communities floristically from the ones described from Central Europe.

Since such communities have been erroneously included in associations described from Central Europe (DOBRESCU 1968, POP 1968, MONAH 2001), or published under different names (POPESCU et al. 1997, COROI 2001, CHIFU et al. 2004, 2006, SANDA et al. 2008), with this syntaxonomic revision we aim to clarify the Romanian phytosociological system and to correlate it with the European syntaxonomic context (RODWELL et al. 2002).

2. Study area

Romania comprises nine historical provinces, six larger ones: Muntenia, Transylvania, Moldavia, Crişana, Banat, Oltenia, and three smaller: Dobruja, Bukovina and Sătmar-Maramureş (Fig. 1, 2). Floodplain forests are present in all the provinces, from low altitudes (50–100 m a.s.l) as the ones from the Western, Romanian and Moldavian plains to the intramontane river floodplains at higher altitudes (700–1,000 m a.s.l.) such as Anieş Valley (Rodnei Mountains), Sadu Valley (Făgăraş Mountains) or Râul Mare Valley (Retezat Mountains). The lowland floodplain forests are dominated by species from the genera *Quercus*, *Fraxinus* and *Ulmus*, while the intramontane floodplain forests are dominated by *Alnus glutinosa*, *Alnus incana* and *Fraxinus excelsior.*

The climatic conditions from the plains in the western part of Romania are clearly different from the ones from the eastern and southern part. The multiannual (1951–1998) average temperature in the Western Plain is 10.7 °C and the multiannual average rainfall is 630 mm/year (POP 1968, ARDELEAN 1999), while in the southern and eastern plains the multiannual average temperature is 9.8 °C and the multiannual average rainfall is 467 mm/year (OPREA 1997, CHIFU et al. 2006). The absolute temperature amplitude is 66.5 °C in the west and 72.2 °C in the east (MONAH 2001), revealing the more continental character of the climate in the eastern plains of Romania. These climatic differences between the western and southeastern plains account for the noticeable floristic differences between the floodplain communities dominated by *Ulmus, Fraxinus* and *Quercus* that were therefore grouped in distinctive associations.

The climatic conditions in the floodplains of intramontane rivers from the Romanian Carpathians, where forests are dominated by *Alnus* species, are much more uniform. The multiannual average temperatures are between 6.5–8 °C, while the multiannual average

rainfall is between 630–850 mm/year. These forests have more homogenous floristic structures, and only those at higher altitudes (800–1,000 m a.s.l.) display notable floristic differences.

3. Material and methods

In order to achieve a thorough syntaxonomic perspective on the floodplain forests of Romania we examined all the available relevés (over 550) that were published in Romania for this vegetation type. The relevés that were published as synthetic tables were excluded from the analysis. The 473 analyzed vegetation relevés were recorded by different experts in floodplain forests throughout Romania following the method of BRAUN-BLANQUET (1964) (see also WESTHOFF & VAN DER MAAREL 1973). Most of them were published, as analytical tables, between the years 1968 and 2015, only seven relevés being from the authors' unpublished data. The origin of the relevés is detailed in Supplement E1.

We grouped the relevés from our database into plant associations on the basis of character species and into subassociations on the basis of geographic and ecological differential species (DIERSCHKE 1984, 1992, 1994). For each of the selected relevé groups a raw table was constructed in a spreadsheet. Species from the raw tables were manually reordered to form constancy tables, and subsequently differentiated tables, on the basis of differentiating species, were built. On the basis of character species, differentiated tables were manually rearranged into characterized (association) tables. Finally, the synoptic table was constructed, by manually sorting the data according to character and differential species, and considering species constancy within the syntaxa.

We expressed the frequency of each species within the established and described syntaxa (constancy) as percentage and not as frequency classes, to better highlight the differences between associations (OBERDORFER 1992). Most species with very low constancy (under 20%), except differential species and certain species with regional importance, were presented at the foot of Supplement S1.

The nomenclature of the cormophyte species follows CIOCÂRLAN (2009). The syntaxonomic nomenclature used is in agreement with the principles of the International Code of Phytosociological Nomenclature (WEBER et al. 2000).

In order to show the spatial distribution of each floodplain association in Romania, we generated two synchorological maps displaying the geographical position of the analyzed relevés.

4. Results and discussion

On the basis of the obtained results we have classified the forest associations specific to the Romanian floodplains, similarly to the ones described in Central Europe (SEIBERT 1992, WILLNER & GRABHERR 2007, VUKELIĆ et al. 2012) and Eastern Europe (MATUSZKIEWICZ 2008, ONYSHCHENKO 2010, CHYTRÝ 2013, DOUDA 2013), in the following syntaxonomical system:

Class *Carpino-Fagetea* Jakucs ex Passarge 1968
- Order *Fagetalia* Pawl. 1928
  - Alliance *Alnion incanae* Pawł. 1928
    - Suball. *Alnenion glutinosae-incanae* Oberdorfer 1953
      - Ass. *Stellorio nemorum-Alnetum glutinosae* Lohmeyer 1957
      - Ass. *Telekio speciosae-Alnetum incanae* Coldea 1990
      - Ass. *Carici remotae-Fraxinetum excelsioris* Koch ex Faber 1936
    - Suball. *Ulmenion* Oberdorfer 1953
      - Ass. *Fraxino pannonicae-Ulmetum glabrae* Aszód 1935 corr. Soó 1963
      - Ass. *Ulmo campestris-Fraxinetum holotrichae* Borza ex Sanda 1970
      - Ass *Fraxino pallisae-Quercetum pedunculiflorae* Oprea 1997

The six alluvial forest associations established for Romania are grouped within the alliance *Alnion incanae* Pawł.1928, similar to the approach of phytosociologists from neighboring countries (Hungary: BORHIDI 2003, Austria: WILLNER & GRABHERR 2007, Czech Republic: DOUDA 2013). This alliance is presently considered valid, although there are numerous synonyms used by phytosociologists for this vegetation type, such as *Alno-Padion* Knapp 1942, *Alno-Ulmion minoris* Br.-Bl. et Tx. 1943, *Filipendulo-Fraxinion excelsioris* Passarge et Hofmann 1968 (MUCINA et al. 1993). The alliance comprises the hygrophilous forests from plains and hill areas, dominated by communities of *Alnus glutinosa*, *Ulmus minor*, *U. laevis*, *Quercus robur*, *Q. pedunculiflora*, *Fraxinus excelsior*, *F. angustifolia* and *F. pallisae*, up to the montane belt where communities of *Alnus incana* prevail.

Since the communities dominated by *Alnus* species are floristically and ecologically different from the ones dominated by *Ulmus* and *Fraxinus* species, we have grouped them in two distinct suballiances, as proposed by OBERDORFER (1953), SEIBERT (1992), POTT (1995) and ELLENBERG (1996).

Within the suballiance *Alnenion glutinosae-incanae* Oberdorfer 1953, which is distinguished by a few character species such as *Alnus glutinosa*, *A. incana*, *Rubus idaeus*, *Cirsium oleraceum*, *Matteuccia struthiopteris*, *Stellaria nemorum*, *Equisetum hyemale*, we have grouped the three associations specific to intramontane river floodplains.

***Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957 (Supplement S1, column 1a–1b; Fig. 1)**

Syn.: *Alnus glutinosa-Salix purpurea* Paucă 1941 (Art. 5), *Alnetum glutinosae* auct. roman. (Art. 36).

The *Alnus glutinosa*-dominated communities are frequent in valleys and along rivulets in the hill and submontane area of Romania (PĂUN 1966, SANDA et al. 1970, MONAH 2001, SĂMĂRGHIŢAN 2005, CHIFU et al. 2006, OPREA & SÎRBU 2009). They are usually found on sandy-loamy Fluvisols and Gleyic Cambisols, moderately deep (25–40 cm), often with skeleton, moist from groundwater, periodically flooded and weakly acidic (pH 5.8–6.7) (DONIŢĂ et al. 1990). In the tree layer of these communities, besides *A. glutinosa*, other species such as *Acer campestre*, *Carpinus betulus*, *Fraxinus excelsior* and *Tilia cordata* can be found. At higher altitudes, *Fagus sylvatica*, *Acer pseudoplatanus* and *Alnus incana* are more frequent. The shrub layer of these communities has an average cover of 30% and includes *Cornus sanguinea*, *Corylus avellana*, *Crataegus monogyna*, *Euonymus europaeus*, *Frangula alnus*, *Ligustrum vulgare*, *Rosa canina*, and *Sambucus nigra*. In the herb layer, besides the differential species for the association, *Stellaria nemorum*, *Potentilla reptans*, *Chaerophyllum aromaticum* and *Anthriscus sylvestris*, species that are characteristic of the order *Fagetalia* are also frequent. The floristic structure of *Alnus glutinosa* communities differs according to the characteristics of the soils (humidity, temperature and nutrient abundance) within the floodplains that they inhabit (COSTE 1984, SANDA et al. 2005).

