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BLOCK FOREST (*ROSO PENDULINAE-TILIETUM CORDATAE*), A NEW FOREST COMMUNITY OF THE CARPATHIAN BASIN (CEROVÁ VRCHOVINA, SLOVAKIA)

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A new plant association (*Roso pendulinae-Tilietum cordatae*), similar to the *Poo nemoralis-Tilietum cordatae* Firbas et Sigmond 1928 (Central European siliceous block field forest), has been described. This forest community develops on the periglacial block fields of southern Slovakia (Cerová Vrchovina, syn.: Nógrád–Gömör basalt region). The community has been separated from the *Mercuriali-Tilietum* Zólyomi et Jakucs 1958 common in the submontane belt of the Pannonicum using phytocoenological comparative analyses. The ecological demand and the species combination clearly distinguish this association from the other forest communities described earlier from northern periglacial block fields of Hungary (e.g. *Mercuriali-Tilietum, Tilio tomentosae-Fraxinetum orni*). The absence of the early vernal aspect (e.g. *Adoxa moschatellina*, *Corydalis cava*, *C. solida*, *Galanthus nivalis*, *Isopyrum thalictroides*, etc.), of submediterranean shrubs, such as *Cornus mas*, *Staphylea pinnata*, *Viburnum lantana*, as well as of *Fraxinus excelsior* and *F. ornus* is remarkable at all sites. On the other hand, the block field forest contains species characteristic of continental forest-steppes (e.g. *Cotoneaster matrensis*, *Euonymus verrucosus*, *Spiraea media*, etc.), coexisting with montane elements (e.g. *Rosa pendulina*, *Sambucus racemosa*, *Sorbus aucuparia*, *Dryopteris dilatata*, etc.). These habitats are suitable for the abundant growth of mosses, hepatics and lichens, especially *Andreaea rupestris*, *Cladonia rangiferina*, *C. squamosa*, *Dicranum tauricum*, *Diploschistes scruposus*, *Hedwigia ciliata*, *Polytrichum piliferum*, *Tritomaria quinquedentata*, etc. The herb layer is dominated by ferns, such as *Asplenium septentrionale*, *A. trichomanes*, *A.* × *alternifolium*, *Cystopteris fragilis*, *Dryopteris carthusiana*, *D. dilatata*, *D. filix-mas* and *Polypodium vulgare*.

Key words: basalt, block forest, Cerová Vrchovina, *Mercuriali-Tilietum*, Northern Hungarian Mts, periglacial block fields, phytosociological system

INTRODUCTION

Phytogeographical situation

The Nógrád–Gömör basalt region (approx. 430 km^2) is situated along the central part of the Hungarian–Slovakian border. According to modern phytogeographical divisions, the territory belongs to the sector of the Northern Hungarian Mts (Matricum) within the Pannonian flora province (Pannonicum). Slovak botanists define the area as part of the Ipel-Rimavska brazda (Dostál and Cervenka 1991), while the Hungarian region is considered as part of the Agriense (Soó 1960).

The area is to be considered as one of the northernmost representative of the Pannonian flora, being also in close contact with the Carpathian province (Michalko 1987). It is supposed that during the Late Holocene (subboreal period) the vegetation of the area was dominantly mesophilous beech wood of a more accentuated Carpathian character. This assumption is supported by the occurrence of some relict species, such as *Dentaria glandulosa*, *Matteuccia struthiopteris*, *Prenanthes purpurea*, *Petasites albus*, etc., living in the submontane belt of the basalt area.

From geomorphological aspect the basalt is characterized by high relief, where the special flora of the habitats of various morphological features (e.g. periglacial block fields) refers to the different stages of the vegetation history (e.g. *Andreaea rupestris*, *Spiraea media*, *Rosa spinosissima*, *R. pendulina*, *Dryopteris dilatata*, *Sambucus racemosa* and *Valeriana stolonifera*).

Ecological survey

In spite of the geological diversity (rhyolite, andesite, basalt, sandstone, etc.) the basalt outcrops (basalt plateaux, basalt volcanic cones) and the underlying Oligocene-Miocene sediments define the land morphology of the region. This structure resulted in varied topography (Jugovics 1971, Horváth et al. 1997). The extent of the periglacial block fields in the Nógrád–Gömör basalt region is unusual in the submontane belt of the region. The basalt has undergone rapid physical weathering due to its special characteristics (olivin content, horizontal and vertical jointing) and the intensive frost shattering during the Pleistocene (Jugovics 1971, Gábris 1995).

At the higher altitudes climate shows a montane character (mean temperature in January: from –2.5 to –6 °C, the same in July: from 17 to 19.5 °C, annual precipitation: 600–850 mm) (Michalko 1987). The majority of the block fields is located in the altitude of 400–600 m asl. belonging to the oak-hornbeam (*Carici pilosae-Carpinetum*) and the submontane beech (*Melitti-Fagetum*) zone here.

The large (basalt) blocks create a special microclimate on the scree slopes (Kun 1998). The emerging rock surfaces act as edaphic deserts (arid and warm, arid and cold), while the cavities between them act as frost traps (humid and cold). Under the debris cover the snow remains until May at the entrance of the secondary caves. Extensive block fields and blocks of considerable size are found only along the rims of the basalt plateaux and larger basalt cones. At some places contact springs issue under the block fields. Due to these springs and the secondary caves a special cold and humid microclimate prevails between the blocks, which has preserved relict animals, like *Salamandra salamandra*. This amphibian is abundant only on these slopes and along some streams in the Nógrád–Gömör basalt region.

These edaphic conditions cannot be found on narrow ridges as it was written in earlier papers (Kun 1998).

At places, where the regolith is too thick (more than 1 m in diameter) for the roots of higher plants, there are extensive gaps. This competition-free habitat is suitable for lichens, mosses and some ferns. Some very rare species live in these gaps such as the glacial relict moss of the Hungarian submontane region, *Andreaea rupestris*, the montane fern species, *Dryopteris dilatata* and some sporadic hybrid taxa, such as *Asplenium* × *alternifolium* and *Rosa* × *reversa*. The largest *Hypno-Polypodietum* stands are growing here, forming a mosaic pattern under the canopy as well.

The microclimatic bipolarity of these habitats and the special transitional situation of the Nógrád–Gömör basalt region between the phytogeographical provinces Pannonicum and Carpaticum preserved relict species from different stages of the vegetation history (Boreal and subboreal periods).

Usually the block forest stands are in contact with submontane beech woods, Carpathian oak-hornbeam woods and in some cases with stands of the *Tilio-Fraxinetum.* On basalt cones block forests occur only on the northern slopes, while on basalt plateaux in all exposition.

Some periglacial block fields are also present at lower altitudes adjoining to xero-mesophilous oak woods, but in their flora the characteristic Tilio-Acerion and Fagetalia elements are represented by a lower number of species and decreasing abundance. It is assumed that the fall in the selectivity and relict preserving capacity of the block fields is in accordance with the lower altitude, higher temperature, the smaller block size and the decreasing thickness of the debris cover.

Phytosociological antecedents

Several previous phytosociological descriptions have been published about scree slopes and ridges in the Carpathian Basin. The lime scree forests on northern steep rocky slopes have been differentiated by Zólyomi (1958) as *Mercuriali-Tilietum*. The typical stand comes from the dachstein limestone scree slope of the Buda Hills. The *Mercuriali-Tilietum* definitely differs from *Tilio-Fraxinetum excelsioris* Zólyomi (1934) 1967 described earlier from crests, ridges and rocky peaks in the absence of continental elements (e.g. *Spiraea media*, *Carex brevicollis*) and the increasing ratio of Fagetalia (e.g. *Acer pseudoplatanus*) and submediterranean species (e.g. *Scutellaria columnae*). Based on these differences, they were classified into separate phytosociological classes (Table 1).

As for physiognomy, lime-dominated scree forests are similar along the Transdanubian and Northern Hungarian Mts: the canopy layer is built up by tree species well adapted to the rocky substrate such as lime, maple and ash with their curved trunks forming bunches, by the shrub layer of

Table 1
The treated communities in the actual syntaxonomic system according to Borhidi (1996) and Mucina et al. (1993)

XI. Broadleaved forests
- 32. Class: Querco-Fagetea Br.-Bl. et Vlieger in Vlieger 1937 emend. Borhidi 1996
  - Order: Fagetalia sylvaticae Pawlowski in Pawlowski et al. 1928
    - Alliance: Tilio platyphyllae-Acerion pseudoplatani Klika 1955
      - (Association group rich in maple (Mucina et al. (1993)):
        - Ass.: *Parietario-Aceretum* (Horánszky 1964) Soó 1971
        - Ass.: *Scolopendrio-Fraxinetum* Schwickerath 1938
      - (Association group rich in lime (Mucina et al. (1993)):
        - Ass.: *Mercuriali-Tilietum* Zólyomi et Jakucs in Zólyomi 1958
        - Ass.: *Poo nemoralis-Tilietum cordatae* Firbas et Sigmond 1928
        - Ass.: *Roso pendulinae-Tilietum cordatae,* ass. nova
    - Alliance: Fagion sylvaticae Luquet 1926
      - Suballiance: Cephalanthero-Fagenion R. Tx. in R. Tx. and Oberd. 1958
        - Ass.: *Tilio-Sorbetum* Zólyomi et Jakucs (1957) 1967
    - Alliance: Aremonio-Fagion (I. Horvat 1938) Borhidi in Török et al. 1989
      - Suballiance: Polysticho setiferi-Acerenion pseudoplatani Borhidi et Kevey 1996
        - Ass.: *Tilio tomentosae-Fraxinetum orni* (A. O. Horv. 1958) Soó et Borhidi in Soó 1962
- 33. Class: Quercetea pubescentis-petraeae (Oberd. 1948) Jakucs 1960
  - Order: Quercetalia cerris Borhidi 1996
    - Alliance: Aceri tatarici-Quercion Zólyomi et Jakucs 1957
      - Ass.: *Tilio-Fraxinetum excelsioris* Zólyomi (1934) 1967

Cornus mas and *Staphylea pinnata*, while the herb layer is characterized by a striking vernal aspect. Due to atlantic and mediterranean influences the *Tilio tomentosae-Fraxinetum orni* (A. O. Horv. 1958) Soó et Borhidi in Soó 1962 of the Mecsek and Villány Mts is rich in submediterranean and subatlantic elements, such as *Tilia tomentosa* in the canopy, *Ruscus aculeatus* in the shrub layer and *Aremonia agrimonoides*, *Asperula taurina*, *Doronicum orientale*, *Ruscus hypoglossum*, *Helleborus odorus*, *Chaerophyllum aureum* in the herb layer.

