Acta Botanica Hungarica 44(1–2), pp. 85–115, 2002

TOP-FORESTS (*VERATRO NIGRI-FRAXINETUM ORNI*) OF THE BAKONY MOUNTAINS

B. KEVEY[1] and A. BORHIDI[2]

[1]*Dept. Botany, University of Pécs, H-7624 Pécs, Ifjúság u. 6, Hungary; E-mail: keveyb@ttk.pte.hu*
[2]*Inst. Ecology and Botany, Hungarian Academy of Sciences, H-2163 Vácrátót, Alkotmány út 4–6, Hungary; E-mail: borhidi@botanika.hu*

Present study describes a new community type recently found in the Hungarian Mountain Range (Bakony). The so-called "top-forests" (*Veratro nigri-Fraxinetum orni*) are found in dolomite mountains where the steep southern and northern slopes are connected by a relatively flat surface, and the parent rock is covered by rendzina soil. The southern slopes are occupied by thermophilous oak woodlands (*Orno-Quercetum pubescentis*), the northern slopes are covered by oak-hornbeam (*Carici pilosae-Carpinetum*) and beech woodlands (*Daphno laureolae-Fagetum*). Top-forests (*Veratro nigri-Fraxinetum orni*) are found on flat ridges, and substitute for Turkey oak-sessile oak (*Quercetum petraeae-cerris*) and slope woodlands (*Mercuriali-Tilietum*). The community is characterised by xerophilous canopy and shrub layers and a mesophilous herb layer. It is placed in the Orno-Cotinion *coenological group.*

Key words: Bakony Mts, Hungary, phytocoenology, top-forest

INTRODUCTION

The term "top-forest" is relatively new in the coenological literature. The usage of the name is not obligatory since forests covering the mountain-tops may belong to various associations (Turkey oak-sessile oak woodland, oak-hornbeam woodland, beech woodland, etc.) depending on site conditions. The "top-forest", in the sense we use, is a peculiar sub-Mediterranean community type which has been described only recently (cf. Borhidi and Kevey 1996, Kevey and Borhidi 1998).

RESEARCH HISTORY

Balázs Kevey has been studying the mesophilous deciduous woodlands of the dolomite Keszthely Mts and the surrounding basalt volcano mountains since 1984. He found stands similar to the top-forests of the Mecsek Mts at some localities of the area. He has not published his coenological relevés yet. Later, he continued his research in the Bakony Mts, too. Here he met forest engineer Csaba Kelemen who called his attention to the wood of Vöröstó peak

0236–6495/02/$ 5.00

near the town of Nagyvázsony, which was composed of *Fraxinus ornus* and *Quercus pubescens*, and a large amount of *Allium ursinum* in the herb layer. In a concerted field trip in April 1992, Balázs Kevey realised that the community corresponded to the top-forests (*Aconito anthorae-Fraxinetum orni*) of the Mecsek Mts. Later on (in 1998 and 1999), he found further similar stands in the Bakony Mts, and then in 2000 he traversed all mountain tops and flattening ranges where top-forests could be expected. Subsequently, academic Attila Borhidi also joined the field trips and confirmed that these sites contained a top-forest community not described so far.

METHODS

Sampling was carried out with the traditional quadrat method introduced by Braun-Blanquet (1928). The tables of coenological relevés were compiled and the frequencies of characteristic species based on occurrence data were calculated with the help the "NS" (Kevey and Hirmann) computer programme. For the detailed description of the sampling procedure and calculations see Kevey (1993, 1997).

To mark off Bakony top-forests from those of the Mecsek Mts, we chose species which appeared in only one of the two landscape units, i.e. reflected different phytogenetic traits. Furthermore, we also considered species which had at least two degrees of difference in their constancy values between the top-forests of the Bakony and the Mecsek Mts. We also found significant difference between the two associations in terms of the frequency of characteristic species based on occurrence data, and the relative ecological values (Borhidi 1993, 1995). Finally, cluster analysis was performed (similarity index: Sorensen, fusion algorithm: simple average (WPGMA)) using the SYN-TAX 5.0 program package (Podani 1993).

The nomenclature followed Horváth *et al.* (1995) for species, and Borhidi and Kevey (1996) for communities. The structure of coenological tables was based on Soó's (1964–1980) coenological system. The coenosystematic classification of plants also followed the above work, although more recent results were also consulted (cf. Borhidi 1993, 1995, Horváth *et al.* 1995).

RESULTS AND DISCUSSION

Description of the Bakony top-forests

Thirty-five coenological relevés have been taken by Balázs Kevey, of which the most typical 20 are chosen (cf. Table 1). The below description of the

Table 1
Veratro nigri-Fraxinetum orni

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Molinio-Juncetea																								
Serratula tinctoria (Qrp, Qpp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	I	10
Molinietalia coeruleae																								
Valeriana officinalis s. str. (Mag, FiC)	C	+	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	I	15
Festuco-Brometea																								
Anthericum ramosum (Qpp)	C	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	I	20
Brachypodium pinnatum (Bra, Qpp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	+	I	15
Muscari racemosum (Qpp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	10
Festucetalia valesiacae																								
Cardaminopsis arenosa (TAc, Qpp)	C	–	–	+	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Erysimum odoratum (Qpp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	I	10
Campanula rotundifolia s. str. (Qrp, Qpp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Festuca valesiaca (Qpp)	C	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Asplenio-Festucion pallentis																								
Asplenium trichomanes (BrF, TAc, Qrp, OCn)	C	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Festucion rupicolae																								
Allium oleraceum (Qpp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	+	I	15
Ornithogalum sphaerocarpum (Cp, Qpp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Cynodonto-Festucion																								
Cerinthe minor (Sea)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Aperetalia (incl. Aphanion)																								
Myosotis arvensis (Arn, CyF)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5
Chenopodietea																								
Ballota nigra (Ar)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5
Galio-Alliarion																								
Alliaria petiolata (Epa)	C	+	+	+	+	+	+	+	+	+	–	–	–	–	+	+	1	1	1	1	2	+–2	IV	80
Chaerophyllum temulum	C	+	+	–	+	–	–	–	–	–	–	–	–	–	–	+	–	–	+	+	–	+	II	30
Calystegion sepium																								
Lamium maculatum (CF, Agi, Cp, Qrp)	C	–	1	–	–	–	–	–	–	–	–	+	+	+	+	–	–	–	–	–	–	+–1	II	25
Sisymbrium strictissimum (Ar, Sal)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Querco-Fagea																								
Fraxinus excelsior (AP, TAc)	A1	2	1	–	+	2	+	1	+	+	1	1	–	–	–	–	1	1	2	2	–	+–2	IV	70
	A2	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	I	15
	B1	+	1	–	–	–	–	–	–	–	–	–	–	–	–	1	+	–	–	+	–	+–1	II	25
	B2	–	2	+	+	+	+	+	+	+	+	+	1	+	+	1	1	1	1	+	+	+–2	V	95
	S	2	2	+	+	2	+	1	+	+	1	1	1	+	+	2	2	2	2	2	+	+–2	V	100
Geum urbanum (Epa, Cp)	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	100
Melica uniflora (Cp)	C	3	2	1	2	2	2	2	2	2	2	2	4	2	2	1	2	2	2	2	2	1–4	V	100
Acer campestre	A1	+	–	+	+	–	+	–	–	+	–	–	–	+	–	–	–	–	–	–	–	+	II	30
	A2	+	+	+	–	+	+	+	+	+	–	+	+	+	+	1	–	+	+	+	+	+–1	V	85
	B1	–	2	–	–	+	–	–	–	+	–	+	+	–	+	–	–	–	+	+	–	+–2	II	40
	B2	1	1	+	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+–1	V	95
	S	1	2	1	+	1	1	+	+	1	+	1	1	1	1	1	–	+	1	1	+	+–2	V	95
Brachypodium sylvaticum	C	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	95
Crataegus monogyna (Qpp)	B1	2	1	–	–	1	+	+	1	+	1	–	–	1	2	2	+	1	1	1	1	+–2	IV	80
	B2	–	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	90
	S	2	1	–	+	1	+	+	1	+	1	+	+	1	2	2	+	1	1	1	1	+–2	V	95
Fallopia dumetorum (GA)	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	V	95
Crataegus oxyacantha	B1	1	+	+	+	+	2	1	+	1	1	1	1	–	+	1	+	1	–	–	+	+–2	V	85
	B2	–	–	+	–	+	+	–	+	+	+	+	–	–	–	–	+	–	+	–	+	+	III	50
	S	1	+	+	+	+	2	1	+	1	1	1	1	–	+	1	+	1	+	–	+	+–2	V	90
Viola odorata	C	1	+	+	+	1	+	1	+	+	+	1	2	1	1	–	+	–	+	+	+	+–2	V	90
Dactylis polygama (Cp)	C	+	+	+	1	+	+	+	+	+	–	+	–	–	–	+	1	+	+	+	+	+–1	IV	80
Fragaria vesca (Epa)	C	+	+	–	–	+	+	+	+	+	+	–	+	–	+	+	+	+	+	+	+	+	IV	80
Primula veris (Ara)	C	+	1	+	+	+	+	+	+	+	–	–	–	+	–	+	1	+	+	+	+	+–1	IV	80
Geranium robertianum (Epa, CF)	C	+	+	+	+	+	–	–	–	+	–	+	+	+	–	+	+	+	1	+	+	+–1	IV	75
Polygonatum latifolium	C	–	–	+	+	+	–	+	+	–	+	+	+	+	+	+	2	2	2	4	–	+–4	IV	75
Veratrum nigrum	C	1	1	–	–	–	–	+	+	+	+	+	+	+	+	+	+	+	+	–	+	+–1	IV	75
Viola mirabilis (CF, Qpp)	C	1	1	+	–	–	+	–	+	–	+	+	+	+	–	+	+	+	+	+	+	+–1	IV	75
Sedum maximum (FB, TAc, Qpp)	C	+	+	+	+	–	+	–	+	–	+	–	–	–	–	+	+	+	+	+	+	+	IV	65
Polygonatum multiflorum (CF)	C	+	+	+	+	–	–	–	–	–	+	–	–	–	+	+	1	1	1	+	1	+–1	III	60
Veronica chamaedrys subsp. *vindobonensis* (Ara)	C	–	+	+	–	+	+	+	–	–	+	–	+	+	–	+	+	–	+	+	–	+	III	60
Bromus ramosus agg.	C	+	+	+	+	–	+	–	–	+	–	–	–	–	–	+	+	+	+	+	–	+	III	55