Most of the *Alnus glutinosa* communities in the broad floodplains from the colline belt valleys, on poorly developed Fluvisols and with slow water flow were placed in the subassociation *typicum* (COSTE 1984) (Supplement S1, column 1a). Such forests are widespread in most of the Romanian provinces and amount to about 6,000 ha (DONIŢĂ et al. 2005).

The *Alnus glutinosa* communities inhabiting the narrow floodplains of the intramontane valleys on periodically flooded gley soils and that have a few differential species such as *Petasites hybridus*, *Epilobium hirsutum*, *Hypericum tetrapterum* and *Dipsacus laciniatus*, were placed in the subassociation *Stellario nemorum-Alnetum glutinosae petasitetosum hybridi* subass. nova (Supplement S1, column 1b) (PAUCĂ 1941, OROIAN 1988).

Nomenclatural type for the *Stellario nemorum-Alnetum glutinosae petasitetosum hybridi*: PAUCĂ 1941, tab. 12, relevé 9. Lectotypus hoc loco: tree layer: *Alnus glutinosa* 2, *Carpinus betulus* +, *Tilia cordata* +, *Acer campestre* +, upper shrub layer: *Salix cinerea* +, *Coryllus avelana* +, *Staphylea pinnata* +, *Cornus mas* +, *Sambucus nigra* +, *Viburnum opulus* +, lower shrub layer: *Humulus lupulus* +, *Clematis vitalba* +, herb layer: *Petasites hybridus* 2, *Festuca gigantea* +, *Solanum dulcamara* +, *Chrysosplenium alternifolium* +, *Stellaria nemorum* +, *Pulmonaria officinalis* +, *Galeobdolon luteum* +, *Urtica dioica* +, *Epilobium hirsutum* +, *Ranunculus repens* +, *Hypericum tetrapterum* +, *Caltha palustris* +, *Geranium phaeum* +, *Athyrium filix-femina* +, *Galium aparine* +, *Salvia glutinosa* +, *Valeriana officinalis* +, *Equisetum maximum* +, *Melilotus officinalis* +, *Arctium lappa* +, *Alliaria officinalis* +, *Symphytum tuberosum* +.

Locality: Romania, Crişana region, Valea Deznei, relevé area: 100 m^2, altitude 160 m, slope 3º, limestone, cover tree layer 30%.

Telekio speciosae-Alnetum incanae **Coldea 1990**
(Supplement S1, column 2a–2b; Fig. 1)

Syn.: *Alnetum incanae* auct. roman. (Art. 36).

Nomenclatural type for the *Telekio speciosae-Alnetum incanae*: Coldea 1990, tab. 61, rel. 7. Lectotypus hoc loco: tree layer: *Alnus incana* 4, upper shrub layer: *Salix cinerea* 1, herb layer: *Aegopodium podagraria* 2, *Eupatorium cannabinum* 2, *Matteuccia struthiopteris* 2, *Brachypodium sylvaticum* 1, *Galeopsis speciosa* 1, *Impatiens noli-tangere* 1, *Petasites hybridus* 1, *Urtica dioica* 1, *Alliaria petiolate* +, *Anthriscus nitida* +, *Campanula trachelium* +, *Carduus personata* +, *Cirsium oleraceum* +, *Digitalis grandiflora* +, *Elymus caninus* +, *Epilobium parviflorum* +, *Equisetum sylvaticum* +, *Festuca gigantea* +, *Lycopus europaeus* +, *Lysimachia nummularia* +, *Myosotis sylvatica* +, *Scrophularia nodosa* +, *Senecio ovatus* +, *Stachys sylvatica* +, *Stellaria nemorum* +, *Telekia speciosa* +

Locality: Romania, Transylvania region, Valea Cormaia, relevé area: 400 m^2, altitude 560 m, slope 5º, aspect S, cover tree layer 80%, cover herb layer 60%.

The forest communities dominated by *Alnus incana* are frequent in the Romanian Carpathians, in intramontane valleys between 400 m and 1,100 m altitude (DIHORU 1975, ALEXIU 1998, COROI 2001, MIHĂILESCU 2001). The floristic structure of these communities differs from the ones described from Central Europe (SCHWABE 1985, SEIBERT 1992, VUKELIĆ et al. 2012, DOUDA et al. 2015, PIELECH 2015), therefore we have placed them in a specific regional association (COLDEA 1991). The Carpathian-Balkan species that are distinctive for this association are *Telekia speciosa*, *Symphytum cordatum*, *Pulmonaria rubra*, *Leucanthemum waldsteinii*, *Carduus personata* subsp. *albidus*, *Heracleum palmatum* and *Petasites kitaibelianus* (ONYSHCHENKO 2010). Unlike *Alnus glutinosa* communities, those dominated by *Alnus incana* inhabit the floodplains of narrow valleys, with developing terraces, mainly on skeleton soils, such as Haplic Fluvisols (DONIŢĂ et al. 1990).

The tree layer of these communities has an average canopy cover of 60% and, besides *Alnus incana*, also frequently contains *Fagus sylvatica*, *Acer pseudoplatanus* and *Fraxinus excelsior*, while at lower altitudes (400–450 m a.s.l.), *A. glutinosa*, *Salix alba* and *Carpinus betulus* are common. The herb layer includes diagnostic species for the suballiance *Alnenion glutinosae-incanae* as well as for the alliance *Alnion incanae*, similarly to the plant communities described from Central Europe (SEIBERT 1992, WILLNER & GRABHERR 2007, DOUDA 2013). The floristic diversity of the *Alnus incana* communities in Romania is lower than that described from Austria (WILLNER & GRABHERR 2007), which is why we grouped them into a single plant community type. The differential species from these communities were only considered for the differentiation of subassociations.

We grouped the *Alnus incana* communities in the montane belt, which are richer in species characteristic of the alliance *Alnion incanae,* in the subassociation *typicum* (Supplement S1, column 2a) (COLDEA 1990. Tab. 61, p. p.). These forest communities cover an area of less than 4,000 ha in Romania.

We grouped the montane grey alder communities from the upper basins of intramontane valleys with skeleton-rich Haplic Fluvisols, coming into contact with tall herbaceous vegetation and with the differential species *Petasites kablikianus*, *P. hybridus*, *Aconitum moldavicum* and *Cortusa matthioli*, in the subassociation *Telekio speciosae-Alnetum incanae petasitetosum kablikiani* Coldea 1990 corr. hoc loco (Supplement S1, column 2b) (COLDEA 1990, 1993, NECHITA 2003).

Nomenclatural type for the *Telekio speciosae-Alnetum incanae petasitetosum kablikiani* Coldea 1990, tab. 61, rel. 1. Lectotypus hoc loco: tree layer: *Alnus incana* 4, *Salix alba* 2, *Picea abies* +, upper shrub layer: *Sambucus nigra* +, lower shrub layer: *Rubus idaeus* 2, *Clematis alpina* +, herb layer: *Petasites kablikianus* 2, *Urtica dioica* 1, *Stellaria nemorum* 1, *Dryopteris filix-mas* 1, *Athyrium filix-femina* +, *Calamagrostis arundinacea* +, *Cardamine impatiens* +, *Carduus personata* +, *Chaerophyllum hirsutum* +, *Chrysosplenium alternifolium* +, *Doronicum austriacum* +, *Epilobium montanum* +, *Geranium phaeum* +, *Geranium robertianum* +, *Impatiens noli-tangere* +, *Lamium maculatum* +, *Luzula sylvatica* +, *Matteuccia struthiopteris* +, *Milium effusum* +, *Oxalis acetosella* +, *Petasites albus* +, *Petasites hybridus* +, *Poa nemoralis* +, *Polypodium vulgare* +, *Polystichum aculeatum* +, *Silene dioica* +, *Spiraea chamaedryfolia* +, *Symphytum cordatum* +, *Telekia speciosa* +, *Veronica urticifolia* +.

Locality: Romania, Transylvania region, Valea Rebra, relevé area: 400 m^2, altitude 930 m, slope 25º, aspect V, cover tree layer 60%, cover herb layer 35%.