In spite of considerable overlap in the flora, the physiognomy of the gorge forests (e.g. *Scolopendrio-Fraxinetum* Schwickerath 1938, *Parietario-Aceretum* (Horánszky 1964) Soó 1971) and lime-dominated scree forests differs well in the height and habit of trees. Mucina et al. (1993) divided the Tilio platyphyllae-Acerion pseudoplatani Klika 1955 into two groups (Table 1): one dominated by maple (e.g. gorgeforests) and another one rich in lime (e.g. block forests).

Roso pendulinae-Tilietum has many common species with the *Tilio-Sorbetum* Zólyomi et Jakucs (1957) 1967, described from the limestone escarpments of the Bükk Mts. In contrast with scree forests, the stands of *Tilio-Sorbetum* grow on steep rocks, their canopy is lower, the shrub layer is mostly sparse and several calciphilous differential species characterize the herb and moss layers.

Mercuriali-Tilietum stands are widespread in the Hungarian mountains, as reported in numerous papers (Jakucs 1961, Fekete and Járai-Komlódi 1962, Fekete 1964, Horánszky 1964, Szujkó-Lacza 1967, Zólyomi 1967, Isépy 1968, Kovács 1968, Simon 1977, Debreczy 1981, Bartha et al. 1995, Kovács and Takács 1995, Vojtkó 1990, 1995, 1996, Fekete et al. 1997). Due to the frequent occurrence of transitional stands, many sampled plots were treated as rocky beech forest, gorge forest or typical *Mercuriali-Tilietum* (Fekete 1964, Kovács 1968, Simon 1977, Szmorad 1994, Nagy 1999).

Lime block forests (*Aceri-Tilietum*, *Tilia cordata-Poa nemoralis*, *Acero-Tilietum*, *Acereto-Tilietum*, etc.) growing on siliceous substrate have often been mentioned in German studies (Firbas and Sigmond 1928, Bartsch and Bartsch 1940, Oberdorfer 1957, Mayer 1984). These forests are typical edaphic, intrazonal associations in the submontane beech and oak-hornbeam belts, with a characteristic physiognomy, structure and composition influenced mostly by the morphology of the surface (periglacial "Felsenmeer" with large blocks).

Due to their successful generative and vegetative reproduction and distribution strategy (spreading by wind and animals) the characteristic tree and shrub species tolerate the talus creep and are well adapted to the shallow soil. In case of some species (e.g. *Tilia cordata*) self-saprophytism might have been advantageous for the roots to grow through unfavourable soil layers (Sen 1961).

The phytosociological consideration of these lime block forest associations has not always been uniform. According to their diffuse, sporadic occurrence in Central Europe, their flora is influenced by the elements of the neighbouring phytogeographical provinces. In the Swiss Jura and around Lake Boden they are rich in submediterranean and subatlantic elements (e.g. *Tamus communis*, *Helleborus foetidus*, *Ilex aquifolium*, *Euonymus latifolius*, *Asperula taurina*, etc.), while in the Hungarian mountains more continental elements are present (e.g. *Spiraea media*, *Euonymus verrucosus*, etc.). The floristical differences point to the diverse historical development of a given stand.

Mucina et al. (1993) separated a part of the relevés from the block forests considering them as *Poo nemoralis-Tilietum cordatae* Firbas et Sigmond 1928 ("Silikat-Blokkhalden-Lindenwald"). Since block forests have not yet been reported from the Hungarian mountains, Hungarian botanists treated these stands as gorge forests or montane beech forests. The presence of some species characteristic of gorge forest, such as *Lunaria rediviva*, *Polystichum* spp. supports this decision. Because of the high altitude and humidity of these sites, their soil type is similar to that of the gorge forests. Where the debris of the block forest is so thick that permits only a loose closing of the canopy, the characteristic species of the gorge forest disappear and they will replaced by other elements unusual in them.

The edaphic associations mentioned above are (relatively) easily distinguishable with the help of the following table (Table 2).

MATERIAL AND METHODS

Sampling plots were studied with the square method of the Zürich-Montpellier school according to Braun-Blanquet (1928). All the sampling plots were studied twice a year (because of the absence of the vernal aspect only the summer aspect was recorded). Table ordination of the species (Raunkiaer's life form categories, flora elements, Borhidi's ecological indicator values, phytosociological characterization) and relevés calculations based on the presence and absence of the species were carried out with the software developed by Kevey and Hirmann (Kevey 1993, 1997, Kevey and

Table 2

Differences between the forest associations of the rocky habitats in the Pannonicum

	Rocky steppe forest	Lime-dominated scree forest	Block forest	Gorge forest
Occurrence (veg. belt)	oak and beech	beech	oak and beech	beech
Geomorphology	rocky peak, ridge	scree slope	"Felsenmeer", block field	valley, steep slope
Substrate (bed-rock)	limestone, volcanic	limestone, volcanic	volcanic	limestone, andesite
Soil type	rendzina, "mullranker"	black humus	("mullranker")	black humus
Canopy, cover	open	close	open	close
Canopy, height	low (10–15 m)	middle high (15–25 m)	middle high (10–20 m)	high (20–35 m)
Physiognomy	curved trunk forming bunch	curved trunk forming bunch	curved trunk forming bunch	timber trees
Shrub layer	well developed	well developed	well developed	undeveloped
Herb layer	striking vernal aspect	striking vernal aspect	absence of vernal aspect	striking vernal aspect
Moss layer	subordinated	well developed	very well developed	well developed
Selective factors	exposed rocks	mobile rocks (scree)	blocks (heat and frost)	wet rocky slopes, frost

Borhidi 1998). According to the synthetic tables of the forests (Zólyomi 1958, Isépy 1968, Kovács 1968, Simon 1977, Kevey ined., Nagy ined.) the characteristic species combination of the *Roso pendulinae-Tilietum cordatae* was stated based on the constancy of the differential species.

Based on relevés made by Kevey (ined.) (Keszthely Mts, Bakony Mts, Gerecse Mts), Kovács (1968) and Simon (1977), the associations of the Hungarian scree slopes were compared with the block forests of the Cerová Vrchovina using cluster analysis (Statistica for Windows). Within the phytosociological table species are grouped according to their position in the syntaxonomic system following the catalogue of Soó elaborated for the Hungarian Flora, amplified and critically revised by Borhidi (1993, 1995) (see also Horváth et al. 1995). For the vascular plant names Simon (1992), for the moss and hepatic names Corley et al. (1981), Corley and Crundwell (1991), Grolle (1983), for the lichen names Verseghy (1994), for the syntaxonomic nomenclature Borhidi (1996), Mucina et al. (1993) and Pott (1995) were considered.

RESULTS

Distinction and characterization of the
Roso pendulinae-Tilietum cordatae *ass. nova*

Mercuriali-Tilietum and *Roso pendulinae-Tilietum cordatae* relevés originating from four Hungarian mountains (Keszthely Mts, Bakony Mts, Mátra Mts and Cerová Vrchovina) were used to characterize the block forests of the Nógrád–Gömör basalt region. In the block forests xerophilous grassland elements (Festuco-Bromea), acidophilous oak wood species (Quercetea robori-petraeae) and xerophilous oak forest plants (Quercetea pubescentis-petraeae) are represented with higher frequency (Fig. 1). The role of these elements keeps increasing starting from the Transdanubian Mts up to the Northern Hungarian Mts. The Herbosa/Lignosa ratio is also the highest in the block forest stands. It may suggest strong geological influence, as

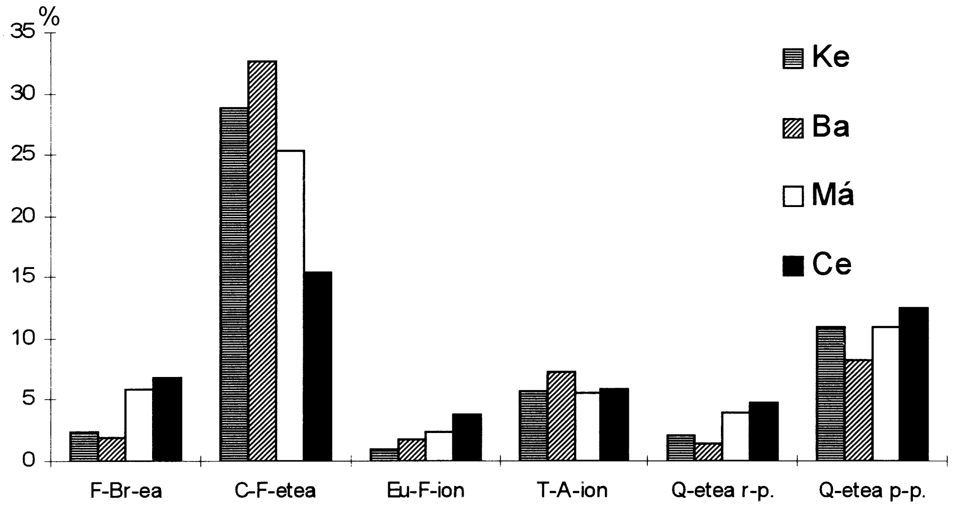

Fig. 1. Frequency of the phytosociological groups. F-Br-ea: Festuco-Bromea, C-F-etea: Carpino-Fagetea, Eu-F-ion: Eu-Fagion, T-A-ion: Tilio-Acerion, Q-etea r-p.: Quercetea robori-petraeae, Q-etea p-p.: Quercetea pubescentis-petraeae, Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

periglacial weathering was more intensive on the volcanic rocks of the Northern Hungarian Mts, producing coarser-grained debris than on the carbonates of the Transdanubian Mts (Kun 1998). Due to the thick debris closed canopy could not form, consequently, light plants and xerophilous species had opportunity to colonize abundantly here (e.g. *Asplenium septentrionale, Sedum maximum* and *Sedum acre*). In accordance with this, mesophilous forest (Carpino-Fagetea) elements are scarce in the block forests of the Nógrád–Gömör basalt region, since they are unable to survive in directly lighted and dry habitats. The microclimatic conditions of the cavities between the blocks and the shade under the patches of canopy might have favoured the survival of these subboreal phase elements in the collin-submontane region of the Pannonicum.