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Campanula trachelium (Epa, Cp)	C	+	+	–	+	–	–	–	–	–	+	+	–	–	+	+	+	+	+	+	–	+	III	55
Rhamnus catharticus (Qpp, Pru)	B1	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	+	+	–	+	–	+	–	–	–	–	–	+	–	–	+	+	+	+	+	+	+	III	55
	S	+	+	–	+	–	+	–	–	–	–	–	+	–	–	+	+	+	+	+	+	+	III	55
Symphytum tuberosum subsp. *angustifolium* (CF, Cp)	C	1	+	+	–	+	–	+	–	–	–	–	–	+	+	+	+	+	+	–	–	+–1	III	55
Campanula rapunculoides (Epa)	C	+	+	+	+	+	–	–	–	–	–	–	–	–	–	+	+	+	+	–	+	+	III	50
Melittis carpatica (Cp, Qia)	C	+	+	+	+	–	–	–	–	–	+	–	+	–	–	+	+	+	–	–	+	+	III	50
Veronica hederifolia (Sea)	C	–	–	–	–	+	+	–	+	+	+	+	+	+	+	+	–	–	–	–	–	+	III	50
Viola cyanea (Qpp)	C	–	1	+	–	–	–	–	–	–	+	–	–	–	+	+	1	1	1	1	1	+–1	III	50
Ajuga reptans (MoA)	C	+	+	+	+	+	–	–	–	–	+	–	–	–	+	+	–	+	–	–	–	+	III	45
Campanula persicifolia	C	+	–	–	+	–	–	–	–	–	+	–	–	–	–	+	+	+	+	+	+	+	III	45
Euonymus europaea (Qpp)	B1	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	+	1	–	+	–	–	–	+	+	–	+	–	–	–	–	–	+	+	+	–	+–1	III	45
	S	+	1	–	+	–	–	–	+	+	–	+	–	–	–	–	–	+	+	+	–	+–1	III	45
Melica nutans	C	–	–	–	–	+	+	+	+	–	+	–	+	+	+	–	–	–	–	–	+	+	III	45
Smyrnium perfoliatum (GA)	C	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–	+	+	+	1	+	+–1	III	45
Clinopodium vulgare (Qpp)	C	–	+	–	+	+	+	+	–	–	–	–	–	–	–	+	+	+	–	–	–	+	II	40
Convallaria majalis	C	+	–	+	–	–	–	–	–	–	+	+	–	–	–	1	+	+	–	–	+	+–1	II	40
Ligustrum vulgare (Cp, Qpp)	B1	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	+	+	I	20
	B2	–	–	+	+	–	–	–	–	+	–	–	–	+	–	+	–	+	+	–	1	+–1	II	40
	S	–	–	+	+	–	–	–	–	+	–	–	–	+	–	+	–	+	+	–	1	+–1	II	40
Carex divulsa (CF)	C	–	–	+	–	+	+	+	–	+	–	–	+	–	–	–	–	–	–	–	+	+	II	35
Cornus sanguinea (Qpp)	B1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1–2	I	10
	B2	+	1	–	+	–	–	–	+	–	–	–	–	–	–	+	–	–	+	–	–	+–1	II	30
	S	+	2	–	+	–	–	–	+	–	–	–	–	–	–	1	–	–	+	–	–	+–2	II	30
Viola alba	C	+	+	+	+	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	+	II	30
Clematis vitalba	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	I	5
	B2	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	+	–	+	II	25
	S	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	+	–	+	II	25
Lapsana communis (GA, Epa)	C	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	–	+	+	+	–	+	II	25
Mycelis muralis	C	–	–	–	+	–	–	–	+	–	–	–	–	+	–	–	+	–	+	–	–	+	II	25
Poa nemoralis	C	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	I	20

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Staphylea pinnata (Cp, TAc)	B1	–	–	+	+	–	–	–	–	–	–	–	–	–	–	1	–	+	–	–	–	+–1	I	20
	B2	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	I	15
	S	–	–	+	+	–	–	–	–	–	–	–	–	–	–	1	–	+	–	–	–	+–1	I	20
Carex pairae (Epa)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	+	–	+	I	15
Lactuca quercina subsp. *sagittata* (Qpp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	+	I	15
Platanthera bifolia (NC, Moa)	C	+	+	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	I	15
Sorbus aria agg. (TAc, CeF, VP)	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	5
	B2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	I	10
	S	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	–	+	I	15
Corylus avellana	B1	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	10
	S	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	10
Heracleum sphondylium (MoA)	C	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Lonicera xylosteum	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	+	I	10
Stellaria holostea (CF, Cp)	C	1	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	I	10
Vicia sepium (Ara, Qpp)	C	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Digitalis grandiflora (Epa)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Epipactis helleborine agg. (CF)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	5
Ficaria verna (AP)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	I	5
Melampyrum nemorosum (Cp, Qpp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Neottia nidus-avis (CF)	C	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Tilia cordata (Cp, Qpp)	A1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	I	5
	A2	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	S	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	I	5
Ulmus minor (AP, Ulm)	B1	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Vicia dumetorum (Qpp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Salicion albae																								
Agropyron caninum (Ulm, Qpp)	C	–	–	–	–	–	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	+	I	15
Carpino-Fagetea (incl. Fagetalia)																								
Corydalis cava	C	2	+	+	+	1	+	+	+	+	1	1	2	1	1	2	1	2	1	2	3	+–3	V	100
Corydalis pumila (Cp, Qpp)	C	1	+	1	+	+	+	+	+	+	1	+	1	+	+	1	+	1	+	+	+	+–1	V	100
Tilia platyphyllos (TAc, Qpp)	A1	1	+	–	–	1	+	1	+	+	+	–	+	1	–	+	+	+	+	2	1	+–2	IV	80
	A2	–	–	+	+	1	+	+	–	–	+	–	–	–	+	–	+	–	–	–	1	+–1	III	45
	B1	+	+	–	–	–	–	–	–	–	+	+	–	–	–	+	–	–	–	–	1	+–1	II	30