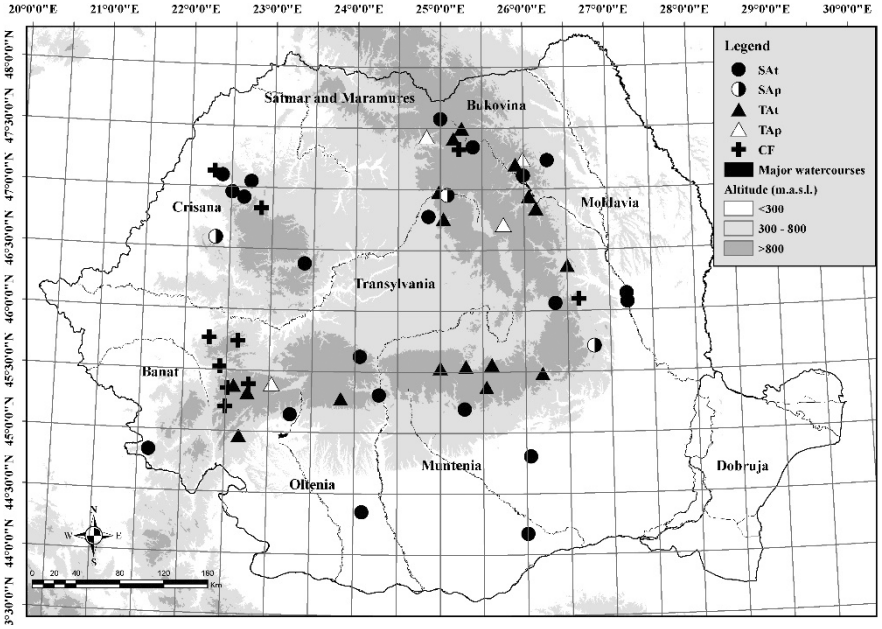

Fig. 1. The synchorological map of the intramontane floodplain forests in Romania: *Stellario nemorum-Alnetum glutinosae typicum* (SAt), *Stellario nemorum-Alnetum glutinosae petatisetosum hybridi* (SAp), *Telekio speciosae-Alnetum incanae typicum* (TAt), *Telekio speciosae-Alnetum incanae petasitetosum kablikiani* (TAp), *Carici remotae-Fraxinetum excelsioris* (CF).

Abb. 1. Synchorologische Karte der intramontanen Auenwälder Rumäniens. Communities see above.

Carici remotae-Fraxinetum excelsioris Koch ex Faber 1936
(Supplement S1, column 3; Fig. 1)

Within this plant community type, we grouped the hygro-mesophilous forests dominated by *Fraxinus excelsior* that are sporadic in the floodplains of certain intramontane valleys from western and eastern Romania (GURĂU 2004, COLDEA et al. 2015) and grow on Gleyic Fluvisols that are periodically flooded for short timespans. *Acer campestre*, *A pseudoplatanus*, *Alnus glutinosa*, *A. incana,* and *Carpinus betulus* are occasionally present in the tree layer. Frequent shrub species include *Corylus avellana*, *Crataegus monogyna*, *Sambucus nigra*, while *S. racemosa* is also present at higher altitudes. Besides the character species (*Carex remota*, *Geranium phaeum*, *Veronica montana*), the herb layer of the *F. excelsior* communities also contains hygro-mesophilous species characteristic of the suballiance *Alnenion glutinosae-incanae* and of the alliance *Alnion incanae* (SEIBERT 1992, WILLNER & GRABHERR 2007, DOUDA 2013). The area occupied by these communities in the floodplains of intramontane valleys is small, because of ash tree felling for use in traditional tool-making.

Within the suballiance *Ulmenion* Oberdorfer 1953, which is distinguished by several character species such as *Ulmus minor*, *U. procera*, *Populus alba*, *Quercus robur*, *Q. pedunculiflora*, *Fraxinus angustifolia* subsp. *oxycarpa*, *F. pallisae*, *Acer tataricum*, *Asparagus tenuifolius* and *Poa sylvicola*, we grouped the three associations specific to lowland river floodplains of Romania.

Fraxino pannonicae-Ulmetum glabrae Aszód 1935 corr. Soó 1963
(Supplement S1, column 4a–4b; Fig. 2)

Syn.: *Querco-Ulmetum* Pop 1968 non Issler 1924.

Syntax. Syn.: *Fraxino danubialis-Ulmetum* Sanda et Popescu 1999.

Within this association, of pannonic distribution, we grouped the plant communities dominated by the pedunculate oak (*Quercus robur*) and elm (*Ulmus* sp.); fragmentarily, ash (*Fraxinus excelsior*) can also be co-dominant (POP 1968, 1979). They are only present in small areas in the Western Plain of Romania (POP 1968, 1979) and in the floodplains of certain rivers in eastern Romania (DOBRESCU 1968, BUICULESCU & BARBU 1981, MONAH 2001). They grow on Gleyic Eutric Cambisols and Fluvisols that are periodically flooded and have a high water table in spring but are almost dry in summer. The presence of *Fraxinus angustifolia* subsp. *oxycarpa* in these communities, besides other regional species such as *Acer tataricum*, *Poa sylvicola*, *Pulmonaria mollissima*, and *Ulmus procera*, indicates major structural differences from the plant community type *Querco-Ulmetum minoris* Issler 1924 described from Central Europe. Thus, there are no floristic grounds for the inclusion of the Romanian communities within the community type specific to Central Europe. These communities contain significant numbers of character species of the alliance *Alnion incanae*, as well as character species for the order *Fagetalia* and class *Carpino-Fagetea.*

The communities from eastern Romania are set apart to some extent by the presence of certain ecological differential species such as *Euonymus nana*, *Fritillaria meleagris* and *Leonurus marrubiastrum*, that allowed the differentiation of the subassociation *Fraxino pannonicae-Ulmetum glabrae euonymetosum nanae* Dobrescu 1968 (Supplement S1, column 4b) (MONAH 2001).

Nomenclatural type for *Fraxino pannonicae-Ulmetum glabrae euonymetosum nanae* Dobrescu 1968, tab. 1, rel. 3. Lectotypus hoc loco: tree layer: *Fraxinus angustifolia* subsp. *oxycarpa* 3, *Ulmus minor* (*U. glabra* Mill.) 1, *Quercus robur* 1, *Acer campestre* 1, *Tilia tomentosa* +, *Tilia cordata* +, *Cerasus avium* +, *Malus sylvestris* +, *Pyrus pyraster* +, *Carpinus betulus* r, *Ulmus laevis* r, upper shrub layer: *Acer tataricum* 1, *Cornus sanguinea* 1, *Cornus mas* +, *Corylus avellana* +, *Crataegus monogyna* +, *Ligustrum vulgare* +, *Viburnum lautana* +, *Viburnum opulus* +, lower shrub layer: *Euonynmus nana* 2, *Rubus caesius* 2, *Euonynmus verrucosa* 1, *Prunus spinosa* subsp. *dasyphylla* 1, *Euonynmus europaea* +, seedlings: *Fraxinus angustifolia* subsp. *oxycarpa* 2, *Acer campestre* 1, *Quercus robur* 1, *Ulmus minor* 1, herb layer: *Poa sylvicola* 3, *Aegopodium podagraria* 2, *Agrostis stolonifera* 2, *Aristolochia clematites* 2, *Calamagrostis epigeios* 2, *Stellaria holostea* 2, *Convallaria majalis* 1, *Leucojum aestivum* 1, *Lysimachia nummularia* 1, *Aethusa cynapium* +, *Ajuga genevensis* +, *Alliaria officinalis* +, *Anemone ranunculoides* +, *Brachypodium sylvaticum* +, *Campanula rapunculoides* +, *Carex divulsa* +, *Corydalis cava* +, *Corydalis solida* +, *Crocus variegatus* +, *Cynanchum vincetoxicum* +, *Dactylis glomerata* +, *Deschampsia caespitosa* +, *Epipactis latifolia* +, *Fritillaria montana* +, *Galium aparine* +, *Geum urbanum* +, *Glechoma hirsuta* +, *Hypericum hirsutum* +, *Inula britannica* +, *Isopyrum thalictroides* +, *Lapsana communis* +, *Lathyrus niger* +, *Lathyrus vernus* +, *Melampyrum pratense* +, *Melica uniflora* +, *Physalis alkekengi* +, *Polygonatum latifolium* +, *Prunella vulgaris* +, *Pulmonaria officinalis* +, *Ranunculus ficaria* +, *Scilla bifolia* +, *Scrophularia nodosa* +, *Serratula tinctoria* +, *Stachys germanica* +, *Torillis japonica* +, *Tulipa sylvestris* subsp. *australis* +, *Urtica dioica* +, *Valeriana officinalis* +, *Vicia dumetorum* +, *Viola reichenbachiana* +, *Iris graminea* r, *Viola elatior* r.