Comparing twelve synthetic tables from the following mountains – Keszthely Mts (Kevey ined.), Bakony Mts (Kevey ined.), Vértes Mts (Isépy 1968), Gerecse Mts (Kevey ined.), Buda Hills (Zólyomi 1958), Börzsöny Mts (Nagy ined.), Mátra Mts (Kovács 1968), Zemplén Mts (Simon 1977), Cerová Vrchovina (Csiky ined.), Swiss Jura (Oberdorfer 1957), Frankenwald (Oberdorfer 1957), Schwarzwald (Oberdorfer 1957), conspicuous similarities were found among the frequent species of the scree and block forests (Table 3). The dominant species in the canopy are *Tilia platyphyllos* and *Tilia cordata*. *Euonymus verrucosus* plays a considerable role in the shrub layer in the Pannonicum, while it is absent in the relevés recorded west from the Carpathians. *Poa nemoralis* and *Dryopteris filix-mas* are usually present in the herb layer with a high constancy.

There are important and characteristic differencies between the *Roso pendulinae-Tilietum cordatae* and the *Mercuriali-Tilietum*. Some species lacking from the block forests of the Cerová Vrchovina are present in the lime-dominated scree forests with high constancy, such as *Fraxinus excelsior* in the canopy and *Staphylea pinnata* and *Cornus mas* in the shrub layer. *Viburnum lantana* is absent from (the scree forests of) the Northern Hungarian Mts. The species of the vernal aspect and the characteristic species of the *Mercuriali-Tilietum*, such as *Adoxa moschatellina*, *Mercurialis perennis*, *Omphalodes scorpioides*, *Gagea minima*, *Geranium lucidum* fail completely from the block forests of the Nógrád–Gömör basalt region. *Melica uniflora*, dominant and widespread in other scree habitats, is sporadic here. The mentioned species (e.g. *Melica uniflora*, *Anemone ranunculoides*, *Corydalis cava*, *C. solida*, *Galanthus nivalis*, etc.) play a decreasing role from the Transdanubian Mts to the Northern Hungarian Mts. Most of the characteristic

Table 3

The constancy values of common and differential species in Roso pendulinae-Tilietum cordatae (9), Mercuriali-Tilietum (1–8) and "Aceri-Tilietum" (Poo nemoralis-Tilietum cordatae) (10–12)

Common species	1	2	3	4	5	6	7	8	9	10	11	12
Tilia cordata	III	I	V	I	–	III	II	III	III	I	III	–
Tilia platyphyllos	V	V	V	V	V	V	III	II	III	V	II	III
Euonymus verrucosus	V	II	IV	IV	V	III	III	II	V	–	–	–
Dryopteris filix-mas s. str.	V	IV	–	IV	–	IV	IV	II	V	I	II	II
Melica uniflora	III	IV	IV	V	V	V	III	III	I	III	–	I
Poa nemoralis	IV	IV	II	V	–	IV	V	IV	V	III	IV	II
Polypodium vulgare	II	III	II	III	III	III	–	III	V	–	–	–
Sedum maximum	III	III	II	IV	V	III	V	III	V	–	–	–
Negative differential species	1	2	3	4	5	6	7	8	9	10	11	12
Fraxinus excelsior	V	V	V	V	V	V	II	II	–	V	III	III
Cornus mas	IV	III	V	III	V	II	–	I	–	–	–	–
Staphylea pinnata	V	IV	–	II	V	I	–	II	–	–	–	–
Viburnum lantana	I	II	I	–	IV	–	–	–	–	IV	I	I
Aconitum vulparia	–	IV	–	V	I	–	–	–	–	I	–	–
Adoxa moschatellina	III	II	–	V	III	I	I	–	–	–	–	–
Allium ursinum	V	V	–	V	–	–	–	–	–	–	–	–
Anemone ranunculoides	II	IV	III	V	V	III	II	–	–	–	–	–
Anthriscus nitida	–	III	–	–	–	–	–	–	–	–	–	–
Asarum europaeum	II	III	I	III	III	–	–	III	–	I	–	–
Corydalis cava	V	V	III	V	V	II	II	–	–	–	–	–
Corydalis intermedia	–	V	III	V	–	–	–	–	–	–	–	–
Corydalis solida	V	–	–	V	V	III	II	I	–	–	–	–
Dentaria bulbifera	–	IV	I	V	I	II	I	I	–	–	–	–
Gagea lutea	IV	III	–	V	II	II	–	–	–	–	–	–
Gagea minima	–	–	–	–	IV	I	I	–	–	–	–	–
Galanthus nivalis	III	V	I	V	IV	II	II	–	–	–	–	–
Geranium lucidum	–	–	–	III	IV	II	–	–	–	–	–	–
Geranium phaeum	I	III	–	I	–	–	I	–	–	–	–	–
Isopyrum thalictroides	–	IV	–	III	III	I	II	–	–	–	–	–
Melica uniflora	III	IV	IV	V	V	V	III	III	I	III	–	–
Mercurialis perennis	IV	II	V	V	IV	II	IV	III	–	V	III	III
Omphalodes scorpioides	–	II	–	V	I	–	I	–	–	–	–	–

Positive differential species	1	2	3	4	5	6	7	8	9	10	11	12
Betula pendula	–	–	–	–	–	–	–	I	IV	–	–	–
Populus tremula	–	–	–	–	–	–	–	I	III	–	–	–
Salix caprea	–	–	–	–	–	–	–	–	II	–	–	–
Sorbus aucuparia	–	–	–	–	–	–	–	II	III	I	III	–
Cotoneaster matrensis	–	–	–	–	–	–	–	–	I	–	–	–
Rosa pendulina	–	–	–	–	–	–	II	–	V	–	I	–
Rosa spinosissima	–	–	–	–	–	–	–	–	I	–	–	–
Rubus idaeus	–	–	–	–	–	I	–	II	V	II	III	II
Sambucus racemosa	–	–	–	–	–	–	–	I	IV	–	I	–
Spiraea media	–	–	–	–	–	–	I	–	I	–	–	–
Asplenium septentrionale	–	–	–	–	–	–	–	I	III	–	–	–
Chrysosplenium alternifolium	–	–	–	–	–	–	–	–	I	–	–	–
Dryopteris carthusiana s. str.	–	–	–	–	–	–	–	I	I	–	–	–
Dryopteris dilatata	–	–	–	–	–	–	–	–	I	–	–	–
Festuca altissima	–	–	–	–	–	–	–	–	I	–	–	–
Luzula luzuloides	–	–	–	–	–	–	I	–	II	–	–	–
Sedum acre	–	–	–	–	–	–	–	–	I	–	–	–
Solanum dulcamara	–	–	–	–	–	I	–	I	III	–	–	–
Viscaria vulgaris	–	–	–	–	–	–	–	I	I	–	–	–

1: Keszthely Mts (Kevey ined.), 2: Bakony Mts (Kevey ined.), 3: Vértes Mts (Isépy 1968), 4: Gerecse Mts (Kevey ined.), 5: Buda Mts (Zólyomi 1958), 6: Börzsöny Mts (Nagy ined.), 7: Mátra Mts (Kovács 1968), 8: Zemplén Mts (Simon 1977), 9: Cerová Vrchovina (Csiky ined.), 10: Swiss Jura (Oberdorfer 1957), 11: Frankenwald (Oberdorfer 1957), 12: Schwarzwald (Oberdorfer 1957)

species of the *Mercuriali-Tilietum* are already absent in the northest part of the Northern Hungarian Mts (Zemplén Mts).

The majority of the positive differential species (represented in the *Roso pendulinae-Tilietum cordatae* with values of at least two frequency categories higher than in other associations) belong mainly to the "gap species" of the Carpathian beech forests (e.g. *Sorbus aucuparia*, *Sambucus racemosa*, *Rosa pendulina*, *Rubus idaeus*, *Populus tremula*, *Betula pendula*, *Dryopteris dilatata*, etc.), and may be considered as relics of the subboreal phase. Xerophilous grassland plants, such as *Asplenium septentrionale*, *Sedum acre*, *Spiraea media*, *Cotoneaster matrensis*, acidophilous forest elements (e.g. *Luzula luzuloides*, *Viscaria vulgaris*) and alder wood species (e. g. *Dryopteris carthusiana*, *Chrysosplenium alternifolium, Solanum dulcamara*) are also typical of this block forest, but occurring less frequently.