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Tilia platyphyllos (TAc, Qpp)	B2	+	+	+	+	–	–	–	+	–	+	+	+	–	+	+	+	+	+	+	+	+	IV	75
	S	1	1	+	+	2	+	1	+	+	1	+	+	1	+	1	1	+	+	2	2	+–2	V	100
Anemone ranunculoides	C	1	–	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+–1	V	95
Galanthus nivalis	C	+	–	+	+	+	+	+	+	+	+	+	+	+	+	1	+	1	+	+	+	+–1	V	95
Mercurialis perennis	C	+	+	+	+	+	+	+	+	+	1	–	+	+	+	2	+	+	+	2	+	+–2	V	95
Acer platanoides (TAc)	A1	–	–	–	–	+	–	–	–	–	+	+	–	–	+	+	–	–	–	+	–	+	II	30
	A2	–	–	–	+	–	+	–	–	–	+	–	–	–	+	–	–	–	–	–	–	+	I	20
	B1	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	+	I	10
	B2	+	–	+	+	–	–	–	–	–	–	+	+	–	+	+	+	+	+	+	+	+	III	60
	S	+	–	+	+	+	+	–	–	–	+	1	+	–	1	+	+	+	+	+	+	+–1	IV	75
Allium ursinum	C	2	2	3	5	5	5	5	5	5	5	5	2	5	5	–	–	–	–	–	–	2–5	IV	70
Glechoma hirsuta (Cp)	C	1	+	2	+	+	+	+	–	–	–	+	–	–	–	2	3	2	3	2	2	+–3	IV	70
Hedera helix	A2	+	–	+	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	I	20
	B1	–	+	+	+	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	+	II	25
	B2	+	1	+	+	–	–	–	+	–	+	+	–	+	+	+	+	+	+	–	1	+–1	IV	70
	S	+	1	1	1	–	–	–	+	–	+	+	–	+	+	+	1	+	+	–	1	+–1	IV	70
Carpinus betulus (Cp)	A1	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	15
	A2	–	+	+	+	–	–	–	–	–	1	+	–	+	+	+	–	–	–	–	–	+–1	II	40
	B1	+	–	–	–	+	–	+	–	–	–	+	–	+	–	–	–	–	–	–	–	+	II	25
	B2	+	+	–	–	+	–	+	–	–	–	–	–	–	–	–	+	–	–	–	+	+	II	30
	S	+	1	+	+	+	–	+	–	–	1	+	–	+	+	+	+	–	–	–	+	+–1	IV	65
Asarum europaeum	C	1	1	+	–	+	–	–	–	–	+	+	+	+	+	+	–	–	–	–	–	+–1	III	50
Lathyrus vernus	C	+	+	+	+	–	–	–	–	–	+	–	–	+	–	+	+	+	–	–	+	+	III	50
Lilium martagon (QF)	C	+	+	+	+	–	–	–	–	–	+	–	–	–	–	+	+	+	–	+	+	+	III	50
Dentaria bulbifera (EuF)	C	2	1	3	1	+	–	+	–	–	+	–	–	–	+	1	–	–	–	–	–	+–3	III	45
Euphorbia amygdaloides	C	+	–	+	+	+	+	+	–	–	–	–	–	–	–	+	+	–	–	–	+	+	III	45
Gagea lutea (AP, Cp)	C	–	–	–	–	+	+	+	–	+	+	+	+	+	+	–	–	–	–	–	–	+	III	45
Galium odoratum	C	–	1	–	–	–	+	–	–	–	+	+	+	+	+	+	–	+	–	–	–	+–1	III	45
Ulmus glabra (TAc)	A2	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+	I	5
	B1	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	+	+	+	+	–	–	–	–	–	–	–	–	–	–	+	–	–	+	+	–	+	II	35
	S	+	+	+	+	–	–	–	–	–	–	+	–	–	–	+	–	–	+	+	–	+	II	40
Corydalis intermedia	C	–	–	–	–	–	–	–	–	–	+	+	+	+	+	–	–	–	–	+	1	+–1	II	35
Isopyrum thalictroides	C	–	–	–	+	–	–	–	–	–	+	+	+	+	+	–	–	–	–	–	+	+	II	35

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Moehringia trinervia	C	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	+	+	II	35
Pulmonaria officinalis s. str.	C	+	+	–	–	–	–	–	–	–	+	+	–	–	+	+	–	+	–	–	–	+	II	35
Adoxa moschatellina (AP)	C	–	–	–	–	–	–	–	–	–	+	+	+	+	+	–	–	–	+	–	–	+	II	30
Acer pseudo-platanus (TAc)	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5
	B2	–	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	I	20
	S	–	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	II	25
Cerasus avium (Cp)	A1	–	+	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	–	–	–	+	I	15
	B2	–	+	–	+	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	I	15
	S	–	+	–	+	–	–	–	–	–	–	+	–	+	–	+	–	–	–	–	–	+	II	25
Fagus sylvatica (EuF)	A1	–	1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+–1	I	20
	B2	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
	S	–	1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+–1	I	20
Carex pilosa (Cp)	C	+	–	+	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	I	15
Daphne laureola (Qp)	B1	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	15
	S	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	15
Arum maculatum s. str.	C	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Carex digitata (Cp)	C	–	–	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	I	10
Dentaria enneaphyllos (EuF)	C	+	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	10
Galeobdolon luteum	C	–	–	–	+	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	10
Hordelymus europaeus	C	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Viola sylvestris	C	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Arum orientale subsp. *besseranum*	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Dryopteris filix-mas s. str.	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	I	5
Galium sylvaticum (Cp, Qrp)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Lathraea squamaria (Cp)	C	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	5
Stachys sylvatica (Epa)	C	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Tilio-Acerion																								
Geranium lucidum (GA)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	I	10
Cephalanthero-Fagion																								
Taxus baccata (EuF, OCn, AQ)	B1	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Aremonio-Fagion																								
Rosa arvensis (Cp, Qfa)	B2	+	–	–	–	–	+	–	+	+	+	–	+	–	–	–	–	–	–	–	–	+	II	30
Lathyrus venetus (Cp)	C	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Tamus communis (Qfa)	C	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Quercetea pubescentis-petraeae																								
Cornus mas (TAc, OCn, Qia)	B1	2	1	4	4	3	3	2	2	2	3	2	3	2	2	2	4	4	4	3	2	1–4	V	100
	B2	+	–	–	+	+	+	+	–	–	–	+	+	+	+	+	–	+	+	–	–	+	III	60
	S	2	1	4	4	3	3	2	2	2	3	2	3	2	2	2	4	4	4	3	2	1–4	V	100
Euonymus verrucosa (Pru)	B1	+	–	–	–	–	–	–	–	–	+	–	–	+	+	1	+	+	+	+	1	+–1	III	50
	B2	1	1	+	+	+	+	+	+	+	+	+	+	+	+	1	1	1	1	+	1	+–1	V	100
	S	1	1	+	+	+	+	+	+	+	+	+	+	+	+	2	1	1	1	+	2	+–2	V	100
Fraxinus ornus (OCa)	A1	2	2	4	3	1	3	2	2	3	3	2	2	2	2	3	2	3	3	2	3	1–4	V	100
	A2	1	2	3	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	1–3	V	100
	B1	1	2	–	–	–	1	1	2	2	1	–	+	–	–	+	+	–	+	+	2	+–2	IV	65
	B2	+	1	+	–	–	–	+	+	+	+	–	+	+	–	–	+	+	–	–	+	+–1	III	60
	S	2	3	5	4	2	4	3	3	4	4	3	3	3	4	4	3	4	4	3	4	2–5	V	100
Quercus pubescens	A1	3	3	1	2	4	3	4	4	3	3	3	4	3	3	3	4	3	3	3	3	1–4	V	100
	A2	–	1	–	–	1	1	1	2	1	2	1	1	2	1	–	–	1	–	2	1	1–2	IV	70
	B2	–	–	–	–	+	–	–	+	+	+	–	+	–	+	+	+	+	+	+	+	+	III	60
	S	3	3	1	2	4	3	4	5	3	4	3	4	4	3	3	4	3	3	4	3	1–5	V	100
Vincetoxicum hirundinaria (Fvl)	C	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	100
Berberis vulgaris (Pru)	B1	+	+	–	–	–	–	–	–	–	–	–	–	–	+	+	–	+	+	+	1	+–1	II	40
	B2	+	+	+	–	–	–	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	85
	S	+	+	+	–	–	–	+	+	+	+	+	+	+	+	+	+	+	+	+	1	+–1	V	85
Pyrus pyraster (Cp)	A1	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	I	5
	A2	+	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	10
	B1	+	–	–	–	–	–	–	–	–	–	+	+	–	+	–	–	+	–	+	–	+	II	30
	B2	–	+	–	–	+	+	–	+	+	+	–	+	+	–	+	+	+	+	–	–	+	III	60
	S	+	+	–	+	+	+	–	+	+	+	+	+	+	+	+	+	+	+	+	–	+	V	85
Mercurialis ovata	C	–	–	–	–	+	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+	IV	75
Quercus cerris (Qrp)	A1	+	1	1	2	+	1	–	–	1	2	2	1	2	2	1	–	–	–	–	+	+–2	IV	70
	A2	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
	B2	+	–	+	+	–	+	–	+	+	+	–	+	+	+	–	–	–	–	–	–	+	III	50
	S	+	1	1	2	+	1	–	+	1	2	2	1	2	2	1	–	–	–	–	+	+–2	IV	75
Rosa canina agg. (Pru, Prs)	B1	–	+	–	–	–	–	–	+	–	–	–	–	–	–	–	+	–	–	+	–	+	I	20
	B2	+	–	+	+	+	–	+	–	–	–	+	–	+	–	+	+	+	+	+	+	+	IV	65
	S	+	+	+	+	+	–	+	+	–	–	+	–	+	–	+	+	+	+	+	+	+	IV	75