Locality: Romania, Moldavia region, Pădurea Bălteni (Vaslui), relevé area: 400 m^2, altitude 105 m, slope 2º, cover tree layer 70%.

We have grouped the communities from western and central Romania within the subassociation *Fraxino pannonicae-Ulmetum glabrae typicum* (Supplement S1, col. 4a), totaling about 8,000 ha.

Ulmo campestris-Fraxinetum holotrichae **Borza ex Sanda 1970**

Syn.: *Ulmeto campestris-Fraxinetum holotrichae* Borza 1966 (Art. 2b), *Quercetum roboris romanicum* Sanda 1970 (Art. 34)

Syntax. Syn.: *Fraxino pallisae-angustifoliae-Quercetum roboris* Popescu et al. 1984

Nomenclatural type for *Ulmo campestris-Fraxinetum holotrichae* Sanda 1970, Tab. 3, rel. 13.

Lectotypus hoc loco: tree layer: *Fraxinus pallisiae* 3, *Fraxinus angustifolia* 2, *Quercus robur* +, upper shrub layer: *Acer tataricum* 2, *Cornus sanguinea* +, *Crataegus monogyna* +, *Fraxinus pallisiae* +, *Frangula alnus* +, *Ulmus minor* +, *Viburnum opulus* +, lower shrub layer: *Rubus caesius* +, seedlings: *Fraxinus angustifolia* 1, *Fraxinus pallisiae* 1, herb layer: *Brachypodium sylvaticum* 2, *Carex riparia* 1, *Fallopia convolvulus* 1, *Eupatorium cannabium* +, *Galium palustre* +, *Heracleum sphondylium* +, *Iris pseudacorus* +, *Lycopus europaeus* +, *Lysimachia nummularia* +, *Lythrum salicaria* +, *Melampyrum nemorosum* +, *Peucedanum latifolium* +, *Phragmites communis* +, *Pulmonaria officinalis* +, *Scutellaria altissima* +, *Serratula tinctoria* +, *Symphytum officinale* +, *Vincetoxicum hirundinaria* +.

Locality: Romania, Muntenia region, Pădurea Spătaru (Buzău), relevé area: 200 m^2, altitude 955 m, slope 3º, cover tree layer 95%.

The communities from this type (Supplement S1, col. 5. Fig. 2), have been described from the southern and north-eastern part of the Romanian Plain (Comana, Spătaru, Umbrăreşti) (SANDA 1970, POPESCU et al. 1984, COROI 2001), where they grow on the less flooded terraces of valleys (such as Călmăţui, Buzău, Bârlad) but also in micro-depressions with a high water table and periodic flooding in spring (Neajlov). The soils are Gleyic Fluvisols and Gleysols, with moderate depth and humus content, a moderate amount of clay, a weakly acidic or basic reaction and weak salinity. (DONIŢĂ et al. 1990). The tree layer is dominated by *Fraxinus pallisae*, *F. angustifolia* ssp. *oxycarpa* and *Ulmus minor* (*U. cam-*

pestris non. L.), joined sporadically by *Acer campestre*, *A. tataricum*, *Carpinus betulus*, *Quercus robur*, *Populus alba*, and *Tilia tomentosa*. The shrub layer, with an average cover of 15%, is dominated by *Cornus sanguinea*, *Crataegus monogyna*, *Euonymus europaeus*, *Ligustrum vulgare*, *Rubus caesius* and *Viburnum opulus*. The herb layer has an average cover of 30% and contains certain regional elements specific to Southeastern Europe, such as *Asparagus tenuifolius*, *Ornithogalum boucheanum*, *Peucedanum latifolium*, *Polygonatum latifolium*, and *Scutellaria altissima*, that emphasize the regional character of this community type, as well as many widespread hygrophilous species such as *Galium palustre*, *Gladiolus imbricatus*, *Lycopus europaeus*, *Lythrum salicaria*, *Oenanthe aquatic*, *Phragmites australis*, and *Valeriana officinalis*, which indicate the hygro-mesophilous character of these forests. The high floristic diversity of the *Fraxinus pallisae* and *Ulmus minor* forests and their phyto-historical importance has led to the declaration of the Frasinu and Spătaru forests (Călmăţui valley) as natural forest reserves. The area occupied by these plant communities is about 22,000 ha.

Fraxino pallisae-Quercetum pedunculiflorae **Oprea 1997**
(Supplement S1, column 6a–6b; Fig. 2)

Syn.: *Quercetum robori-pedunculiflorae* Simon 1960 (Art. 2b)

Syntax. Syn.: *Fraxino angustifoliae-Quercetum pedunculiflorae* Chifu et al. 2004.

The communities dominated by *Quercus pedunculiflora*, *Fraxinus pallisae* and *F. angustifolia* ssp. *oxycarpa* that we have included in this community type were described from eastern Romania, namely in the floodplain of the Prut river (Medeleni), the middle basin of the rivers Bârlad (Munteni, Umbrăreşti) and Milcov (Petreşti), from the terraces situated between the rivers Călmăţui and Buzău (Spătaru) (OPREA 1997, POPESCU et al. 1984, COROI 2001, CHIFU et al. 2004), and from the Danube Delta (Letea Forest, Haşmacul Omer) (SIMON 1960, POPESCU et al. 1997). They grow on flat ground at low altitudes (10–90 m), with a high water table (c. 1 m), on Mollic Cambisols, Gleyic Chernozems/ Phaeozems and Gleyic Fluvisols, developed on sandy-clayey alluvial deposits (DONIŢĂ et al. 1990). Besides the above-mentioned dominant species, the tree layer sporadically contains *Acer campestre*, *A. tataricum*, *Fraxinus excelsior*, *Populus alba*, *Quercus robur*, *Ulmus minor*, and *U. procera*. Frequent species in the shrub layer include *Cornus sanguinea*, *Crataegus monogyna*, *Prunus spinosa*, *Pyrus pyraster*, *Rosa canina*, and *Viburnum opulus*, while the herb layer contains both differential species for the alliance *Ulmenion* and species characteristic for the order *Fagetalia* and class *Carpino-Fagetea.* The meso-hygrophilous character of this community type is emphasised by the presence of *Agrostis stolonifera*, *Galium palustre*, *Lycopus europaeus*, *Lysimachia vulgaris*, *L. nummularia*, and *Mentha aquatica.* The floristic diversity of these communities differs according to the local micro-climate and soil substrate.

We have grouped *Quercus pedunculiflora* communities growing in river floodplains on Gleyic Chernosems/Phaeosems with high humus content in the subassociation *Fraxino pallisae-Quercetum pedunculiflorae typicum* (Supplement S1, col. 6a). The area occupied by these plant communities is about 8,200 ha.

Communities growing on weakly gleyed Mollic Cambisols from the Danube Delta with ecological differential species such *Periploca graeca*, *Asparagus pseudoscaber*, *Vitis sylvestris* and *Carex acutiformis*, were grouped in the subassociation *Fraxino pallisae-Quercetum pedunculiflorae periplocetosum graecae* subass. nova (Supplement S1, column 6b) (SIMON 1960, POPESCU et al. 1997).

Nomenclatural type for *Fraxino pallisae-Quercetum pedunculiflorae periplocetosum graecae* Simon 1960, rel. 15, p. 317. Lectotypus hoc loco: tree layer: *Quercus pedunculiflora* 4, *Quercus robur* 1, upper shrub layer: *Cornus sanguinea* 2, *Crataegus monogyna* 1, *Fraxinus angustifolia* subsp. *oxycarpa* 1, *Fraxinus pallisiae* 1, lower shrub layer: *Berberis vulgaris* 1, *Ligustrum vulgare* 1, *Periploca graeca* 1, *Prunus spinosa* subsp. *dasyphylla* 1, *Rhamnus cathartica* 1, *Vitis sylvestris* 1, *Rosa canina* +, *Rubus caesius* +, seedlings: *Quercus robur* +, herb layer: *Polygonatum latifolium* 2, *Brachypodium sylvaticum* 1, *Convallaria majalis* 1, *Galium mollugo* 1, *Melica transsilvanica* 1, *Vincetoxicum hirundinaria* 1, *Bromus inermis* +, *Chondrilla juncea* +, *Linaria genistifolia* +, *Viola hirta* +.