Table 4
Roso pendulinae-Tilietum cordatae

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Phragmitetea																			
Solanum dulcamara (Cal, Bia, Spu, Ate, AP)	C	+	+	+	+	+	-	+	-	-	+	-	-	-	-	1	+–1	III	53.3
Arrhenatheretea incl. Arrhenatheretalia)																			
Anthriscus sylvestris (Ar, GA, Spu, AP)	C	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	I	6.7
Calluno-Ulicetea (incl. Vaccinio-Genistetalia et Calluno-Genistion)																			
Betula pendula (Qrp, AbP)	A1	–	–	–	–	–	–	–	–	–	1	–	2	1	–	–	1-2	I	20.0
	B1	–	+	+	+	–	–	+	–	+	+	–	+	1	+	–	+–1	III	60.0
	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	I	13.3
	S	–	+	+	+	–	–	+	–	+	1	–	2	2	+	+	+–2	IV	66.7
Festuco-Brometea																			
Sedum acre	C	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	+	I	13.3
Festucetalia valesiacae																			
Cardaminopsis arenosa (TAc, Qpp)	C	–	–	+	+	+	+	+	–	–	–	–	+	+	+	–	+	III	53.3
Allium montanum	C	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	I	6.7
Asplenio-Festucion pallentis																			
Polypodium vulgare (TAc, Qrp)	C	2	2	1	2	1	1	–	+	1	1	2	2	+	1	2	+–2	V	93.3
Asplenium septentrionale	C	–	–	–	+	–	–	+	+	+	+	–	–	+	1	+	+–1	III	53.3
Asplenium trichomanes (BrF, TAc, Qrp, OCn)	C	+	+	+	–	–	–	–	–	–	–	+	–	–	–	+	+	II	33.3
Calystegion sepium																			
Myosoton aquaticum (Pte, Spu, Ate, AP)	C	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	I	6.7
Epilobietea angustifolii (incl. Epilobietalia)																			
Rubus idaeus (US, CF)	B1	1	1	1	1	1	+	+	+	1	1	+	1	+	1	+	+–1	V	100.0
	C	+	1	+	+	+	+	+	+	+	+	–	+	+	+	–	+–1	V	86.7
	S	1	2	1	1	1	+	+	+	1	1	+	1	+	1	+	+–2	V	100.0
Salix caprea (US, QF)	A1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	I	6.7
	B1	–	–	–	–	1	–	1	–	+	–	–	–	–	1	–	+–1	II	26.7
	S	1	–	–	–	1	–	1	–	+	–	–	–	–	1	–	+–1	II	33.3
Epilobium angustifolium (Epn, Qrp)	C	–	–	+	+	–	–	–	–	–	–	–	–	–	–	+	+	I	20.0

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Urtico-Sambucetea (incl. Sambucetalia et Sambuco-Salicion capreae)																			
Sambucus racemosa (EuF, TAc)	B1	1	1	1	1	2	1	+	1	–	1	–	–	1	–	+	+–2	IV	73.3
	C	+	+	+	+	+	+	+	+	–	+	–	–	–	+	+	+	IV	73.3
	S	1	1	1	1	2	1	+	1	–	1	–	–	1	+	+	+–2	IV	80.0
Querco-Fagea																			
Euonymus verrucosus (Qpp, Pru)	B1	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+–1	V	100.0
	C	+	+	+	+	+	+	+	+	+	+	1	+	+	+	1	+–1	V	100.0
	S	+	1	1	1	1	1	1	1	1	1	2	1	1	1	2	+–2	V	100.0
Poa nemoralis	C	+	1	+	1	+	+	1	1	1	1	+	1	1	1	1	+–1	V	100.0
Sedum maximum (FB, TAc, Qpp)	C	+	1	1	1	+	+	+	+	+	+	+	1	+	+	+	+–1	V	100.0
Geranium robertianum (Epa, CF)	C	1	1	1	1	1	1	1	1	1	1	1	1	+	–	+	+–1	V	93.3
Mycelis muralis	C	+	+	+	+	–	+	+	–	+	+	+	+	+	+	+	+	V	86.7
Corylus avellana	A1	1	–	–	–	–	–	1	–	–	1	–	–	–	–	–	1	I	20.0
	B1	+	–	1	1	1	1	1	+	–	1	1	1	1	1	–	+–1	IV	80.0
	C	+	–	–	+	–	–	–	–	–	–	+	+	+	–	–	+	II	33.3
	S	1	–	1	1	1	1	2	+	–	2	1	1	1	1	–	+–2	IV	80.0
Quercus petraea agg. (Cp, Qrp, Qpp)	A1	–	–	–	1	1	1	2	1	–	1	1	–	2	3	+	+–3	IV	66.7
	B1	–	–	–	–	–	–	+	–	–	–	–	+	–	–	–	+	I	13.3
	C	–	–	–	–	–	–	+	–	–	+	–	–	+	+	–	+	II	26.7
	S	–	–	–	1	1	1	2	1	–	1	1	+	2	3	+	+–3	IV	73.3
Fallopia dumetorum (GA)	C	–	+	–	–	+	+	+	–	–	+	+	+	+	+	+	+	IV	66.7
Galium schultesii (Cp, Qpp)	C	–	+	–	+	+	–	+	–	–	1	–	+	1	1	+	+–1	III	60.0
Populus tremula (Qrp, Qia)	A1	–	2	1	1	–	–	–	–	–	–	1	–	1	1	2	1-2	III	46.7
	B1	–	+	–	–	–	–	+	1	–	–	1	–	1	1	+	+–1	III	46.7
	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	6.7
	S	–	2	1	1	–	–	+	1	–	–	2	–	2	2	2	+–2	III	60.0
Fragaria vesca (Epa)	C	+	–	–	+	–	–	–	+	–	+	–	+	+	+	+	+	III	53.3
Acer campestre	A1	–	–	–	–	2	1	2	1	–	–	–	–	1	–	–	1-2	II	33.3
	B1	–	–	–	–	1	+	1	+	–	–	–	–	1	1	–	+–1	II	40.0

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Acer campestre	C	–	–	–	–	+	+	+	+	–	–	–	–	+	+	+	+	III	46.7
	S	–	–	–	–	2	1	2	1	–	–	–	–	2	1	+	+–2	III	46.7
Campanula rapunculoides (Epa)	C	+	–	–	+	–	–	–	–	–	+	–	+	+	+	+	+	III	46.7
Tilia cordata (Cp, Qpp)	A1	3	2	–	2	3	–	–	2	–	2	–	–	–	–	–	2-3	II	40.0
	B1	1	1	–	1	+	–	–	1	–	1	–	–	–	–	–	+–1	II	40.0
	C	+	+	+	+	+	–	–	+	–	+	–	–	–	–	–	+	III	46.7
	S	3	2	+	2	3	–	–	2	–	2	–	–	–	–	–	+–3	III	46.7
Veronica chamaedrys subsp. *vindobonensis* (Ara)	C	–	–	–	–	–	–	+	+	+	+	–	1	1	+	–	+–1	III	46.7
Cornus sanguinea (Qpp)	B1	–	–	–	+	+	+	–	–	1	1	–	–	–	–	–	+–1	II	33.3
	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
	S	–	–	–	+	+	+	–	–	1	1	–	–	+	–	–	+–1	II	40.0
Pulmonaria obscura (CF)	C	–	+	–	+	+	+	–	–	–	1	–	–	–	–	+	+–1	II	40.0
Campanula persicifolia	C	–	–	–	+	–	–	+	–	–	–	–	–	+	+	+	+	II	33.3
Lonicera xylosteum	B1	1	2	1	+	–	–	–	–	–	–	–	–	–	–	–	+–2	II	26.7
	C	–	+	+	+	–	–	–	–	–	–	–	–	–	–	+	+	II	26.7
	S	1	2	1	+	–	–	–	–	–	–	–	–	–	–	+	+–2	II	33.3
Rhamnus catharticus (Qpp, Pru)	B1	–	–	–	–	1	–	1	–	–	1	–	–	–	–	–	1	I	20.0
	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	I	13.3
	S	–	–	–	–	1	–	1	–	–	1	–	–	+	–	+	+–1	II	33.3
Stellaria holostea (CF, Cp)	C	–	–	–	–	–	+	+	–	–	1	–	+	–	–	+	+–1	II	33.3
Cruciata glabra	C	–	–	–	–	–	–	+	–	–	+	–	+	–	+	–	+	II	26.7
Convallaria majalis	C	–	–	–	1	–	–	–	–	–	–	–	–	1	–	+	+–1	I	20.0
Euonymus europaea (Qpp)	B1	–	–	–	–	1	–	–	–	+	+	–	–	–	–	–	+–1	I	20.0
Galeopsis pubescens (Epa)	C	–	–	–	+	–	–	–	–	+	–	–	–	–	+	–	+	I	20.0
Carex divulsa (CF)	C	–	–	–	–	–	–	–	+	–	–	–	–	–	+	–	+	I	13.3
Clinopodium vulgare (Qpp)	C	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	+	I	13.3
Dactylis polygama (Cp)	C	–	–	–	–	–	–	+	–	–	–	–	–	–	+	–	+	I	13.3
Heracleum sphondylium (MoA)	C	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	+	I	13.3
Ligustrum vulgare (Cp, Qpp)	B1	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	+	I	13.3
Melica nutans	C	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	I	13.3

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Ajuga reptans (MoA)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
Campanula trachelium (Epa, Cp)	C	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	I	6.7
Clematis vitalba	C	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	I	6.7
Hieracium sabaudum agg. (Qrp, AbP)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
Hieracium sylvaticum agg. (Epa, Qrp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	6.7
Hypericum montanum	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
Melica uniflora (Cp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	6.7
Scrophularia nodosa (GA, Epa)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
Symphytum tuberosum subsp. *angustifolium* (CF, Cp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	6.7
Salicion albae																			
Humulus lupulus (Cal, Ate, AP)	B1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
	C	–	–	–	–	+	–	1	+	–	–	–	–	+	+	–	+–1	II	33.3
	S	–	–	–	–	+	–	1	+	–	–	–	–	+	+	–	+–1	II	33.3
Alnetea glutinosae																			
Dryopteris carthusiana s.str. (CF, Agi, Qrp, VP)	C	1	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+–1	I	13.3
Dryopteris dilatata (CF, Agi, Qrp, VP)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	13.3
Carpino-Fagetea (incl. Fagetalia)																			
Dryopteris filix-mas s. str.	C	2	2	2	2	1	1	1	1	2	2	1	1	1	1	2	1-2	V	100.0
Carpinus betulus (Cp)	A1	–	–	–	–	2	2	1	2	2	1	–	–	–	2	3	1-3	III	53.3
	B1	–	+	–	–	+	1	+	1	1	1	–	+	–	+	1	+–1	IV	66.7
	C	–	–	–	–	+	+	+	+	+	+	–	–	–	+	+	+	III	53.3
	S	–	+	–	–	2	2	1	2	2	2	–	+	–	2	3	+–3	IV	66.7
Fagus sylvatica (EuF)	A1	–	2	–	–	–	–	1	–	1	–	1	3	3	2	1	1-3	III	53.3
	B1	–	1	–	–	–	–	–	–	+	–	–	1	1	–	1	+–1	II	33.3
	C	–	+	–	–	–	–	+	–	–	–	–	+	+	+	–	+	II	33.3
	S	–	2	–	–	–	–	1	–	1	–	1	3	3	2	2	1-3	III	53.3
Sorbus aucuparia (Qrp, Qpp, VP)	A1	2	2	2	2	–	–	–	–	–	2	1	–	1	1	–	1-2	III	53.3
	B1	1	1	1	+	–	–	–	–	–	1	1	–	1	+	–	+–1	III	53.3
	C	+	+	+	+	–	–	–	–	–	+	+	–	+	+	–	+	III	53.3
	S	2	2	2	2	–	–	–	–	–	2	2	–	2	1	–	1-2	III	53.3