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Arabis turrita (TAc)	C	+	+	+	+	+	−	−	−	−	+	−	−	−	−	+	+	+	+	+	+	+	III	60
Sorbus torminalis (QF)	A1	+	−	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	+	II	25
	A2	2	+	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	−	+–2	II	35
	B1	+	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	−	−	+	+	I	20
	B2	−	+	+	+	−	−	−	+	−	−	+	−	−	−	+	−	+	+	+	+	+	III	50
	S	2	+	+	+	−	−	−	+	−	−	+	−	−	−	1	+	1	+	+	+	+–2	III	60
Viola hirta	C	−	−	−	−	+	+	+	+	+	+	+	+	+	+	−	−	+	−	−	+	+	III	60
Piptatherum virescens (OCn, AQ)	C	+	−	−	−	+	+	+	+	−	−	−	−	−	−	+	+	+	1	+	+	+–1	III	55
Viburnum lantana (QF)	B1	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	I	15
	B2	1	1	+	+	−	−	−	−	−	+	−	−	−	−	+	+	+	+	+	+	+–1	III	55
	S	1	1	+	+	−	−	−	−	−	+	−	−	−	−	+	+	+	+	+	+	+–1	III	55
Dictamnus albus (Fvl)	C	+	−	−	−	−	+	−	+	−	−	−	+	−	−	+	+	+	+	+	+	+	III	50
Lithospermum purpureo-coeruleum (OCn, AQ)	C	+	−	+	+	−	−	−	−	+	−	+	+	−	−	−	−	−	−	−	+	+	II	35
Prunus spinosa (Pru, Prs)	B2	+	−	−	−	−	+	−	−	−	+	−	−	−	+	−	+	−	−	+	+	+	II	35
Scutellaria columnae (CF)	C	+	+	−	−	−	−	−	−	−	+	+	+	+	−	−	−	−	−	−	+	+	II	35
Euphorbia epithymoides	C	−	+	−	−	−	−	−	−	−	−	−	+	−	−	−	+	−	+	+	+	+	II	30
Polygonatum odoratum (Fvl)	C	−	+	−	−	−	−	−	+	−	−	+	+	−	−	−	−	+	−	−	+	+	II	30
Thalictrum aquilegiifolium	C	−	+	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	−	+	II	30
Carex michelii	C	−	+	−	−	−	−	+	+	−	−	−	+	+	−	−	−	−	−	−	−	+	II	25
Laserpitium latifolium (Fvl)	C	+	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	−	−	+	II	25
Malus sylvestris (AP, Cp)	B2	+	−	+	−	−	−	−	+	−	−	−	−	−	+	−	−	−	−	−	−	+	I	20
Betonica officinalis (MoA)	C	−	−	−	−	+	−	−	+	−	−	−	+	−	−	−	−	−	−	−	−	+	I	15
Clematis recta	C	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	+	−	−	+	I	15
Orchis purpurea (CF, OCn)	C	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	I	15
Bupleurum longifolium (CF)	C	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	I	10
Festuca heterophylla (Qrp, Qp)	C	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	I	10
Peucedanum cervaria (Fvl)	C	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	I	10
Pulmonaria mollis	C	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	+	I	10
Rosa spinosissima (Pru)	B1	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	I	5
	B2	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	I	5
	S	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	I	10
Teucrium chamaedrys (FBt, EP)	C	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	+	−	+	I	10
Astragalus glycyphyllos	C	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	I	5
Campanula bononiensis (Fvl)	C	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	I	5

Table 1 (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A–D	K	%
Inula conyza	C	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Iris graminea (Bra)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Lathyrus niger (Qia)	C	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Lembotropis nigricans (FBt, Qrp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Solidago virga-aurea (NC, Epa, Qrp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Sorbus domestica	B2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	I	5
Thalictrum minus (Fvl)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	I	5
Orno-Cotinetalia																								
Carex alba (CeF, OCn)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	1	1	+	+	+	+–3	II	30
Orno-Cotinion																								
Cotinus coggygria (AQ)	B1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	+	+	I	15
	B2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+	+	+	+	II	30
	S	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+	+	+	+	II	30
Quercetalia pubescentis-petraeae																								
Chrysanthemum corymbosum (Fvl)	C	+	+	–	–	–	–	+	+	–	–	–	–	–	–	+	+	+	+	+	+	+	III	50
Muscari botryoides (Cp)	C	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Indifferens																								
Galium mollugo (MoA, FBt, Qrp, Qpp)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+	+	+	+	II	35
Torilis japonica s. str. (Ar, GA, Epa, QF)	C	–	1	–	+	–	–	+	–	–	–	+	–	–	–	–	+	+	–	+	–	+–1	II	35
Coronilla varia (Ara, FBt, Qpp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	+	I	15
Euphorbia cyparissias (FB, ChS, Epa, Qpp)	C	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	–	+	–	–	+	I	15
Silene vulgaris (Ara, Fvl, Qpp)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	+	+	I	15
Galium aparine (Sea, Epa, QF)	C	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	+	I	10
Ajuga genevensis (Ara, FBt, Qpp)	C	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Anthriscus cerefolium subsp. *trichosperma* (Ar, GA)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5
Chelidonium majus (Che, Ar, GA, Epa)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5
Hypericum perforatum (NC, FB, Qpp, PP)	C	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I	5
Rubus fruticosus agg. (QF, Epa, US)	B2	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+	I	5
Stellaria media (ChS, QF, Spu)	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	I	5

Table 1 (continued)
Data of the relevés (*Veratro nigri-Fraxinetum orni*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Serial no. of relevé	2634	2635	2636	1948	2643	2644	2645	2646	2647	2638	2639	2640	2641	2642	2648	2649	2650	2651	2652	2637
Date of relevé 1	1999	1998	1999	1998	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999	1999	1999	1999	1999	1999
Time of relevé 1	04.16	04.23	04.15	04.21	04.16	04.16	04.16	04.16	04.16	04.17	04.17	04.17	04.17	04.17	04.15	04.15	04.15	04.15	04.15	04.15
Date of relevé 2	1999	1998	1999	1998	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999	1999	1999	1999	1999	1999
Time of relevé 2	07.25	07.29	07.25	07.30	06.28	06.27	06.27	06.15	06.27	06.29	06.28	06.29	06.29	06.29	07.27	07.27	07.27	07.27	07.27	07.27
Elevation (m)	415	420	380	380	430	430	440	430	420	400	410	420	430	420	390	400	390	390	410	350
Exposition	NE	W	NW	NW	NE	SW	–	SW	SW	NE	N	NW	NW	NW	N	N	N	NW	–	N
Slope (angle)	3	5	10	5	10	5	0	5	10	5	5	3	3	10	5	10	5	10	0	10
Cover of upper c.l. (%)	70	70	65	75	75	75	80	75	70	75	75	70	70	70	70	70	70	75	70	75
Cover of lower c.l. (%)	20	25	30	20	20	20	25	20	25	30	30	25	35	35	25	20	25	25	25	20
Cover of shrub layer (%)	35	50	70	60	50	50	25	25	40	50	35	40	25	35	50	60	70	70	50	50
Cover of regen. (%)	10	30	1	1	1	1	1	1	1	1	1	2	1	1	10	5	5	5	1	15
Cover of herb layer (%)	75	60	80	100	100	95	100	95	95	100	100	70	90	100	90	85	80	75	90	90
Height of upper c.l. (m)	12	15	13	15	16	15	17	15	15	15	16	15	16	15	12	13	12	12	14	10
Height of lower c.l. (m)	8	12	9	10	10	20	12	12	10	10	12	10	12	10	8	8	8	8	10	8
Height of shrub l. (m)	200	150	300	300	300	400	300	300	350	350	300	350	300	350	200	250	250	250	250	200
Av.d. at breast h. (cm)	35	30	25	30	35	30	35	25	25	25	35	30	35	35	25	35	35	30	35	25
Stand age (year)	120	100	80	100	120	100	120	80	80	80	120	100	120	120	80	120	120	100	120	80
Area of relevé (m^2)	1600	1000	800	1600	1200	1600	1600	1600	1600	1600	1200	1200	1600	1600	1200	1200	1200	1200	1200	1200

Site of relevé: 1–2: Márkó, "Esztergáli valley"; 3–4: Szentgál, "Miklóspál mountain"; 5–9: Nagyvázsony, "Vöröstó peak"; 10–14: Nemesvámos, "Hárs mountain"; 15–19: Bánd, "Malom mountain"; 20: Veszprém, "Csatár mountain". – Parent rock: 1–20: dolomite. – Soil type: 1–20: rendzina. Field worker: 1–20: Kevey (in Kevey and Borhidi 2001).