Locality: Romania, Dobruja region, Hasmac Omer (Danube Delta), relevé area: 100 m^2, altitude 6 m, slope -, cover tree layer 65%, cover shrub layer 50%, cover herb layer 60%.

The area occupied by these plant communities is about 1,600 ha.

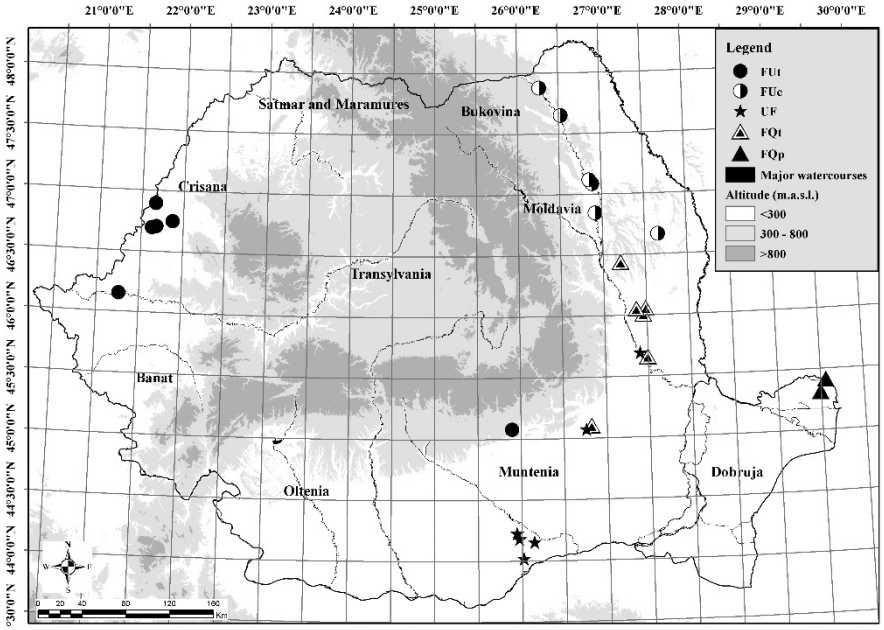

Fig. 2. The synchorological map of the floodplain forests in the plain areas of Romania: *Fraxino pannonicae-Ulmetum glabrae typicum* (FUt), *Fraxino pannonicae-Ulmetum glabrae euonymetosum nana*e (FUe), *Ulmo campestris-Fraxinetum holotrichae* (UF), *Fraxino pallisae-Quercetum pedunculiflorae typicum* (FQt), *Fraxino pallisae-Quercetum pedunculiflorae periplocetosum graecae* (FQp).

Abb. 2. Synchorologische Karte der Flachland-Auenwälder Rumäniens. Communities see above.

This study aimed to clarify the syntaxonomical position of alder and ash communites that grow in the river floodplains from the plain areas of Romania to the colline and montane belts of the Romanian Carpathians. These pluristratified forests have a major importance in the development of Fluvisols, preventing soil erosion in the floodplains. They significantly mitigate the effects of spring and autumn floods, which are frequently disastrous in the mountains, where the deciduous or evergreen forests from slopes were clearcut. In addition, the ecological conditions of the *Alnus* dominated communities, even at low altitudes, favor the persistence of many Carpathian and Carpathian-Balkan species that confer these forests a particular phytogeographical character from those from Central Europe. The forests of oak,

elm and ash from certain river floodplains and microdepressions from the eastern and south-eastern part of Romania have, in their floristic structure, regional, Pontic-Balkan species of European interest, that confer to these communities a submeridional Southeastern European character.

Although within the Natura 2000 approach only the habitat 91E0 was granted a priority status, we consider that, given the large losses in area, the forests included in the habitat 91F0 should also receive conservation priority in Romania.

Erweiterte deutsche Zusammenfassung

Einleitung - In einer syntaxonomischen und ökologischen Untersuchung wurden die Auenwälder Rumäniens im Vergleich zu denen Zentral- und Südost-Europas analysiert.

Methoden - Zu diesem Zweck wurden 473 phytocoenologische Aufnahmen, die im Laufe der Jahre von verschiedenen Autoren aus allen Landesteilen Rumäniens veröffentlicht wurden, analysiert und syntaxonomisch eingeordnet. Die floristische Struktur der einzelnen Syntaxa wurde in einer synoptischen Tabelle zusammengefasst, wobei die Stetigkeit der Arten prozentuell wiedergegeben wird.

Ergebnisse und Diskussion - Aufgrund von Charakter- und Trennarten wurden die identifizierten Pflanzengesellschaften (Assoziationen) von uns in den Verband *Alnion incanae* Pawłowski 1928 entsprechend den heutigen phytosoziologischen Auffassungen gruppiert (s. Beilage S1). Da sich die spezifischen Phytocoenosen der intramontanen Flussauen und der Ebene floristisch prägnant voneinander unterscheiden, erscheint es sinnvoll, die abgegrenzten Assoziationen zwei verschiedenen Unterverbänden zuzuordnen. In den durch die Differenzialarten *Alnus glutinosa*, *A. incana*, *Caltha palustris*, *Chaerophyllum hirsutum*, *Chrysosplenium alternifolium*, *Cirsium oleraceum*, *Crepis paludosa*, *Equisetum hyemale*, *E. sylvaticum*, *Matteuccia struthiopteris*, *Petasites albus*, *Senecio ovatus*, und *Stellaria nemorum* gekennzeichneten Unterverband *Alnenion glutinosae-incanae* Oberdorfer 1953 wurden die Assoziationen *Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957, *Telekio speciosae-Alnetum incanae* Coldea 1990 und *Carici remotae-Fraxinetum excelsioris* Koch ex Faber 1936 eingegliedert.

Dem Unterverband *Ulmenion* Oberdorfer 1953, der sich vom ersten Unterverband durch die Trennarten *Acer tataricum*, *Asparagus tenuifolius*, *Convallaria majalis*, *Malus sylvestris*, *Poa sylvicola*, *Polygonatum latifolium, Populus alba, Pyrus pyraster, Quercus pedunculiflora, Q. robur, Rhamnus catharticus* und *Ulmus minor* unterscheidet, wurden die Assoziationen *Fraxino pannonicae-Ulmetum glabrae* Aszód 1953 corr. Soó 1963, *Ulmo campestris-Fraxinetum holotrichae* Borza ex Sanda 1970 und *Fraxino pallisae-Quercetum pedunculiflorae* Oprea 1997 untergeordnet.

Die Verbreitung der untersuchten Pflanzengesellschaften auf dem Gebiete Rumäniens ist aus den zwei beigefügten Karten (Abb. 1, 2) mit den Ortsangaben der phytosoziologischen Aufnahmen der jeweiligen Syntaxa ersichtlich.

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Supplements

Supplement S1. The associations of the *Alnion incanae* from Romania.

Beilage S1. Die Assoziations des *Alnion incanae* aus Rumänien.

Additional supporting information may be found in the online version of this article.

Zusätzliche unterstützende Information ist in der Online-Version dieses Artikels zu finden.

Supplement E1. Origin of relevés.

Anhang E1. Herkunft der Aufnahmen.

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Supplement S1. The associations of the *Alnion incanae* from Romania

Beilage S1. Die Assoziationen des *Alnion incanae* aus Rumänien

Associations:

1a. Stellario nemorum-Alnetum glutinosae Lohmeyer 1957-typicum (SAt)
1b. Stellario nemorum-Alnetum glutinosae-petatisetosum hybridi subass. nova h.l. (SAp)
2a. Telekio speciosae-Alnetum incanae Coldea 1991-typicum (TAt)
2b. Telekio speciosae-Alnetum incanae-petasitetosum kablikiani Coldea 1991 corr. h.l. (TAp)
3. Carici remotae-Fraxinetum excelsioris Koch ex Faber 1936 (CF)
4a. Fraxino pannonicae-Ulmetum glabrae Aszód 1953 corr. Soó 1963-typicum (FUt)
4b. Fraxino pannonicae-Ulmetum glabrae-euonymetosum nanae Dobrescu 1968 (FUe)
5. Ulmeto campestris-Fraxinetum holotrichae Borza ex Sanda 1970 (UF)
6a. Fraxino pallisae-Quercetum pedunculiflorae Oprea 1997-typicum (FQt)
6b. Fraxino pallisae-Quercetum pedunculiflorae-periplocetosum graecae subass. nova h.l. (FQp)