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Tilia platyphyllos (TAc, Qpp)	A1	2	–	3	2	2	3	–	–	3	–	2	–	–	–	1	1-3	III	53.3
	B1	–	–	+	1	1	+	–	–	2	–	1	–	–	–	1	+–2	III	46.7
	C	–	–	–	+	+	+	–	–	+	–	+	–	–	–	+	+	II	40.0
	S	2	–	3	2	2	3	–	–	4	–	2	–	–	–	2	2-4	III	53.3
Galeobdolon luteum	C	–	–	–	–	2	1	+	1	+	–	–	1	–	–	1	+–2	III	46.7
Glechoma hirsuta (Cp)	C	–	–	–	–	2	2	2	1	1	1	–	–	–	–	1	1-2	III	46.7
Acer pseudo-platanus (TAc)	A1	–	–	–	–	–	–	2	2	1	2	–	–	–	–	1	1-2	II	33.3
	B1	–	–	–	–	–	–	+	+	1	1	–	–	–	–	–	+–1	II	26.7
	C	+	–	–	–	–	–	+	1	+	+	–	–	–	–	+	+–1	II	40.0
	S	+	–	–	–	–	–	2	2	2	2	–	–	–	–	1	+–2	II	40.0
Moehringia trinervia	C	+	+	+	+	–	–	–	+	+	–	–	–	–	–	–	+	II	40.0
Lathyrus vernus	C	+	–	–	–	–	–	–	–	–	+	–	+	–	+	+	+	II	33.3
Acer platanoides (TAc)	A1	–	–	–	–	–	2	–	–	–	2	3	–	–	–	2	2-3	II	26.7
	B1	–	–	–	–	–	+	–	–	–	–	+	–	–	–	1	+–1	I	20.0
	C	–	–	–	–	–	+	–	–	–	+	+	–	–	–	+	+	II	26.7
	S	–	–	–	–	–	2	–	–	–	2	3	–	–	–	2	2-3	II	26.7
Cerasus avium (Cp)	A1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	1	I	13.3
	B1	–	+	–	–	1	–	–	–	–	–	1	–	–	–	+	+–1	II	26.7
	C	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	6.7
	S	–	+	–	–	2	–	–	–	–	–	1	–	–	–	1	+–2	II	26.7
Epilobium montanum (Epa, Qrp)	C	–	+	+	+	–	–	–	–	+	–	–	–	–	–	–	+	II	26.7
Ribes uva-crispa (AP, TAc, Pru)	B1	–	1	–	1	1	–	–	–	–	–	–	–	–	–	1	1	II	26.7
	C	–	+	–	–	1	–	–	–	–	–	–	–	–	–	+	+–1	I	20.0
	S	–	1	–	1	2	–	–	–	–	–	–	–	–	–	1	1-2	II	26.7
Hieracium lachenalii agg. (Qrp)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+	I	20.0
Oxalis acetosella (VP)	C	1	+	2	–	–	–	–	–	–	–	–	–	–	–	–	+–2	I	20.0
Carex digitata (Cp)	C	–	–	–	–	–	–	–	–	+	–	–	–	+	–	–	+	I	13.3
Lilium martagon (QF)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	I	13.3
Rubus hirtus (Epa, US)	B1	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	I	6.7
	C	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	+	I	13.3
	S	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	+	I	13.3

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Viola sylvestris	C	+	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	I	13.3
Actaea spicata (EuF, TAc)	C	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	I	6.7
Athyrium filix-femina (Qrp, VP)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	6.7
Hedera helix	A1	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
	C	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
	S	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
Salvia glutinosa	C	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
Ulmus glabra (TAc)	A1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	I	6.7
	B1	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
	C	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	6.7
	S	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	I	6.7
Alno-Padion																			
Impatiens noli-tangere (Sal)	C	+	+	1	+	–	–	–	–	–	–	–	–	–	–	–	+–1	II	26.7
Chrysosplenium alternifolium (TAc)	C	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	I	6.7
Festuca gigantea (Cal, Epa)	C	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	I	6.7
Eu-Fagion																			
Rosa pendulina	B1	1	1	1	–	2	–	1	1	1	2	2	2	1	+	+	+–2	V	86.7
	C	+	+	+	–	+	–	+	1	+	1	1	+	1	+	+	+–1	V	86.7
	S	1	1	1	–	2	–	1	2	1	2	2	2	2	+	+	+–2	V	86.7
Festuca altissima (TAc)	C	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	2	I	6.7
Tilio-Acerion																			
Cystopteris fragilis (AFe)	C	+	+	+	+	+	+	+	+	+	+	+	1	–	+	+	+–1	V	93.3
Quercetea robori-petraeae (incl. Pino-Quercetalia)																			
Luzula luzuloides (CU, AbP)	C	–	–	+	+	–	–	–	–	–	–	–	1	–	1	+	+–1	II	33.3
Calamagrostis arundinacea (Epa)	C	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	1-2	I	13.3
Viscaria vulgaris (Qpp)	C	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	+	I	13.3
Hieracium umbellatum agg. (NC, Epa, Qpp, PP)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
Veronica officinalis (NC, Epa, PP, VP)	C	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	I	6.7

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Quercetea pubescentis-petraeae																			
Rosa canina agg. (Pru, Prs)	B1	–	1	–	+	1	+	1	+	+	+	1	–	1	+	+	+–1	IV	80.0
	C	–	–	–	+	+	+	+	+	+	+	–	–	+	–	–	+	III	53.3
	S	–	1	–	+	1	+	1	+	+	+	1	–	1	+	+	+–1	IV	80.0
Polygonatum odoratum (Fvl)	C	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	I	13.3
Chamaecytisus hirsutus (Fvl)	C	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	I	6.7
Rosa spinosissima (Pru)	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
	C	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
	S	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
Solidago virga-aurea (NC, Epa, Qrp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
Vincetoxicum hirundinaria (Fvl)	C	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	I	6.7
Orno-Cotinion																			
Sorbus graeca	A1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	6.7
Quercetalia pubescentis-petraeae																			
Valeriana stolonifera	C	–	–	–	–	–	–	–	–	–	+	–	+	+	+	–	+	II	26.7
Trifolium medium	C	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
Aceri tatarico-Quercion																			
Spiraea media (SFe, AFe)	B1	–	–	–	–	–	–	–	–	–	–	–	2	1	–	–	1-2	I	13.3
	C	–	–	–	–	–	–	–	–	–	–	–	1	1	+	–	+–1	I	20.0
	S	–	–	–	–	–	–	–	–	–	–	–	2	2	+	–	+–2	I	20.0
Cotoneaster matrensis (Qpp)	B1	–	–	–	–	–	–	–	–	–	–	–	2	–	–	1	1-2	I	13.3
Indifferent																			
Urtica dioica (Ar, GA, Epa, Spu)	C	+	1	1	1	1	1	1	1	1	1	+	1	+	1	1	+–1	V	100.0
Taraxacum officinale (MoA, FPe, CyF, ChS)	C	+	+	+	+	+	+	+	+	+	–	–	+	+	–	+	+	IV	80.0
Galium aparine (Sea, Epa, QF)	C	–	+	–	+	+	+	1	+	+	+	+	–	–	+	+	+–1	IV	73.3
Chelidonium majus (Che, Ar, GA, Epa)	C	–	–	+	+	1	+	–	+	–	–	–	–	–	–	+	+–1	II	40.0
Euphorbia cyparissias (FB, ChS, Epa, Qpp)	C	–	–	–	–	–	–	+	–	–	–	–	–	+	–	–	+	I	13.3
Hypericum perforatum (NC, FB, Qpp, PP)	C	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	+	I	13.3
Poa angustifolia (Ara, FPi, FBt, ChS, Qpp)	C	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–	+	I	13.3
Galium mollugo (MoA, FBt, Qrp, Qpp)	C	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	I	6.7

Table 4 (cont.)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A-D	K	%
Juniperus communis (NC, Fvg, Qpp, EP, PP)	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	6.7
Silene vulgaris (Ara, Fvl, Qpp)	C	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	6.7

Roso pendulinae-Tilietum cordatae (Basic data of relevés)

Localities	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
Serial number	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2369	2370	2371
Year	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999
Date of relevé	20.06	20.06	20.06	20.06	20.06	20.06	21.06	21.06	21.06	21.06	12.07	12.07	17.08	17.08	17.08
Basic rock	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt	basalt	andesite	basalt	basalt	basalt	basalt
Block surface, mean (m×m)	1×2	1×2	1×2	1×1	0.5×1	0.5×1	0.5×1	0.5×1	1×1	0.5×.5	0.3×.5	0.2×.3	1×2	1×2	1×1
Altitude (m asl.)	500	500	510	520	500	500	540	500	460	500	500	450	530	525	530
Exposition (degree)	360	345	330	270	260	285	270	285	270	315	40	5	195	210	60
Declination (degree)	25	25	35	30	25	25	35	35	20	10	35	20	10	15	60
Upper canopy, cover (%)	60	60	55	60	60	60	55	50	65	60	50	60	60	50	50
Shrub layer, cover (%)	15	35	25	20	30	10	10	10	15	25	35	35	35	15	10
Herb layer, cover (%)	25	30	40	25	35	30	20	15	15	50	20	30	35	25	25
Moss layer, cover (%)	90	70	80	70	60	40	20	50	70	40	50	40	50	40	40
Upper canopy, height (m)	15	15	18	18	17	18	17	18	18	15	20	20	17	15	10
Shrub layer, height (m)	5	5	5	5	5	5	3	5	5	5	5	4	5	5	3
Plot size (m^2)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

Localities: 1–6.: Obrucna (Abroncsos): Medves Plateau (northern rim), 7–8.: Surice (Sőreg): Maly Karad (western rim), 9–10.: Surice (Sőreg): Sovi Vrch (western rim), 11.: Bukovinka (Sátoros): Siator (northeastern slope), 12.: Bukovinka (Sátoros): Somoska (northern slope), 13–14.: Stara Basta (Egyházasbást): Pohansky Vrch (southern rim), 15.: Stara Basta (Egyházasbást): Pohansky Vrch (eastern rim). Nomenclatural type: 1 (Serial number: 2394). Relevés made by Csiky, J. (ined.).