Table 2
Top-forests of the Bakony and Mecsek mountains (*Veratro nigri-Fraxinetum orni, Aconito anthorae-Fraxinetum orni*)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Molinio-Arrhenatherea						
Colchicum autumnale (Moa)	–	–	–	+	I	10
Molinio-Juncetea						
Serratula tinctoria (Qrp, Qpp)	+	I	10	+	I	15
Molinietalia coeruleae						
Valeriana officinalis s. str. (Mag, FiC)	+	I	15	+	I	5
Festuco-Brometea						
Anthericum ramosum (Qpp)	+	I	20	+	I	5
Brachypodium pinnatum (Bra, Qpp)	+	I	15	+	I	5
Carex humilis (Fvl, Qpp)	–	–	–	+	I	5
Filipendula vulgaris (Qpp)	–	–	–	+	II	25
Muscari racemosum (Qpp)	+	I	10	+	I	10
Festucetalia valesiacae						
Campanula rotundifolia s. str. (Qrp, Qpp)	+	I	5	–	–	–
Cardaminopsis arenosa (TAc, Qpp)	+	I	10	–	–	–
Erysimum odoratum (Qpp)	+	I	10	+	I	15
Festuca valesiaca (Qpp)	+	I	5	–	–	–
Geranium columbinum (Fru, Qpp)	–	–	–	+	I	10
Asplenio-Festucion pallentis						
Asplenium trichomanes (BrF, TAc, Qrp, OCn)	+	I	5	–	–	–
Festucion rupicolae						
Allium oleraceum (Qpp)	+	I	15	+	I	5
Ornithogalum sphaerocarpum (Cp, Qpp)	+	I	5	+	II	35
Cynodonto-Festucion						
Cerinthe minor (Sea)	+	I	5	–	–	–
Aperetalia (incl. Aphanion)						
Myosotis arvensis (Arn, CyF)	+	I	5	–	–	–
Chenopodietea						
Ballota nigra (Ar)	+	I	5	–	–	–
Galio-Alliarion						
Alliaria petiolata (Epa)	+–2	IV	80	+–2	V	95
Chaerophyllum temulum	+	II	30	+–1	III	50
Calystegion sepium						
Lamium maculatum (CF, Agi, Cp, Qrp)	+–1	II	25	+–2	V	95
Sisymbrium strictissimum (Ar, Sal)	+	I	5	–	–	–
Querco-Fagea						
Acer campestre	+–2	V	95	+–1	IV	80
Ajuga reptans (MoA)	+	III	45	+	II	25
Brachypodium sylvaticum	+	V	95	+–1	II	25
Bromus ramosus agg.	+	III	55	+	IV	75
Campanula persicifolia	+	III	45	+	IV	70
Campanula rapunculoides (Epa)	+	III	50	+–1	V	90
Campanula trachelium (Epa, Cp)	+	III	55	+	I	10
Carex divulsa (CF)	+	II	35	–	–	–
Carex pairae (Epa)	+	I	15	+	I	10

Table 2 (continued)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Cephalanthera damasonium	–	–	–	+	I	15
Clematis vitalba	+	II	25	+	II	25
Clinopodium vulgare (Qpp)	+	II	40	+	II	40
Convallaria majalis	+–1	II	40	+	II	40
Cornus sanguinea (Qpp)	+–2	II	30	+	I	5
Corylus avellana	+	I	10	+	I	5
Crataegus monogyna (Qpp)	+–2	V	95	+–2	V	100
Crataegus oxyacantha	+–2	V	90	+–1	III	60
Dactylis polygama (Cp)	+–1	IV	80	+	III	45
Digitalis grandiflora (Epa)	+	I	5	–	–	–
Epipactis helleborine agg. (CF)	+	I	5	–	–	–
Euonymus europaea (Qpp)	+–1	III	45	+	III	60
Fallopia dumetorum (GA)	+	V	95	+	V	95
Ficaria verna (AP)	1	I	5	+	II	30
Fragaria vesca (Epa)	+	IV	80	+	V	100
Fraxinus excelsior (AP, TAc)	+–2	V	100	+–1	II	25
Galium schultesii (Cp, Qpp)	–	–	–	+	I	20
Geranium robertianum (Epa, CF)	+–1	IV	75	+–1	V	95
Geum urbanum (Epa, Cp)	+	V	100	+–1	V	100
Heracleum sphondylium (MoA)	+	I	10	+	II	25
Hieracium sabaudum agg. (Qrp, AbP)	–	–	–	+	I	5
Hypericum hirsutum (Qpp)	–	–	–	+	I	5
Lactuca quercina subsp. *sagittata* (Qpp)	+	I	15	+	V	85
Lapsana communis (GA, Epa)	+	II	25	+	I	10
Ligustrum vulgare (Cp, Qpp)	+–1	II	40	+–2	V	100
Lonicera xylosteum	+	I	10	–	–	–
Melampyrum nemorosum (Cp, Qpp)	+	I	5	+	I	15
Melica nutans	+	III	45	–	–	–
Melica uniflora (Cp)	1–4	V	100	+–4	V	100
Melittis carpatica (Cp, Qia)	+	III	50	+	V	85
Mycelis muralis	+	II	25	+	I	5
Neottia nidus-avis (CF)	+	I	5	–	–	–
Platanthera bifolia (NC, Moa)	+	I	15	+	I	10
Poa nemoralis	+	I	20	+	I	5
Polygonatum latifolium	+–4	IV	75	–	–	–
Polygonatum multiflorum (CF)	+–1	III	60	+–1	V	95
Primula veris (Ara)	+–1	IV	80	–	–	–
Quercus petraea agg. (Cp, Qrp, Qpp)	–	–	–	+–1	I	20
Rhamnus catharticus (Qpp, Pru)	+	III	55	–	–	–
Sedum maximum (FB, TAc, Qpp)	+	IV	65	+	V	90
Smyrnium perfoliatum (GA)	+–1	III	45	–	–	–
Sorbus aria agg. (TAc, CeF, VP)	+	I	15	–	–	–
Staphylea pinnata (Cp, TAc)	+–1	I	20	+–1	II	40
Stellaria holostea (CF, Cp)	+–1	I	10	+–2	V	95
Symphytum tuberosum subsp. *angustifolium* (CF, Cp)	+–1	III	55	+	IV	80
Tilia cordata (Cp, Qpp)	1	I	5	–	–	–
Ulmus minor (AP, Ulm)	+	I	5	1	I	5
Veratrum nigrum	+–1	IV	75	–	–	–

Table 2 (continued)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Veronica chamaedrys subsp. *vindobonensis* (Ara)	+	III	60	+	II	25
Veronica hederifolia (Sea)	+	III	50	+–1	IV	70
Vicia dumetorum (Qpp)	+	I	5	–	–	–
Vicia sepium (Ara, Qpp)	+	I	10	–	–	–
Viola alba	+	II	30	+	III	55
Viola cyanea (Qpp)	+–1	III	50	+	I	10
Viola mirabilis (CF, Qpp)	+–1	IV	75	+	I	5
Viola odorata	+–2	V	90	+–1	V	100
Salicion albae						
Agropyron caninum (Ulm, Qpp)	+	I	15	–	–	–
Carpino-Fagetea (incl. Fagetalia)						
Acer platanoides (TAc)	+–1	IV	75	+	II	35
Acer pseudo-platanus (TAc)	+	II	25	+	I	10
Adoxa moschatellina (AP)	+	II	30	+–2	III	45
Allium ursinum	2–5	IV	70	+–5	V	100
Anemone ranunculoides	+–1	V	95	+–2	IV	80
Arum maculatum s. str.	+	I	10	+	V	100
Arum orientale subsp. *besseranum*	+	I	5	–	–	–
Asarum europaeum	+–1	III	50	+	III	50
Cardamine impatiens	–	–	–	+	I	20
Carex digitata (Cp)	+	I	10	–	–	–
Carex pilosa (Cp)	+	I	15	+	II	30
Carpinus betulus (Cp)	+–1	IV	65	+–1	II	40
Cerasus avium (Cp)	+	II	25	+–1	I	15
Corydalis cava	+–3	V	100	+–2	IV	65
Corydalis intermedia	+–1	II	35	–	–	–
Corydalis pumila (Cp, Qpp)	+–1	V	100	–	–	–
Corydalis solida (Qrp)	–	–	–	+–3	V	100
Daphne laureola (Qp)	+	I	15	–	–	–
Dentaria bulbifera (EuF)	+–3	III	45	+–1	IV	70
Dentaria enneaphyllos (EuF)	+	I	10	+–2	I	15
Dryopteris filix-mas s. str.	+	I	5	–	–	–
Euphorbia amygdaloides	+	III	45	+	III	45
Fagus sylvatica (EuF)	+–1	I	20	+	I	10
Gagea lutea (AP, Cp)	+	III	45	+	II	40
Galanthus nivalis	+–1	V	95	+–2	V	85
Galeobdolon luteum	+	I	10	+	I	15
Galium odoratum	+–1	III	45	+	I	15
Galium sylvaticum (Cp, Qrp)	+	I	5	–	–	–
Glechoma hirsuta (Cp)	+–3	IV	70	+–1	V	100
Hedera helix	+–1	IV	70	+	V	95
Hepatica nobilis	–	–	–	+	IV	75
Hordelymus europaeus	+	I	10	+	I	5
Isopyrum thalictroides	+	II	35	+	III	55
Lathraea squamaria (Cp)	+	I	5	–	–	–
Lathyrus vernus	+	III	50	+	IV	75
Lilium martagon (QF)	+	III	50	+	IV	75
Mercurialis perennis	+–2	V	95	+–2	V	85