Association code	SAt	SAp	TAt	TAp	CF	FUt	FUe	UF	FQt	FQp
Association no.	1a	1b	2a	2b	3	4a	4b	5	6a	6b
Number of relevés	141	18	151	23	15	19	8	59	20	19
Altitude m.a.s.l.	85-550	160-550	290-910	550-1100	500-1000	90-400	100-280	40-300	40-90	4-10
Char. et diff. ass.										
Stellaria nemorum	49	33	45	65	47	·	63	·	·	·
Potentilla reptans	28	17	7	8	·	·	·	·	·	11
Chaerophyllum aromaticum	17	33	9	·	53	11	·	·	·	·
Telekia speciosa	18	44	67	78	47	21	·	·	·	·
Symphytum cordatum	2	11	14	30	20	·	·	·	·	·
Pulmonaria rubra	4	22	18	30	7	·	·	·	·	·
Carduus personata	4	·	15	48	20	·	·	·	·	·
Chaerophyllum hirsutum	6	17	45	35	7	·	·	·	·	·
Cirsium erisithales	·	·	9	22	·	·	·	·	·	·
Leucanthemum waldsteinii	·	·	3	17	·	·	·	·	·	·
Dentaria glandulosa	·	·	7	4	·	·	·	·	·	·
Geranium phaeum	26	33	29	61	87	11	·	·	·	·
Veronica montana	·	·	1	·	20	·	·	·	·	·
Silene heuffelii	·	·	1	11	13	·	·	·	·	·
Cerasus avium	·	·	·	·	7	32	50	·	40	·
Cornus mas	1	22	·	·	·	74	25	·	25	·
Arum maculatum	·	·	·	·	7	26	13	·	·	·
Pulmonaria mollisima	·	·	·	·	·	42	13	·	·	·
Fraxinus angustifolia subsp. oxycarpa	4	·	3	·	·	11	100	100	100	21
Tilia tomentosa	·	·	·	·	·	·	38	25	·	·
Serratula tinctoria	·	·	·	·	·	·	38	51	25	·
Peucedanum latifolium	·	·	·	·	·	·	·	51	10	·
Melampyrum nemorosum	·	·	·	·	·	·	·	25	·	·
Scutellaria altissima	·	·	·	·	·	·	·	17	·	·
Fraxinus pallisae	·	·	·	·	·	·	·	98	100	95
Quercus pedunculiflora	·	·	·	·	·	·	·	·	100	74
Diff. sub-ass.										
Petasites hybridus	9	83	31	61	7	·	·	·	·	·
Epilobium hirsutum	·	67	1	·	·	·	·	·	·	·
Dipsacus laciniatus	·	33	·	·	·	·	·	·	·	·
Hypericum tetrapterum	·	28	·	·	·	·	·	·	·	·
Petasites kablikianus	1	·	4	78	·	·	·	·	·	·
Aconitum moldavicum	·	·	·	17	·	·	·	·	·	·
Heracleum palmatum	·	·	1	13	·	·	·	·	·	·
Campanula abietina	·	·	4	13	·	·	·	·	·	·
Cortusa matthioli	·	·	·	13	·	·	·	·	·	·
Euonymus nana	·	·	·	·	·	·	88	·	·	·
Euonymus verrucosa	4	·	·	·	7	·	38	·	·	·
Scilla bifolia	·	·	·	·	·	·	63	2	·	·
Fritillaria montana	·	·	·	·	·	·	38	·	·	·
Leonurus marrubiastrum	·	·	·	·	·	·	25	2	·	·
Leucojum aestivum	·	·	·	·	·	·	38	10	·	·
Periploca graeca	·	·	·	·	·	·	·	·	·	100
Vitis sylvestris	·	·	·	·	·	26	·	5	·	47
Carex acutiformis	·	·	·	·	·	·	·	·	·	47
Euphorbia palustris	·	·	·	·	·	·	·	·	5	32
Carex hirta	·	·	·	·	13	·	·	·	·	42
Lythrum virgatum	·	·	·	·	·	·	·	·	·	26
Alnion incane										
Ulmus laevis	5	·	2	·	·	16	50	·	·	·
Rubus caesius	58	17	20	4	7	74	88	51	70	100
Viburnum opulus	13	33	9	·	·	16	88	27	15	42
Ulmus glabra	·	·	5	9	7	58	·	·	25	·
Prunus padus	2	·	5	·	13	·	·	·	·	·
Frangula alnus	11	28	2	·	·	32	25	15	10	16
Glechoma hederacea	46	11	34	57	40	11	63	5	55	21
Carex brizoides	4	·	3	4	7	21	50	·	·	·
Impatiens noli-tangere	33	78	48	65	47	5	13	·	·	·
Carex remota	22	22	16	22	93	21	38	2	25	·
Circaea lutetiana	34	39	28	26	20	53	25	·	·	·
Festuca gigantea	22	39	27	22	33	37	88	14	·	·
Lysimachia vulgaris	9	17	11	9	13	·	·	14	25	11
Rumex sanguineus	9	·	3	·	13	11	·	·	20	·
Elymus caninus	4	22	18	35	27	·	·	·	25	·
Stachys sylvatica	33	33	42	57	47	32	63	·	·	·
Thalictrum aquilegiifolium	2	6	12	22	·	·	·	·	·	·
Physalis alkekengi	4	·	5	·	·	5	63	2	·	·
Alnenion glutinosae-incanae										
Alnus glutinosa	100	100	17	4	40	·	·	·	·	21
Mentha longifolia	35	50	42	48	27	·	·	·	·	·
Cirsium oleraceum	21	28	32	43	27	·	·	·	·	·
Equisetum arvense	21	17	21	9	27	·	·	·	·	·
Matteuccia struthiopteris	19	33	28	52	7	·	·	·	·	·
Alnus incana	19	6	99	100	40	·	·	·	·	·
Caltha palustris	18	67	25	26	6	·	·	·	·	·
Scirpus sylvaticus	16	17	16	4	6	·	·	·	·	·
Potentilla anserina	14	17	5	13	·	·	·	·	·	·
Rubus idaeus	9	6	26	39	7	·	·	·	·	·
Senecio ovatus	6	28	16	35	·	·	·	·	·	·
Equisetum hyemale	5	6	11	17	·	·	·	·	·	·
Chrysosplenium alternifolium	4	6	11	17	13	·	·	·	·	·
Equisetum sylvaticum	4	·	7	30	6	·	·	·	·	·
Poa trivialis	4	11	11	26	7	·	·	·	·	·
Crepis paludosa	3	·	3	9	20	·	·	·	·	·
Spiraea chamaedryfolia	2	6	10	9	6	·	·	·	·	·
Cirsium palustris	1	22	6	4	6	·	·	·	·	·
Petasites albus	·	·	13	30	6	·	·	·	·	·
Doronicum austriacum	·	·	7	13	·	·	·	·	·	·
Ulmenion										
Quercus robur	1	·	·	·	·	100	100	56	30	42
Ulmus minor	3	·	·	·	·	58	100	47	75	5
Epipactis helleborine	·	·	·	·	·	53	25	·	20	16
Acer tataricum	·	·	·	·	·	42	50	46	65	·
Carex divulsa	·	·	·	·	13	42	50	12	45	·
Convallaria majalis	·	·	·	·	·	42	38	41	50	26
Polygonatum latifolium	·	·	·	·	·	42	38	22	45	5
Hypericum hirsutum	·	·	·	·	·	42	38	5	·	·
Polygonatum odoratum	·	·	·	·	·	42	·	22	25	11
Populus alba	·	·	·	·	·	37	13	20	15	21
Trifolium medium	·	·	·	·	·	32	·	8	20	·
Malus sylvestris	·	·	·	·	·	26	50	3	20	21
Vincetoxicum hirundinaria	·	·	·	·	·	26	25	34	20	21
Astragalus glycyphyllus	·	·	·	·	·	26	25	5	15	5
Rhamnus catharticus	·	·	·	·	·	26	13	3	10	11
Pyrus pyraster	1	·	1	·	·	21	38	24	30	53
Aristolochia clematitis	·	·	·	·	·	21	38	3	50	·
Ranunculus auricomus	·	·	·	·	·	21	13	8	20	·
Ulmus procera	·	·	·	·	·	21	·	·	35	·
Viola hirta	·	·	·	·	·	16	·	2	·	5
Asparagus tenuifolius	·	·	·	·	·	11	·	12	55	16
Ranunculus cassubicus	·	·	·	·	·	11	·	3	35	·
Poa sylvicola	·	·	·	·	·	·	38	3	10	32
Fagetalia										
Fagus sylvatica	2	17	19	13	13	21	·	·	·	·
Fraxinus excelsior	11	22	13	9	100	95	25	·	40	·
Acer pseudoplatanus	5	22	36	13	27	21	·	·	·	·
Daphne mezereum	·	·	13	17	7	·	·	·	·	·
Tilia plathyphyllos	1	·	·	·	·	21	·	·	·	·
Tilia cordata	2	11	3	4	13	26	75	·	·	·
Viola reichenbachiana	26	·	18	9	·	84	50	37	45	·
Scrophularia nodosa	16	·	15	26	13	47	25	19	10	·
Salvia glutinosa	38	44	45	35	47	21	·	·	·	·
Cardamine impatiens	12	11	8	35	13	11	·	8	50	·
Lamium galeobdolon	17	6	9	·	13	16	·	2	·	·
Pulmonaria officinalis	21	17	9	12	20	37	50	15	10	·
Paris quadrifolia	3	11	3	22	·	5	·	·	·	·
Euphorbia amygdaloides	11	28	37	30	13	11	·	2	·	·
Campanula trachelium	6	22	6	13	·	16	25	·	·	·
Sanicula europaea	13	·	11	4	7	26	·	2	·	·
Asarum europaeum	20	17	13	4	33	26	50	2	·	·
Epilobium montanum	6	·	13	26	·	·	·	·	·	·
Veronica urticifolia	8	6	7	43	·	·	·	·	·	·
Geum urbanum	52	28	48	52	47	84	63	27	75	·
Galium schultesii	3	6	4	4	·	47	25	·	·	·
Anemone ranunculoides	11	·	1	·	·	5	63	12	20	·
Allium ursinum	10	·	·	·	20	·	63	3	·	·
Mycelis muralis	16	28	34	30	13	32	·	·	·	·
Carex sylvatica	8	6	23	30	27	21	25	20	15	·
Corydalis solida	4	·	2	·	·	16	50	2	·	·
Dentaria bulbifera	4	·	·	·	·	·	63	2	·	·
Mercurialis perennis	1	·	11	17	7	5	·	·	·	·
Stellaria holostea	4	·	6	4	·	5	88	·	·	·
Carex pilosa	2	·	1	·	·	5	25	17	·	·
Equisetum telmateja	3	17	13	·	·	16	·	·	·	·
Geranium robertianum	32	39	50	78	47	47	25	·	35	·
Luzula luzuloides	2	·	5	17	7	32	·	·	·	·
Myosotis sylvatica	10	·	5	43	27	·	50	5	·	·
Oxalis acetosella	27	22	28	26	33	16	·	·	·	·
Galium odoratum	3	11	15	4	13	5	63	5	·	·
Campanula rapunculoides	9	28	·	·	7	·	38	3	·	·
Geum rivale	·	·	9	17	·	·	·	·	·	·
Polygonatum multiflorum	2	·	·	·	·	16	·	·	·	·