Abbreviations in the phytosociological tables. A1: upper canopy, AbP: Abieti-Piceea, AFe: Asplenio-Festucion pallentis, Agi: Alnion glutinosae-incanae, AP: Alno-Padion, Ar: Artemisietea, Ara: Arrhenatheretea, Ate: *Alnetea glutinosae*, B1: shrub layer, Bia: Bidentetea, BrF: Bromo-Festucion pallentis, C: herb layer, Cal: *Calystegion sepium*, CF: Carpino-Fagetea, Che: Chenopodietea, ChS: Chenopodio-Scleranthea, Cp: Carpinion, CU: Calluno-Ulicetea, CyF: Cynodonto-Festucion, EP: Erico-Pinetea, Epa: *Epilobietea angustifolii*, Epn: *Epilobion angustifolii*, EuF: Eu-Fagion, FB: Festuco-Bromea, FBt: Festuco-Brometea, FPe: Festuco-Puccinellietea, FPi: Festuco-Puccinellietalia, Fvg: *Festucetea vaginatae*, Fvl: *Festucetalia valesiacae*, GA: Galio-Alliarion, MoA: Molinio-Arrhenatherea, NC: Nardo-Callunetea, OCn: Orno-Cotinion, PP: Pulsatillo-Pinetea, Prs: Prunion *spinosae*, Pru: Prunetalia, Pte: Phragmitetea, QF: Querco-Fagea, Qia: *Quercetalia pubescentis-petraeae*, Qpp: *Quercetea pubescentis-petraeae*, Qrp: *Quercetea robori-petraeae*, S: sum (in total), Sal: *Salicion albae*, Sea: Secalietea, SFe: Seslerio-Festucion pallentis, Spu: *Salicetea purpureae*, TAc: Tilio-Acerion, US: Urtico-Sambucetea, VP: Vaccinio-Piceetea

The differential species of the *Poo nemoralis-Tilietum cordatae* are definitely acidophilous plants in the herb layer, such as *Vaccinium myrtillus*, *Deschampsia flexuosa*, *Teucrium scorodonia*. These species are absent from the

Table 5

Lichen, moss and hepatic species combination of northern and southern type of the *Roso pendulinae-Tilietum cordatae*

Northern type (serial number: 2394)	Southern type (serial number: 2369)
Lichens (35 species)	
On basalt: *Diploschistes scruposus* (Schreber) Norman *Trapelia coarctata* (Sm.) Choisy	On basalt: *Acarospora fuscata* (Nyl.) Th. Fr. *Diploschistes scruposus* (Schreber) Norman *Hypocenomyce scalaris* (Ach. ex Lilj.) Choisy *Lasallia pustulata* (L.) Mérat *Lecanora polytropa* (Ehrh. ex Hoffm.) Rabenh. *Lecanora rupicola* (L.) Zahlbr. *Lecidea fuscoatra* (L.) Ach. *Lepraria caesioalba* (B. de Lesd.) Laundon *Leproloma membranaceum* (Dickson) Vainio *Melanelia disjuncta* (Erichsen) Essl. *Melanelia sorediata* (Ach.) Goward et Ahti *Neofuscelia pulla* (Ach.) Essl. *Peltigera praetextata* (Flörke ex Sommerf.) Zopf *Porpidia glaucophaea* (Körber) Hertel et Knoph *Rhizocarpon geographicum* (L.) DC. *Scoliciosporum umbrinum* (Ach.) Arnold *Xanthoparmelia conspersa* (Ehrh. ex Ach.) Hale *Xanthoparmelia somloensis* (Gyelnik) Hale
On soil: *Cladonia coccifera* (L.) Willd. *Cladonia fimbriata* (L.) Fr. *Cladonia pyxidata* (L.) Hoffm. *Cladonia rangiferina* (L.) Weber ex Wigg. *Cladonia squamosa* (Scop.) Hoffm.	On soil: *Cladonia cenotea* (Ach.) Schaerer *Cladonia macilenta* Hoffm. *Cladonia rangiferina* (L.) Weber ex Wigg. *Cladonia squamosa* (Scop.) Hoffm.
On trunk (bark): *Cladonia coniocraea* auct. *Lecanora conizaeoides* Nyl. ex Crombie *Lecidella elaeochroma* (Ach.) Choisy *Lepraria incana* (L.) Ach. *Melanelia glabratula* (Lamy) Essl. *Parmelina tiliacea* (Hoffm.) Hale *Phlyctis argena* (Sprengel) Flotow	On trunk: *Hypocenomyce scalaris* (Ach. ex Lilj.) Choisy *Micarea denigrata* (Fr.) Hedl. *Parmeliopsis ambigua* (Wulfen) Nyl.

Mosses and hepatics (32 species)	
Andreaea rupestris Hedw.	*Andreaea rupestris* Hedw.
Barbilophozia barbata (Schmid ex Schreb.) Loeske	*Barbilophozia barbata* (Schmid ex Schreb.) Loeske
Bartramia pomiformis Hedw.	*Brachythecium velutinum* (Hedw.) B., S. & G.
Brachythecium velutinum (Hedw.) B., S. & G.	*Bryum flaccidum* Brid.
Bryum flaccidum Brid.	*Cynodontium polycarpon* (Hedw.) Schimp.
Dicranum scoparium Hedw.	*Dicranum scoparium* Hedw.
Grimmia hartmanii Schimp.	*Dicranum tauricum* Sap.
Grimmia trichophylla Grev.	*Grimmia hartmanii* Schimp.
Hedwigia ciliata (Hedw.) P. Beauv.	*Grimmia ovalis* (Hedw.)
Hylocomium splendens (Hedw.) B., S. & G.	*Grimmia trichophylla* Grev.
Hypnum cupressiforme Hedw.	*Hedwigia ciliata* (Hedw.) P. Beauv.
Lophozia excisa (Dicks.) Dum.	*Hypnum cupressiforme* Hedw.
Mnium stellare Hedw.	*Mnium stellare* Hedw.
Ortotrichum obtusifolium Brid.	*Paraleucobryum longifolium* (Hedw.) Loeske
Paraleucobryum longifolium (Hedw.) Loeske	*Platygyrium repens* (Brid.) B., S. & G.
Plagiochila porelloides (Torrey et Nees) Lindenb.	*Pohlia nutans* (Hedw.) Lindb.
Plagiomnium cuspidatum (Hedw.) T. Kop.	*Polytrichum formosum* Hedw.
Plagiothecium denticulatum (Hedw.) B., S. & G.	*Polytrichum juniperinum* (Willd.) Hedw.
Pleurozium schreberi (Brid.) Mitt.	*Ptilidium pulcherrimum* (G. Web.) Vainio
Polytrichum formosum Hedw.	*Thamnobryum alopecurum* (Hedw.) Nieuwl.
Polytrichum juniperinum (Willd.) Hedw.	*Tritomaria quinquedentata* (Huds.) Buch
Polytrichum piliferum Hedw.	
Pterygynandrum filiforme (Timm.) Hedw.	
Schistidium apocarpum (Hedw.) B., S. & G.	
Thamnobryum alopecurum (Hedw.) Nieuwl.	
Tritomaria quinquedentata (Huds.) Buch	

Nógrád–Gömör area or the occurrence of these acidophilous elements has not been proved.

The negative differential species of the *Roso pendulinae-Tilietum cordatae* against the *Poo nemoralis-Tilietum cordatae* in the canopy is the *Fraxinus excelsior* (Bartsch and Bartsch 1940), which occurs at several localities but is always absent on the thick periglacial block fields of the Cerová Vrchovina. The ash occurs only on thinner scree slopes, where the canopy is better developed and more closed. In these habitats the species combination of the shrub, herb and moss layers recall rather the flora of the submontane beech woods. The conifers are absent in the canopy because of certain vegetation historical causes (Zólyomi 1952). The positive differential species of the *Roso pendulinae-Tilietum cordatae* are the continental elements of the oak woods and rocky grasslands, which are widely distributed in the Matricum (e.g. *Spiraea media*, *Cotoneaster matrensis*, *Rosa spinosissima*, *Euonymus verru-*

cosus in the shrub layer), and the elements of the montane-alpine region, which occur in the Alps and the Carpathians, such as *Rosa pendulina* (Meusel and Jäger 1992). *Asplenium septentrionale*, *Sedum maximum*, *Solanum dulcamara* and *Andreaea rupestris* are characteristic in the herb and moss layers, but they are absent in the *Poo nemoralis-Tilietum cordatae* (Firbas and Sigmond 1928).

The characteristic species combination of the *Roso pendulinae-Tilietum cordatae* ass. nova (Table 4, relevés 1–15; nomenclatural type: Table 4, relevé 1) is the following: *Tilia cordata* in the canopy, *Sorbus aucuparia*, *Betula pendula*, *Populus tremula* occurring both in the canopy and shrub layer, *Rosa pendulina*, *Sambucus racemosa*, *Rubus idaeus*, *Spiraea media* in the shrub layer, *Asplenium septentrionale*, *Dryopteris dilatata*, *Solanum dulcamara*, *Luzula luzuloides*, *Festuca altissima* in the herb layer, *Andreaea rupestris*, *Dicranum tauricum*, *Tritomaria quinquedentata* and *Cladonia rangiferina* in the moss layer. Other characteristic species are *Tilia platyphyllos* in the canopy, *Euonymus verrucosus*, *Lonicera xylosteum* in the shrub layer, *Dryopteris filix-mas*, *Polypodium vulgare*, *Poa nemoralis* in the herb layer, *Barbilophozia barbata*, *Dicranum scoparium*, *Paraleucobryum longifolium*, *Polytrichum* spp., *Hedwigia ciliata* and *Diploschistes scruposus* in the moss layer. There are two subtypes of this community, one in southern (e.g. serial number 2394) and one in northern exposition (e.g. serial number 2369) (Table 4). In these cases the presence/absence of the *Tilia* species and the moss layer show the greatest ecological difference (Table 5).