Table 2 (continued)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Moehringia trinervia	+	II	35	+	III	60
Primula vulgaris (ArF)	–	–	–	+	III	60
Pulmonaria officinalis s. str.	+	II	35	+	II	25
Rubus hirtus (Epa, US)	–	–	–	+	I	5
Scilla vindobonensis (AP, Cp)	–	–	–	+	I	5
Stachys alpina (Epa)	–	–	–	+	I	5
Stachys sylvatica (Epa)	+	I	5	–	–	–
Tilia platyphyllos (TAc, Qpp)	+–2	V	100	+–3	III	55
Ulmus glabra (TAc)	+	II	40	+	I	20
Viola sylvestris	+	I	10	+	I	10
Tilio-Acerion						
Geranium lucidum (GA)	+	I	10	–	–	–
Cephalanthero-Fagion						
Taxus baccata (EuF, OCn, AQ)	+	I	10	–	–	–
Aremonio-Fagion						
Aremonia agrimonioides (Cp)	–	–	–	+	I	10
Asperula taurina (Cp)	–	–	–	+	I	20
Chaerophyllum aureum (Ar, Cp, TAc)	–	–	–	+	II	25
Doronicum orientale (Qfa)	–	–	–	+	I	5
Helleborus odorus (QF, Qfa)	–	–	–	+–1	V	100
Lathyrus venetus (Cp)	+	I	10	–	–	–
Rosa arvensis (Cp, Qfa)	+	II	30	+	IV	75
Ruscus aculeatus (Qfa)	–	–	–	+–3	III	45
Ruscus hypoglossum (EuF)	–	–	–	+	I	10
Scutellaria altissima (AQ)	–	–	–	+–1	II	40
Tamus communis (Qfa)	+	I	5	+–2	V	95
Quercetea pubescentis-petraeae						
Aconitum anthora (Fvl)	–	–	–	+	V	85
Arabis turrita (TAc)	+	III	60	+–1	IV	80
Astragalus glycyphyllos	+	I	5	–	–	–
Berberis vulgaris (Pru)	+–1	V	85	–	–	–
Betonica officinalis (MoA)	+	I	15	–	–	–
Bupleurum longifolium (CF)	+	I	10	–	–	–
Calamintha menthifolia subsp. *sylvatica*	–	–	–	+	I	5
Campanula bononiensis (Fvl)	+	I	5	–	–	–
Carex michelii	+	II	25	+	I	5
Clematis recta	+	I	15	–	–	–
Cornus mas (TAc, OCn, Qia)	1–4	V	100	3–5	V	100
Dictamnus albus (Fvl)	+	III	50	+	IV	80
Doronicum hungaricum (AQ)	–	–	–	+	I	20
Euonymus verrucosa (Pru)	+–2	V	100	+–1	V	100
Euphorbia epithymoides	+	II	30	+	II	25
Festuca heterophylla (Qrp, Qp)	+	I	10	+	I	15
Fraxinus ornus (OCa)	2–5	V	100	2–5	V	100
Inula conyza	+	I	5	–	–	–
Iris graminea (Bra)	+	I	5	+	I	20
Iris variegata (Fvl)	–	–	–	+	I	5
Laser trilobum	–	–	–	+	I	5

Table 2 (continued)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Laserpitium latifolium (Fvl)	+	II	25	+	I	20
Lathyrus niger (Qia)	+	I	5	+	I	20
Lembotropis nigricans (FBt, Qrp)	+	I	5	–	–	–
Lithospermum purpureo-coeruleum (OCn, AQ)	+	II	35	+	IV	65
Lychnis coronaria	–	–	–	+	I	5
Malus sylvestris (AP, Cp)	+	I	20	+	I	5
Mercurialis ovata	+	IV	75	+	III	45
Orchis purpurea (CF, OCn)	+	I	15	–	–	–
Peucedanum cervaria (Fvl)	+	I	10	–	–	–
Piptatherum virescens (OCn, AQ)	+–1	III	55	–	–	–
Polygonatum odoratum (Fvl)	+	II	30	+	I	15
Prunus spinosa (Pru, Prs)	+	II	35	+	I	5
Pulmonaria mollis	+	I	10	+	I	5
Pyrus pyraster (Cp)	+	V	85	+–2	III	50
Quercus cerris (Qrp)	+–2	IV	75	+–2	V	100
Quercus pubescens	1–5	V	100	2–5	V	100
Rosa canina agg. (Pru, Prs)	+	IV	75	+	IV	65
Rosa spinosissima (Pru)	+	I	10	–	–	–
Scutellaria columnae (CF)	+	II	35	–	–	–
Solidago virga-aurea (NC, Epa, Qrp)	+	I	5	–	–	–
Sorbus domestica	+	I	5	–	–	–
Sorbus torminalis (QF)	+–2	III	60	+	III	60
Teucrium chamaedrys (FBt, EP)	+	I	10	+	I	10
Thalictrum aquilegiifolium	+	II	30	+	I	10
Thalictrum minus (Fvl)	+	I	5	–	–	–
Trifolium alpestre (Fvl)	–	–	–	+	I	10
Viburnum lantana (QF)	+–1	III	55	+	III	60
Vincetoxicum hirundinaria (Fvl)	+	V	100	+	IV	65
Viola hirta	+	III	60	–	–	–
Waldsteinia geoides	–	–	–	+–2	IV	75
Orno-Cotinetalia						
Carex alba (CeF, OCn)	+–3	II	30	–	–	–
Galium lucidum	–	–	–	+	II	25
Orno-Cotinion						
Cotinus coggygria (AQ)	+	II	30	–	–	–
Serratula lycopifolia	–	–	–	+	I	10
Quercion farnetto						
Potentilla micrantha (Qp)	–	–	–	+	I	15
Tilia tomentosa (ArF)	–	–	–	+–3	V	90
Quercetalia pubescentis-petraeae						
Chrysanthemum corymbosum (Fvl)	+	III	50	+	IV	70
Muscari botryoides (Cp)	+	I	5	+	III	60
Indifferens						
Ajuga genevensis (Ara, FBt, Qpp)	+	I	5	–	–	–
Anthriscus cerefolium subsp. *trichosperma* (Ar, GA)	+	I	5	+	I	10
Carex flacca (Mag, MoJ, Arn, FBt, Qpp)	–	–	–	+	I	15
Chelidonium majus (Che, Ar, GA, Epa)	+	I	5	+	I	5
Coronilla varia (Ara, FBt, Qpp)	+	I	15	–	–	–

Table 2 (continued)

	Bakony			Mecsek		
	A–D	K	%	A–D	K	%
Cruciata laevipes (Arn, Fru, Ar, GU, Qpp)	–	–	–	+	I	5
Euphorbia cyparissias (FB, ChS, Epa, Qpp)	+	I	15	+	I	5
Galium aparine (Sea, Epa, QF)	+	I	10	+	II	30
Galium mollugo (MoA, FBt, Qrp, Qpp)	+	II	35	–	–	–
Hypericum perforatum (NC, FB, Qpp, PP)	+	I	5	–	–	–
Ornithogalum umbellatum (Ara, FBt, Sea)	–	–	–	+	II	25
Rubus fruticosus agg. (QF, Epa, US)	+	I	5	–	–	–
Silene vulgaris (Ara, Fvl, Qpp)	+	I	15	+	I	10
Stellaria media (ChS, QF, Spu)	+	I	5	+	I	5
Torilis japonica s. str. (Ar, GA, Epa, QF)	+–1	II	35	+	II	35
Verbascum phoeniceum (FBt, Sea, Che)	–	–	–	+	I	5
Vicia hirsuta (MoA, FB, Sea, Qpp)	–	–	–	+	I	5
Adventiva (incl. Culta, Subspontanea et Indigena)						
Laburnum anagyroides adv.	–	–	–	+	I	5
Pinus nigra adv.	–	–	–	+–1	I	15

Bakony: Bakony top-forests (*Veratro nigri-Fraxinetum orni*); Mecsek: Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*)

Bakony top-forests is based on these relevés. The new association type was described according to the requirements stipulated in the nomenclatural code of plant communities (cf. Barkmann *et al.* 1986, Weber *et al.* 2000) in another paper (cf. Kevey and Borhidi 2001: p. 41 description). The nomenclatural type indicated in the latter study forms relevé 1 in Table 1 (pp. 47–51).