Continued on back page
Fortsetzung auf der Rückseite

Association code	SAt	SAp	TAt	TAp	CF	FUt	FUe	UF	FQt	FQp
Association no.	1a	1b	2a	2b	3	4a	4b	5	6a	6b
Number of relevés	141	18	151	23	15	19	8	59	20	19
Altitude m.a.s.l.	85-550	160-550	290-910	550-1100	500-1000	90-400	100-280	40-300	40-90	4-10
Carpino-Fagetea										
Carpinus betulus	26	39	13	4	33	53	75	14	10	·
Acer campestre	28	39	5	·	27	42	88	24	60	·
Ligustrum vulgare	13	17	7	·	·	89	75	42	35	16
Crataegus monogyna	47	33	24	4	20	100	100	56	70	47
Corylus avellana	36	39	38	13	33	53	88	19	·	11
Cornus sanguinea	17	22	9	·	6	53	100	66	70	53
Rosa canina	22	6	11	4	·	21	25	19	40	21
Prunus spinosa	4	6	1	·	·	42	88	2	50	5
Ribes uva-crispa	4	·	5	·	·	·	·	·	·	·
Euonymus europaeus	12	11	5	·	·	32	·	29	60	·
Lonicera xylosteum	·	·	5	9	7	·	·	·	·	·
Viburnum lantana	·	·	3	·	·	·	38	5	·	5
Hedera helix	6	·	1	·	6	11	38	2	·	·
Glechoma hirsuta	16	22	17	30	60	53	38	19	15	·
Dactylis polygama	11	11	20	17	27	47	63	17	35	·
Brachypodium sylvaticum	11	22	34	22	33	58	38	71	70	32
Clematis vitalba	24	50	15	13	13	47	25	19	10	21
Anemone nemorosa	10	·	5	4	·	5	38	·	·	·
Athyrium filix-femina	21	61	44	57	33	5	·	·	·	·
Dryopteris filix-mas	26	11	29	26	33	·	13	·	·	·
Poa nemoralis	18	·	17	4	27	26	·	3	55	·
Viola mirabilis	4	·	3	·	·	·	·	·	·	·
Moehringia trinervia	7	·	4	9	7	·	·	·	·	·
Symphytum tuberosum	1	6	·	·	·	·	·	·	·	·
Salicetalia purpureae s.l.										
Salix alba	16	28	14	9	7	5	·	·	·	5
Salix purpurea	9	33	4	·	7	16	·	·	·	·
Salix fragilis	11	·	6	9	·	·	·	·	·	21
Humulus lupulus	23	33	1	·	·	37	38	·	·	11
Lysimachia nummularia	44	67	36	17	47	68	38	27	50	16
Myosotis scorpioides	12	39	17	·	·	·	·	·	·	·
Urtica dioica	59	50	61	83	80	63	75	·	25	·
Aegopodium podagraria	60	17	48	52	53	53	100	15	·	·
Solanum dulcamara	22	44	23	4	7	11	25	·	·	·
Lamium maculatum	28	22	29	74	27	5	63	3	10	·
Symphytum officinale	11	11	7	·	·	·	·	41	30	74
Calystegia sepium	11	11	5	·	·	·	·	·	·	42
Companions										
Populus tremula	2	17	1	·	7	·	38	·	10	5
Picea abies	1	·	9	39	7	·	·	·	·	·
Sambucus nigra	38	50	21	26	27	26	88	19	35	·
Salix silesiaca	·	·	4	35	·	·	·	·	·	·
Salix cinerea	·	33	1	·	·	·	·	·	·	47
Ajuga reptans	16	6	19	9	40	·	·	19	20	·
Veronica chamaedrys	14	6	3	17	7	47	25	15	10	·
Plantago major	14	11	9	4	13	·	·	·	·	21
Stachys officinalis	3	11	·	·	·	21	·	8	40	11
Ranunculus acris	2	6	7	·	7	5	·	34	30	·
Ranunculus repens	56	72	47	52	53	26	13	7	20	11
Fragaria vesca	27	17	35	35	7	26	38	3	15	·
Cruciata laevipes	6	28	3	·	7	32	50	3	25	·
Prunella vulgaris	38	22	36	26	7	16	25	7	30	·
Angelica sylvestris	6	11	19	26	·	16	13	·	·	·
Cruciata glabra	9	·	6	9	7	47	13	3	·	·
Eupatorium cannabinum	18	50	15	9	20	·	·	15	10	37
Lapsana communis	20	17	20	4	20	47	63	17	35	·
Alliaria petiolata	11	6	4	4	20	42	88	5	35	5
Galeosis speciosa	23	33	23	9	40	21	50	·	·	·
Lythrum salicaria	14	33	3	·	·	·	·	31	10	·
Lycopus europaeus	35	22	21	22	·	11	·	31	20	32
Tussilago farfara	21	11	27	22	27	11	·	·	·	·
Filipendula ulmaria	13	·	23	30	7	·	25	·	·	·
Agrostis stolonifera	23	·	8	4	·	11	38	37	20	16
Heracleum sphondylium	11	17	8	·	7	·	38	·	5	·
Galium aparine	20	44	7	·	40	47	38	37	55	·
Poa pratensis	20	·	3	9	7	·	·	8	15	16
Ranunculus ficaria	10	·	2	·	7	47	88	22	25	·
Galium palustre	·	28	1	·	·	·	·	24	25	21
Taraxacum officinale	28	17	6	4	7	·	·	25	25	·
Clinopodium vulgare	9	·	6	4	·	32	·	·	10	·
Galium mollugo	4	28	3	·	·	16	·	12	10	5
Deschampsia caespitosa	·	·	8	17	27	·	38	·	·	·
Arctium lappa	9	28	·	·	7	·	·	8	·	·
Torilis japonica	4	·	2	·	·	·	38	20	·	·
Achillea millefolium	20	22	2	·	·	·	·	·	·	·
Juncus effusus	9	22	3	·	·	·	·	·	·	·
Galeopsis tetrahit	9	17	15	22	·	·	·	·	·	·
Trifolium repens	25	·	12	26	7	·	·	·	·	·
Equisetum palustre	·	28	5	·	·	·	·	·	·	·
Rumex crispus	4	22	·	·	·	·	·	·	·	·
Ballota nigra	7	·	·	·	·	·	·	·	10	·
Festuca drymeja	·	·	3	9	·	·	·	·	·	·
Rumex obtusifolius	4	6	8	13	·	26	·	·	·	·
Valeriana officinalis	·	·	10	26	20	·	·	49	·	·
Agrimonia eupatoria	·	·	·	·	·	26	·	·	5	·
Chaerophyllum temulum	·	·	·	·	·	16	25	·	30	·
Melica uniflora	·	·	·	·	·	·	38	34	35	·
Calamagrostis epigejos	·	·	·	·	·	·	38	3	10	16
Galium rubioides	·	·	·	·	·	·	·	17	50	32
Thalictrum lucidum	·	·	·	·	7	·	·	19	30	·
Lathyrus vernus	·	·	·	·	·	·	38	2	·	·
Lathyrus niger	·	·	·	·	·	·	38	·	10	·
Isopyrum thalictroides	·	·	·	·	·	·	38	10	·	·
Arctium nemorosum	·	·	·	·	·	·	50	·	25	·
Leucojum vernum	·	·	·	·	·	·	25	·	10	·
Asperula taurina	·	·	·	·	·	21	·	2	·	·
Phragmites australis	·	·	·	·	·	·	·	34	·	53
Gladiolus imbricatus	·	·	·	·	·	·	·	34	20	·
Colchicum autumnale	·	·	·	·	·	·	·	20	25	·
Carex spicata	·	·	·	·	·	·	·	·	55	·
Sium latifolium	·	·	·	·	·	·	·	·	50	·
Anthriscus cerefolium subsp. trichosperma	·	·	·	·	·	·	·	·	50	·
Viola alba	·	·	·	·	·	·	·	·	50	·
Pulmonaria mollis	·	·	·	4	·	·	13	·	25	·
Euphorbia lucida	·	·	·	·	·	·	·	·	25	·
Viola elatior	·	·	·	·	·	·	·	·	30	·
Iris pseudacorus	1	·	·	·	·	·	·	14	·	32