There are stands with the same species combination in the Mátra Mts (Kékestető–Saskő) and according to the relevés of Simon (1977) in the Zemplén Mts. The characteristic and differential species are present in the Börzsöny Mts too, but they do not coexist within one association (Nagy J. ex verb.).

Raunkiaer's life form categories and flora elements

According to Raunkiaer's life form categories there are characteristic differences between the *Roso pendulinae-Tilietum cordatae* (Cerová Vrchovina) and the *Mercuriali-Tilietum* (Keszthely Mts, Bakony Mts and Mátra Mts). The mega-meso-, the micro- and the nanophanerophyton species (MM, M, N) are represented with high frequency in the block forest, while geophytes play a restricted role (Fig. 2). The presence of the latter on scree slopes gradually decreases from the Transdanubian Mts to the Northern Hungarian Mts. The thicker debris cover, made up of larger blocks, the re-

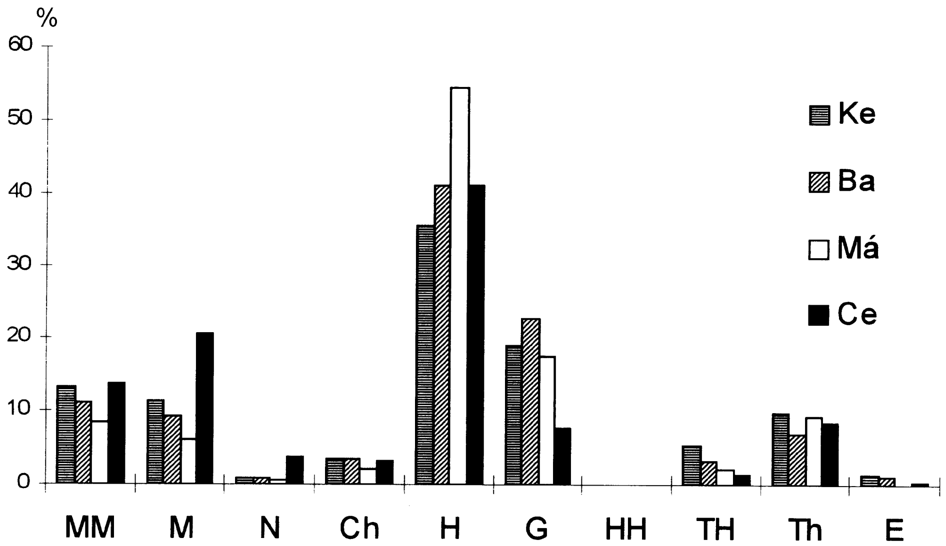

Fig. 2. Raunkiaer's life form categories. Ke: Keszthely Mts. Ba: Bakony Mts. Má: Mátra Mts. Ce: Cerová Vrchovina

stricted soil development and the increasing climatic extremities are considered to be in the background of this observation. In these areas the January mean temperature drops below –3 to –4 °C and the frost is not unusual in spring. Under these circumstances the best growing period for the early vernal geophytes is postponed to the time when the trees come into leaf, but at that time the light and soil conditions are already unfavourable for these species (Kevey 1978). This phenomenon may be amplified by the fact that the locations of the frost traps coincide with those where the thin soil accumulates. The snow may remain among the blocks till May. Only the chasmophytes, lichens, mosses, ferns and some frost-tolerant tree and shrub species can stand these conditions.

There are some characteristic differences between the block forest and the lime-dominated scree forest (*Mercuriali-Tilietum)* considering geo elements and distribution types. The circumpolar, boreal and subalpine species show their maximum in the *Roso pendulinae-Tilietum cordatae.* These plants are the "gap" species of the montane beech woods. Furthermore, European and submediterranean elements play a decreasing role in this community (Fig. 3).

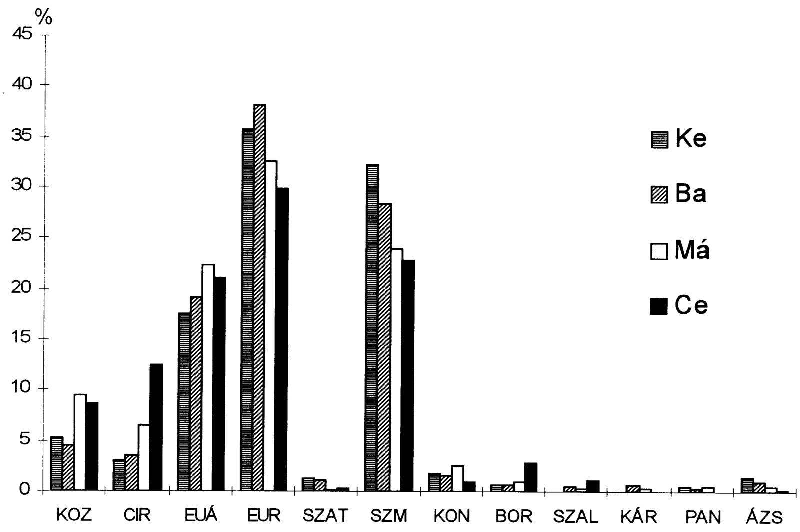

Fig. 3. Geo elements and distribution types. KOZ: cosmopolitan, CIR: circumpolar, EUÁ: Eurasian, EUR: European, SZAT: subatlantic, SZM: submediterranean, KON: continental, BOR: boreal, SZAL: subalpine, KÁR: Carpathian endemic, PAN: Pannonian endemic, ÁZS: Asian, Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

Relative ecological indicator values

Again *Mercuriali-Tilietum* relevés of three Hungarian mountains (Keszthely Mts, Bakony Mts, Mátra Mts) and the block forest relevés of the Cerová Vrchovina were examined using the relative ecological indicator

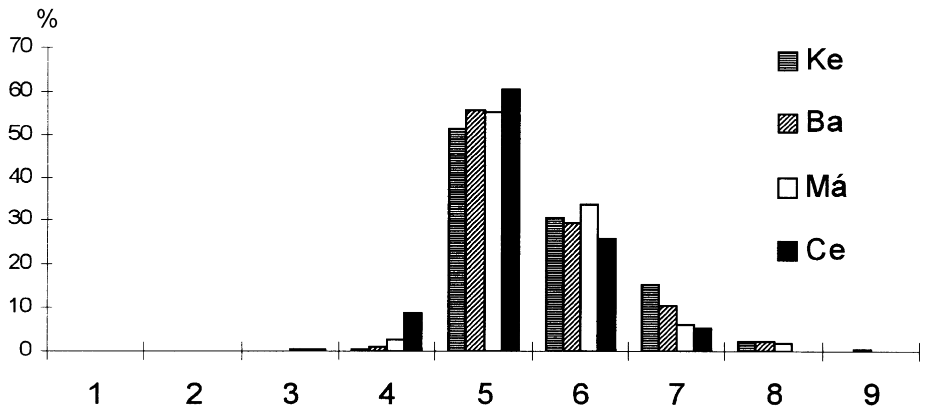

Fig. 4. Relative heat indicator (TB) spectrum. Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

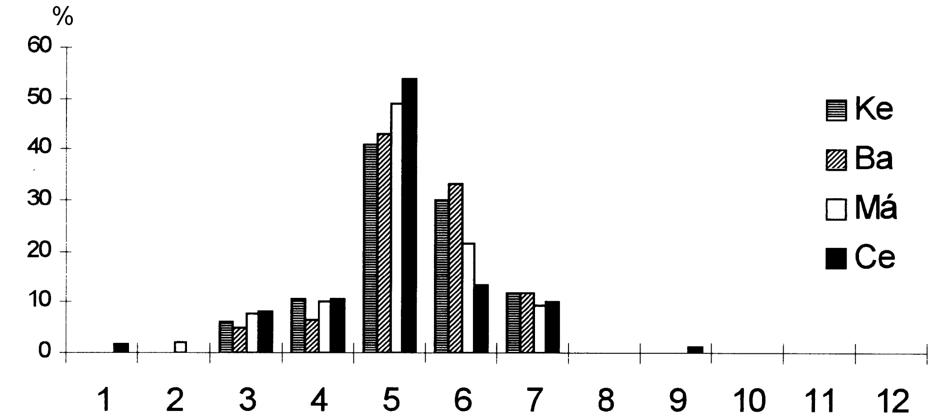

Fig. 5. Relative soil moisture indicator (WB) spectrum. Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

values of Borhidi (1993). Based on the relative temperature figures (TB) it can be stated that in the case of block forest (Fig. 4) the average values shifted towards the cooler, higher zones, which refers to the presence of relict species from the subboreal period.

According to the soil moisture or water table values (WB), a minor microclimatic bipolarity can be seen due to the heterogeneous surface of the block fields (blocks and gaps), so both xerophilous elements and plants of wet habitats are present, while they are absent in lime scree forests (Fig. 5).

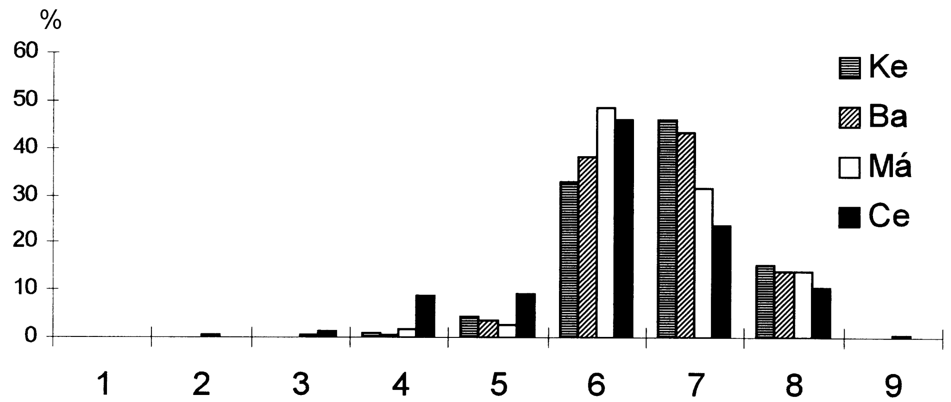

Fig. 6. Relative soil reaction indicator (RB) spectrum. Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

Comparing the two mentioned associations, the acidic soil reaction (RB) categories appear more frequently in the block forest (Fig. 6). It is the result of the siliceous substrate (basalt) and the slow soil development.