Development and site conditions of top-forests

Top-forests are amongst our most sporadic forest communities. They have been encountered only in the western Mecsek, the Villány Mts, the Keszthely Mts, and some localities of the Bakony Mts so far. Their local occurrence implies that they are a relict association type. Typical stands have been found in the Bakony Mts at the following sites: "Malom mountain" at Bánd; "between the Esztergál and the Slézinger valleys" at Márkó; "Vöröstó peak" at Nagyvázsony; "Hárs mountain" at Nemesvámos; "Miklóspál mountain" at Szentgál; "Csatár mountain" at Veszprém. Based on these occurrences we can conclude that top-forests are most often found in the southern Bakony and the southern margin of the central Bakony. In the northern Bakony only fragments have been reported by forest engineer Miklós Péti, on plateau fringes adjoining steep southern or western slopes ("Öregszarvad-árok" ditch at Bakonyszűcs; "Közép-Hajag" at Hárskút). We believe that the reason for this phenomenon is that top-forests are basically sub-Mediterranean community types

Table 3
Share of characteristic species based on occurrence data in the Bakony and Mecsek top-forests (%)

CÖNOTAXON	B	M
MOLINIO-ARRHENATHEREA	0.6	0.5
MOLINIO-JUNCETEA	0.1	0.1
Molinietalia coeruleae	0.2	0.1
Filipendulo-Cirsion oleracei	0.1	0.0
Molinietalia coeruleae summa	0.3	0.1
MOLINIO-JUNCETEA summa	0.4	0.2
ARRHENATHERETEA (incl. **Arrhenatheretalia**)	1.2	0.3
NARDO-CALLUNETEA (incl. **Nardetalia** et Nardo-Agrostion tenuis)	0.1	0.0
MOLINIO-ARRHENATHEREA summa	2.3	1.0
FESTUCO-BROMEA	0.3	0.4
FESTUCO-BROMETEA	0.6	0.5
Festucetalia valesiacae	2.3	2.8
Festucion rupicolae	0.1	0.3
Cynodonto-Festucion	0.1	0.0
Festucion rupicolae summa	0.2	0.3
Festucetalia valesiacae summa	2.5	3.1
Brometalia erecti (incl. Cirsio-Brachypodion)	0.1	0.2
FESTUCO-BROMETEA summa	3.2	3.8
FESTUCO-BROMEA summa	3.5	4.2
CHENOPODIO-SCLERANTHEA	0.1	0.0
SECALIETEA	0.5	0.7
CHENOPODIETEA	0.1	0.0
ARTEMISIETEA (incl. **Artemisietalia** et Arction lappae)	0.2	0.3
GALIO-URTICETEA (incl. **Calystegietalia sepium**)	0.0	0.0
Galio-Alliarion	2.5	2.3
Calystegion sepium	0.1	0.3
GALIO-URTICETEA (incl. **Calystegietalia sepium**) summa	2.6	2.6
EPILOBIETEA ANGUSTIFOLII (incl. Epilobietalia)	3.3	3.5
CHENOPODIO-SCLERANTHEA summa	6.8	7.1
QUERCO-FAGEA	25.9	21.5
SALICETEA PURPUREAE (incl. **Salicetalia purpureae**)	0.0	0.0
Salicion albae	0.1	0.0
SALICETEA PURPUREAE (incl. **Salicetalia purpureae**) summa	0.1	0.0
CARPINO-FAGETEA (incl. **Fagetalia**)	21.0	22.8
Alno-Padion	1.1	0.9
Alnion glutinosae-incanae	0.1	0.3
Ulmion	0.1	0.0
Alno-Padion summa	1.3	1.2
Asperulo-Fagion	0.0	0.0
Eu-Fagion	0.6	0.8
Carpinion	6.3	7.3
Tilio-Acerion	3.4	2.4
Cephalanthero-Fagion	0.2	0.0
Asperulo-Fagion summa	10.5	10.5
Aremonio-Fagion	0.3	3.7
CARPINO-FAGETEA (incl. **Fagetalia**) summa	33.1	38.2

Table 3 (continued)

CÖNOTAXON	B	M
QUERCETEA ROBORI-PETRAEAE (incl. **Pino-Quercetalia**)	1.0	2.0
QUERCETEA PUBESCENTIS-PETRAEAE19.416.2		
Orno-Cotinetalia	0.9	1.1
Orno-Cotinion	1.3	0.8
Quercion farnetto	0.2	2.7
Orno-Cotinetalia summa	2.4	4.6
Quercetalia pubescentis-petraeae	1.1	1.9
Quercion petraeae	0.2	0.2
Aceri tatarico-Quercion	0.7	0.8
Quercetalia pubescentis-petraeae summa	2.0	2.9
Prunetalia	2.3	1.1
Prunion spinosae	0.6	0.3
Prunetalia summa	2.9	1.4
QUERCETEA PUBESCENTIS-PETRAEAE summa	26.7	25.1
QUERCO-FAGEA summa	86.8	86.8
CETERI	0.8	0.9

B: Bakony top-forests (*Veratro nigri-Fraxinetum orni*); M: Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*)

which have had some continental influence during formation, coming from the Mezőföld region. This influence is less distinct in the northern Bakony and has a sub-Atlantic character, which favours the replacement of the association by beech woodland. All these findings are well in accordance with Borhidi's (1961) map of vegetation zones, as the top-forests observed were situated in the closed oak woodland zone or on the border of the closed oak woodland and the oak-hornbeam woodland zones.

Top-forests have probably been formed by long floristical and vegetation historical processes. The changes that have taken place in the vegetation cover of Hungary in the past ten thousand years are known in relatively great detail (cf. Zólyomi 1936, 1952, 1958, 1980, 1987, 1995, Kintzler 1936, Csinády 1953, 1959, 1960, Borsy and Borsy 1955, Vozáry 1957, Járai-Komlódi 1966a, 1966b, 1968, Jakab and Magyari 2000, Járai-Komlódi and Simon 1971). Based on these data we can draw conclusions on the formation of top-forests. The cool and dry "Preboreal phase" (8,000–7,000 BC) that followed the Ice Age is probably preserved by *Carex alba* and *Taxus baccata*. In the warm and dry "Boreal phase" (7,000–5,000 BC) flat mountain tops were probably covered by dry continental oak woodlands. The continental (*Carex michelii, Peucedanum cervaria, Pulmonaria mollis*) or Ponto-sub-Mediterranean (*Clematis recta, Iris graminea, Mercurialis perennis*) plant species found sporadically in the association today are considered the relicts of this phase. Later in the warm and humid "Atlantic phase" (5,500–2,500) mountain-top dry woodlands could have turned mesophilous,

Table 4

Group frequency based on occurrence and coverage data, and the average of Borhidi's (1993) relative ecological figures in the Bakony and Mecsek top-forests

	Gf-o.		Gf-c.			Gf-o.		Gf-c.	
	B	M	B	M		B	M	B	M
T 1	0.0	0.0	0.0	0.0	R Val.	**7.0**	**7.0**	**7.4**	**7.4**
T 2	0.0	0.0	0.0	0.0	N 1	0.0	0.0	0.0	0.0
T 3	0.0	0.0	0.0	0.0	N 2	7.3	6.2	17.6	18.2
T 4	0.5	0.4	0.1	0.0	N 3	15.2	11.4	19.8	15.6
T 5	**42.4**	**32.7**	18.0	17.2	N 4	**20.4**	**23.5**	**23.1**	**34.1**
T 6	**31.5**	**34.9**	29.0	20.1	N 5	**21.1**	**21.6**	9.5	4.4
T 7	16.7	18.7	17.2	27.2	N 6	9.5	11.7	2.3	4.3
T 8	8.2	12.5	**35.6**	**34.6**	N 7	16.4	14.8	6.2	8.6
T 9	0.7	0.8	0.1	0.9	N 8	9.8	10.1	**21.5**	**14.7**
T Val.	**5.9**	**6.1**	**6.7**	**6.8**	N 9	0.3	0.7	0.0	0.1
W 1	0.0	0.0	0.0	0.0	N Val.	**5.0**	**5.1**	**4.6**	**4.5**
W 2	0.5	0.8	0.1	0.1	L 1	0.0	0.0	0.0	0.0
W 3	12.7	10.5	**34.5**	**32.6**	L 2	1.7	1.7	17.0	10.5
W 4	20.1	20.4	19.1	23.6	L 3	11.0	10.0	6.0	7.8
W 5	**41.5**	**44.2**	20.0	26.1	L 4	17.5	18.9	11.8	15.7
W 6	23.6	21.0	26.1	17.2	L 5	**26.2**	**29.4**	**25.5**	**21.4**
W 7	1.4	3.0	0.2	0.4	L 6	**25.6**	**24.6**	**20.1**	**24.6**
W 8	0.2	0.1	0.0	0.0	L 7	15.1	12.7	**19.3**	**19.7**
W 9	0.0	0.0	0.0	0.0	L 8	2.6	2.5	0.3	0.3
W 10	0.0	0.0	0.0	0.0	L 9	0.3	0.2	0.0	0.0
W 11	0.0	0.0	0.0	0.0	L Val.	**5.2**	**5.1**	**4.8**	**5.0**
W 12	0.0	0.0	0.0	0.0	C 1	0.0	0.0	0.0	0.0
W Val.	**4.8**	**4.8**	**4.4**	**4.3**	C 2	10.4	13.0	25.4	22.5
R 1	0.0	0.0	0.0	0.0	C 3	22.6	21.4	6.8	6.9
R 2	0.0	0.0	0.0	0.0	C 4	**35.1**	**34.1**	**56.3**	**58.9**
R 3	0.0	0.0	0.0	0.0	C 5	20.3	17.9	2.9	6.9
R 4	0.1	0.0	0.0	0.0	C 6	5.5	6.4	4.2	1.5
R 5	2.6	1.7	0.4	0.3	C 7	3.8	3.9	3.1	2.4
R 6	23.1	25.1	10.8	15.3	C 8	2.3	3.3	1.3	0.9
R 7	**43.8**	**46.0**	33.2	27.6	C 9	0.0	0.0	0.0	0.0
R 8	29.8	26.9	**55.5**	**56.8**	C Val.	**4.1**	**4.1**	**3.7**	**3.7**
R 9	0.6	0.3	0.1	0.0					

