# X. MEZOPHILOUS DECIDUOUS FORESTS – FAGETALIA SYLVATICAE

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

### *Alnion incanae* Pawłowski in Pawłowski *et al.* 1928

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

### *Alnenion glutinosae-incanae* Oberd. 1953

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

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

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

#### *Habitat characteristics*

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

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

***Physiognomy***

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

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

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

### *Species composition*

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

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

### *Distribution of alder gallery forests on the Tisza plain*

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

### *Ulmenion* **Oberd. 1953**

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

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

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

### *Habitat characteristics and zonality*

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

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

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

### *Physiognomy*

The height of canopy layer of the oak-ash-elm gallery forests is at about 25-30 m with a cover of 60-85 %. When trees are less dense covering about 30-40 %, the

lower canopy layer is well-developed. The dominant trees are *Fraxinus angustifolia* ssp. *pannonica* and *Quercus robur*, although occassionally white poplar (*Populus alba*) may form a consociation. Both elm species, *Ulmus laevis* and *U. minor,* were much more abundant in the past until the elm disease decimated their populations. Today they occur only in small groups or as scattered individual trees.

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

***Species composition***

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

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

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

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

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

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

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

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

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

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

### *Fagion sylvaticae* Luquet 1926

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

### *Carpinenion betuli* Issler 1931

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

### X.3 *Circaeo-Carpinetum* Borhidi 2003

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

#### *Habitat characteristics and zonality*

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

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

extra amount of soil moisture supporting their persistence (for example, Bátorliget „Veres-folyás").

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

***Physiognomy***

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

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

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

The herb layer is characterized typically by high cover values (60–100 %), although lower values (5–30 %) may not be infrequent either. The following species

may be locally abundant: *Aegopodium podagraria, Allium ursinum, Anemone nemorosa, Anemone ranunculoides, Brachypodium sylvaticum, Circaea lutetiana, Convallaria majalis, Corydalis cava, Dentaria bulbifera, Ficaria verna, Gagea spathacea, Galeobdolon luteum, Galium odoratum, Isopyrum thalictroides, Mercurialis perennis, Polygonatum latifolium, Stellaria holostea, Vinca minor*. As it can be seen in this list the early spring aspect is pronounced with a number of additional species: *Corydalis solida, Gagea lutea, Galanthus nivalis, Leucojum vernum, Scilla kladnii, Scilla vindobonensis*.

***Species composition***

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

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

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

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

### *Distribution of oak-hornbeam forests on the Tisza plain*

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

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

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

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

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

### *References*

(For references see the next chapter)