Taxa with very low constancy (under 20 %):

Bellis perennis (SAt: 16, TAt: 6, TAp: 13, CF: 7); *Euphorbia cyparissias* (SAt: 16, TAt: 5, CF: 7); *Plantago media* (SAt: 15, SAp: 6; TAt: 5, CF: 7, UF: 7, FQt: 10);*Potentilla anserina* (SAt: 14, SAp: 17; TAt: 5, TAp: 13); *Anthriscus sylvestris* (SAt: 13, SAp: 17; TAt: 5, CF: 7); *Stellaria media* (SAt: 13, TAt: 6, FUt: 16, UF: 8, FQt: 5); *Lolium perenne* (SAt: 13, SAp: 6; TAt: 1); *Polygonum hydropiper* (SAt: 12, SAp: 6); *Sambucus ebulus* (SAt: 11, SAp: 6); *Poa annua* (SAt: 10, CF: 7); *Parietaria officinalis* (SAt: 9, TAt: 1); *Erigeron annuus* (SAt: 9, SAp: 6; TAt: 2, TAp: 4, CF: 7); *Cerastium fontanum* (SAt: 9, CF: 7); *Erigeron canadensis* (SAt: 9); *Veronica serpyllifolia* (SAt: 8, SAp: 11); *Rubus hirtus* (SAt: 8, SAp: 6; TAt: 9); *Plantago lanceolata* (SAt: 8, SAp: 6; CF: 7); *Abies alba* (SAt: 7, TAt: 5); *Polygonum lapathifolium* (SAt: 6, SAp: 6; TAt: 1); *Arum orientale* (SAt: 6, FUt: 11); *Rorippa sylvestris* (SAt: 6, UF: 5, FQt: 15); *Myosoton aquaticum* (SAt: 6, SAp: 17; TAt: 3, CF: 7, FUt: 5); *Trifolium pratense* (SAt: 6, TAt: 1); *Pulmonaria montana* subsp. *porciusii* (SAt: 6); *Chelidonium majus* (SAt: 5, SAp: 6; TAt: 1, CF: 7); *Daucus carota* (SAt: 5, TAt: 3); *Mentha aquatica* (SAt: 5, UF: 12, FQt: 10, FQp: 5); *Lithospermum officinale* (SAt: 4, SAp: 6; TAt: 1); *Cardamine pratensis* (SAt: 4); *Poa palustris* (SAt: 4, TAt: 7, TAp: 9); *Pteridium aquilinum* (SAt: 4); *Staphylea pinnata* (SAt: 3, SAp: 11; FUt: 5); *Scutellaria galericulata* (SAt: 3, TAt: 3); *Polygonatum verticillatum* (SAt: 3, TAt: 2); *Agrostis capillaris* (SAt: 2, SAp: 6; CF: 7); *Silene latifolia* subsp. *alba* (SAt: 2, CF: 7); *Rudbeckia laciniata* (SAt: 2); *Carex pendula* (SAt: 1, SAp: 17; TAt: 1); *Betula pendula* (SAt: 1, SAp: 6; TAt: 1, TAp: 4); *Sorbus aucuparia* (SAt: 1, TAt: 3, TAp: 9, CF: 6); *Equisetum pratense* (SAt: 1, TAt: 2); *Primula elatior* (SAt: 1, TAt: 1); *Lychnis flos-cuculi* (SAt: 1, SAp:6); *Veratrum album* (SAt: 1, TAt: 7); *Stachys alpina* (SAt: 1, TAt: 3); *Rumex acetosa* (SAt: 1, TAt: 2); *Cardamine amara* (TAt: 12, TAp: 4, CF: 13); *Hypericum maculatum* (TAt: 9); *Silene dioica* (TAt: 7, TAp: 17, CF: 13); *Festuca rubra* (TAt: 7, TAp: 9); *Gentiana asclepiadea* (TAt: 7, CF: 7); *Circaea alpina* (TAt: 5); *Milium effusum* (TAt: 5, TAp: 9, CF: 6, FUt: 11); *Carum carvi* (TAt: 5, TAp: 4); *Luzula sylvatica* (TAt: 4, TAp: 9); *Valeriana tripteris* (TAt: 3, TAp: 4); *Dipsacus pilosus* (TAt: 3, CF: 7, FQt: 5); *Geranium sylvaticum* (TAt: 3); *Salvia verticillata* (TAt: 3); *Aconitum tauricum* (TAt: 3); *Sambucus racemosa* (TAt: 3, TAp: 13, CF: 13); *Senecio subalpinus* (TAt: 3, TAp: 4); *Epilobium parviflorum* (TAt: 3, TAp: 4); *Valeriana sambucifolia* (TAt: 3); *Geranium palustre* (TAt: 3); *Rumex alpinus* (TAt: 2, TAp: 9, CF: 7); *Streptopus amplexifolius* (TAt: 2); *Carduus crispus* (TAt: 2); *Angelica palustris* (TAt: 2); *Origanum vulgare* (TAt: 2); *Melampyrum sylvaticum* (TAt: 2); *Hesperis matronalis* (TAt: 1, CF: 7); *Bromus benekenii* (TAt: 1); *Achillea ptarmica* (TAt: 1); *Cirsium waldsteinii* (TAt: 1); *Calamagrostis arundinacea* (TAt: 1, TAp: 9); *Carex digitata* (TAt: 10); *Listera ovata* (CF: 13, FUt: 16); *Cerastium sylvaticum* (CF: 13); *Vicia sepium* (CF: 7, FUt: 16); *Quercus cerris* (FUt: 16, UF: 10); *Genista tinctoria* (FUt: 16, FQt: 15); *Maianthemum bifolium* (FUt: 16); *Cucubalus baccifer* (FUt: 11, FUe: 13, UF: 2); *Chaerophyllum bulbosum* (FUt: 11, FUe: 13); *Carex vulpina* (FUt: 11, UF: 14, FQt: 15); *Calamintha sylvatica* (FUt: 11, FQt: 15); *Carex tomentosa* (FUt: 11, FQt: 10); *Fallopia convolvulus* (UF: 17, FQt: 10); *Oenanthe aquatica* (UF: 17); *Ornithogalum boucheanum* (UF: 8, FQt: 10).

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