There are no significant differences between the *Mercuriali-Tilietum* and the *Roso pendulinae-Tilietum cordatae* considering the ammonia and nitrate supply of the habitats (NB), except that the spectrum is wider in the block forest and the extreme categories show the highest values (Fig. 7). It may be the consequence of the heterogeneous surface and the open canopy.

In the case of the relative light intensity during the summer (LB), the ratio of light and halflight plants is higher in the block forest than in the *Mercuriali-Tilietum*, which can be explained by the open canopy of the former community (Fig. 8).

Cluster analysis

For this analysis 74 relevés from six mountains in the Carpathian Basin (Keszthely Mts, Bakony Mts, Gerecse Mts, Mátra Mts, Zemplén Mts and Cerová Vrchovina) were included. Distances were calculated using binary data, because the presence/absence of the species is thought to be a more distinctive character between *Mercuriali-Tilietum* and the *Roso pendulinae-Tilietum cordatae* associations than their coverage values. Since there

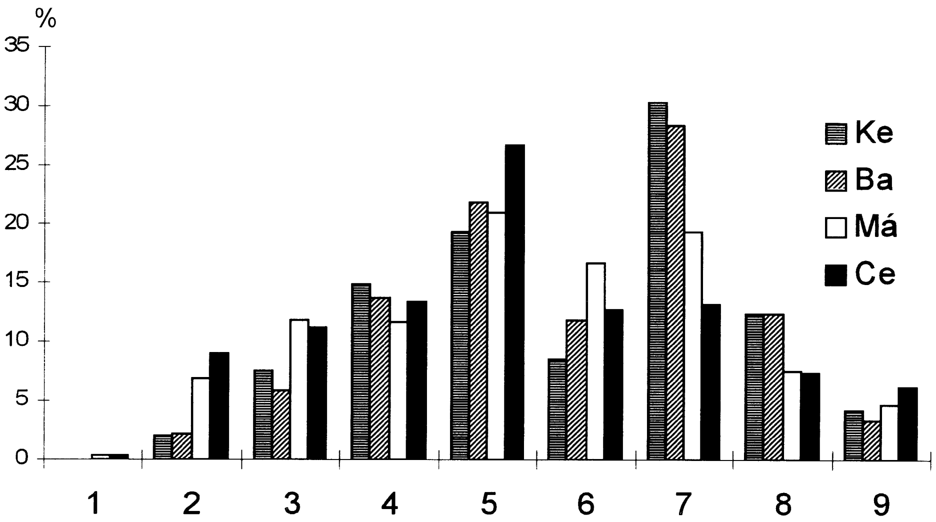

Fig. 7. Relative nutrient supply (NB) spectrum. Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

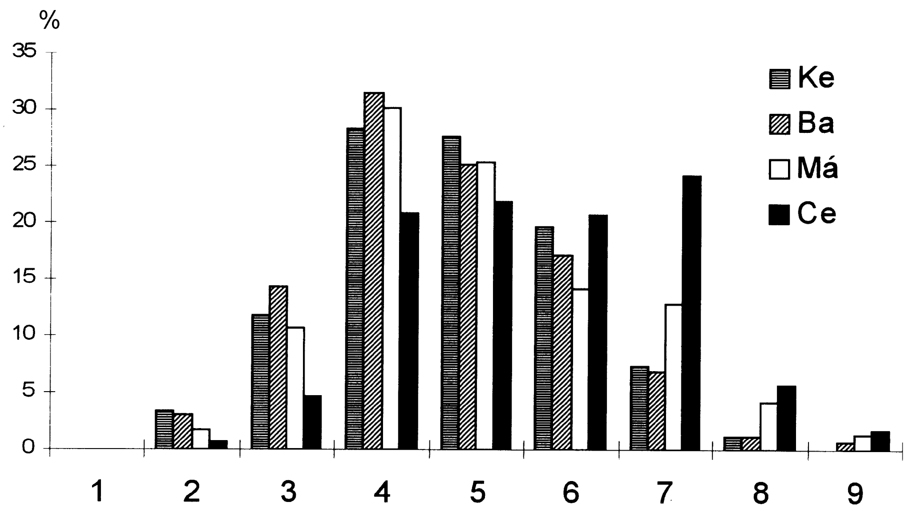

Fig. 8. Relative light intensity (LB) spectrum. Ke: Keszthely Mts, Ba: Bakony Mts, Má: Mátra Mts, Ce: Cerová Vrchovina

were significant differences between the examined forest communities in species combination of the canopy, the shrub and herb layer, distance calculations for all layers were also carried out. Only one dendrogram is shown here (Fig. 9), since all applicable algorithms gave quite similar results.

The relevés of the Northern Hungarian Mts (Mátra Mts, Zemplén Mts and Cerová Vrchovina) gathered in one group and were isolated from the relevés of Transdanubian Mts (Keszthely Mts, Bakony Mts, Gerecse Mts). It may be the consequence of the abiotic background pattern, which is different on the two sides of the so-called "Central Danubian flora boundary", described by Zólyomi (1942) which divides the Pannonicum province into two sectors: one with milder annual temperature and precipitation (Transdanubian region) and one with more extreme climate (northeast from the river Danube). This division is amplified by the geological heterogeny, since mostly sedimental (limestone, dolomite) rocks build up the Transdanubian Mts, while there is mostly volcanic (andesite, rhyolite) substrate in the Northern Hungarian Mts.

The *Roso pendulinae-Tilietum cordatae* stands separate from the *Mercuriali-Tilietum* relevés of the Mátra and Zemplén Mts on the left side of the dendrogram. Only one stand from the Zemplén Mts is similar to those of the block forests from the Cerová Vrchovina, which may show the neigh-

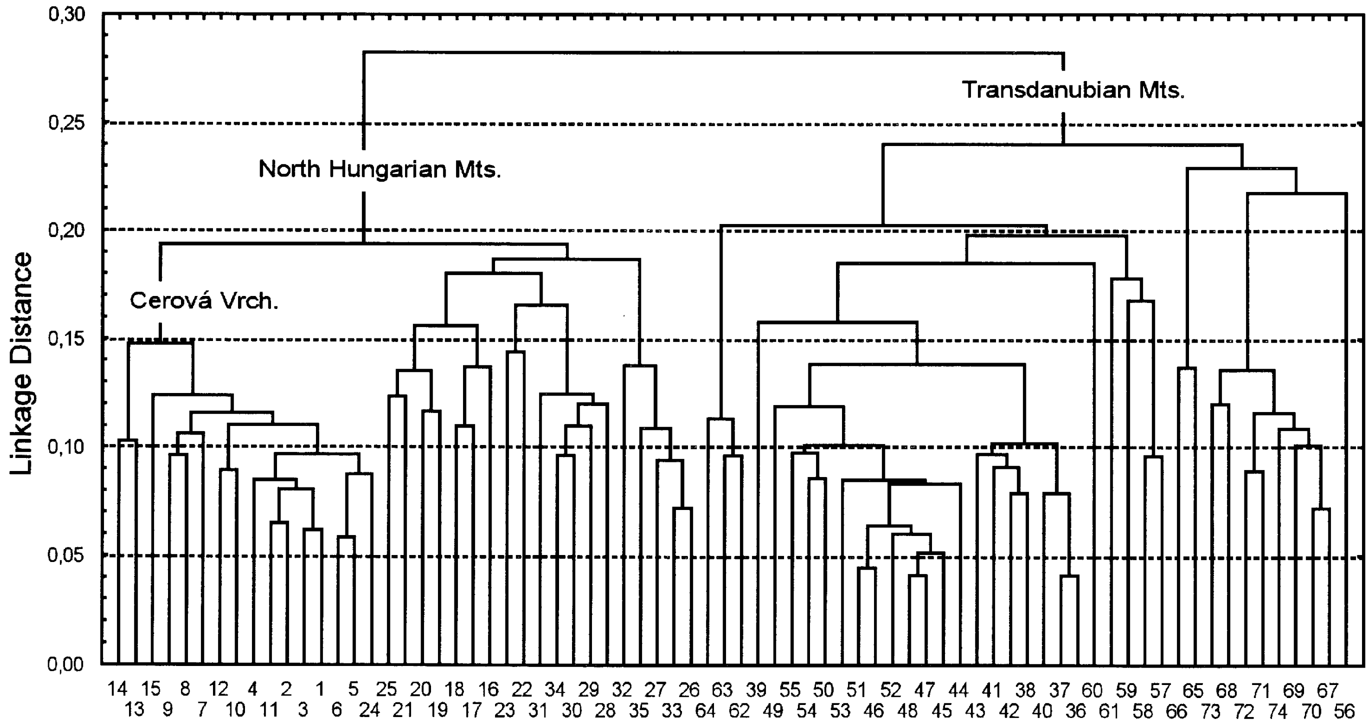

Fig. 9. Dendrogram for the *Mercuriali-Tilietum* and *Roso pendulinae-Tilietum cordatae* relevés on periglacial stony slopes in the Matricum (weighted pair-group average, percent disagreement). 1–15: Cerová Vrchovina, 16–25: Zemplén Mts, 26–35: Mátra Mts, 36–55: Gerecse Mts, 56–64: Bakony Mts, 65–74: Keszthely Mts

bourhood of the Carpathians and the common historical processes of the vegetation.

This separation seems to prove the results of the previous statistical analyses (phytotaxonomic characterization, Raunkiaer's life form categories, flora elements and relative ecological indicator values).

*

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