B: Bakony top-forests (*Veratro nigri-Fraxinetum orni*); M: Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*); Gf-o.: Group frequency based on occurrence data (%); Gf-c.: Group frequency based on coverage data (%); Val.: Value

and dry oak woodlands moved to extrazonal position on southern slopes. This must have been the time when most sub-Mediterranean woodland plant species invaded the area (*Daphne laureola, Lathyrus venetus, Rosa arvensis, Scutellaria columnae, Tamus communis*, etc.). During the cool and humid "Subboreal phase" (2,500–800 BC) top-forests could have mixed with expanding beech woodlands. Some of the thermophilous plants found refuge on the southern

Table 5
Differential species of the Bakony and Mecsek top-forests that reflect different phytogenetic traits

Veratro nigri-Fraxinetum orni (Bakony)	*Aconito anthorae-Fraxinetum orni* (Mecsek)
Arum orientale subsp. *besseranum*	*Aconitum anthora*
Berberis vulgaris	*Aremonia agrimonioides*
Bupleurum longifolium	*Asperula taurina*
Carex alba	*Chaerophyllum aureum*
Corydalis intermedia	*Doronicum orientale*
Corydalis pumila	*Helleborus odorus*
Daphne laureola	*Quercus virgiliana*
Lonicera xylosteum	*Ruscus aculeatus*
Piptatherum virescens	*Ruscus hypoglossum*
Primula veris	*Scilla vindobonensis* subsp. *borhidiana*
Rosa pimpinellifolia	*Scutellaria altissima*
Scutellaria columnae	*Stachys alpina*
Smyrnium perfoliatum	*Tamus communis*
Sorbus aria	*Tilia tomentosa*
Taxus baccata	*Waldsteinia geoides*
Veratrum nigrum	

slopes. Mesophilous plant species (*Adoxa moschatellina, Allium ursinum, Asarum europaeum, Corydalis cava, Dentaria bulbifera, Dentaria enneaphyllos, Gagea lutea, Galanthus nivalis, Galeobdolon luteum, Isopyrum thalictrodes, Lathyrus vernus, Mercurialis perennis,* etc.) characteristic of beech and oak-hornbeam woodlands must have established on mountain-tops in this period. In the warmer, drier, and more continental "Sub-Atlantic phase" (from 8,000 BC) beeches retreated to the northern slopes, while thermophilous species earlier restricted to southern slopes could return to top-forests.

Although top-forests could have transformed several times during the past few millennia, they still preserve remnants from each flora and vegetation historical era. The amount of relict species shows an increasing tendency with time – as is expected. Only two species are left from the subalpine plants of the "Preboreal phase", more species remained from the continental species of the "Boreal phase". The "Atlantic phase" left several sub-Mediterranean plant species, while most plants are mesophilous central European species, relicts of the "Subboreal phase".

Presently, top-forests are found mainly on dolomite mountains where steep southern and northern slopes are connected by a relatively wide and flat surface. Owing to the low declination (0–10°), exposition has no effect on the occurrence of these forests. Under these site conditions the parent rock is covered by a more or less contiguous layer of rendzina soil.

Under the above site conditions, on mountain-tops of transitional climate, the closed thermophilous oak woodlands (*Orno-Quercetum pubescentis*) characteristic of warm and dry southern slopes meet the oak-hornbeam (*Carici*

Table 6
Differential species of the Bakony and Mecsek top-forests based on deviation in constancy values

	B	M		B	M
Acer platanoides	IV	II	*Viola mirabilis*	IV	I
Berberis vulgaris	V	–	*Aconitum anthora*	–	V
Brachypodium sylvaticum	V	II	*Arum maculatum* s. str.	I	V
Campanula trachelium	III	I	*Campanula rapunculoides*	III	V
Carex alba	II	–	*Chaerophyllum aureum*	–	II
Carex divulsa	II	–	*Corydalis solida*	–	V
Carpinus betulus	IV	II	*Filipendula vulgaris*	–	II
Corydalis intermedia	II	–	*Galium lucidum*	–	II
Corydalis pumila	V	–	*Helleborus odorus*	–	V
Cotinus coggygria	II	–	*Hepatica nobilis*	–	IV
Crataegus oxyacantha	V	III	*Lactuca quercina* subsp. *sagittata*	I	V
Fraxinus excelsior	V	II	*Lamium maculatum*	II	V
Galium mollugo	II	–	*Ligustrum vulgare*	II	V
Galium odoratum	III	I	*Lithospermum purpureo-coeruleum*	II	IV
Melica nutans	III	–	*Melittis carpatica*	III	V
Piptatherum virescens	III	–	*Muscari botryoides*	I	III
Polygonatum latifolium	IV	–	*Ornithogalum umbellatum*	–	II
Primula veris	IV	–	*Polygonatum multiflorum*	III	V
Pyrus pyraster	V	III	*Primula vulgaris*	–	III
Rhamnus catharticus	III	–	*Rosa arvensis*	II	IV
Scutellaria columnae	II	–	*Ruscus aculeatus*	–	III
Smyrnium perfoliatum	III	–	*Scutellaria altissima*	–	II
Tilia platyphyllos	V	III	*Stellaria holostea*	I	V
Veratrum nigrum	IV	–	*Tamus communis*	I	V
Viola cyanea	III	I	*Tilia tomentosa*	–	V
Viola hirta	III	–	*Waldsteinia geoides*	–	IV

B: Bakony top-forests (*Veratro nigri-Fraxinetum orni*); M: Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*)

pilosae-Carpinetum) and the beech woodlands (*Daphno laureolae-Fagetum*) of cool, humid northern slopes. The warm, dry climate of southern slopes penetrate up to mountain-tops enabling xerophilous trees (*Fraxinus ornus, Quercus pubescens, Sorbus torminalis*) and shrubs (*Berberis vulgaris, Cornus mas, Euonymus verrucosus, Viburnum lantana*) to establish. In the herb layer, however, far less thermophilous plant species are found. The main reason for this is that the canopy and shrub layers cast a deep shadow on these herbs, creating cool and humid microclimatic conditions coming from the oak-hornbeam and beech woodlands of the northern slopes. The herb layer is therefore dominated by mesophilous species, with xerophilous elements interspersed. The species composition of top-forests is therefore determined by climatic factors similarly

to the relict community *Fago-Ornetum*, where thermo- and mesophilous species appear together.

Consequently, top-forests (*Veratro nigri-Fraxinetum orni*) occupying flat mountain-tops and ridges replace slope woodlands (*Mercuriali-Tilietum*), Turkey oak-sessile oak woodlands (*Quercetum petraeae-cerris*), and occasionally oak-hornbeam woodlands (*Carici pilosae-Carpinetum*). The slight declination and shallow rendzina soil cover of these sites create conditions unfavourable for slope woodlands and oak-hornbeam woodlands, respectively.

Top-forest stands in the Bakony Mts are found at an altitude of 350–440 m above sea level, i.e. in the Turkey oak-sessile oak forest zone and at the border of the Turkey oak-sessile oak and the oak-hornbeam forest zones according to Borhidi's (1961) height graduation. The Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*), however, occupy higher (480–610 m) altitudes. The difference may be attributed to local relief patterns or to the different altitude zone boundaries which vary with latitude.

Stand structure

The canopy layer of top-forests is very similar to that of thermophilous pubescent oak woodlands. It is usually moderately closed, occasionally reaching 65–80% closure, and is short (10–17 m). The average diameter at breast height is only 25–35 cm. The association is composed of *Fraxinus ornus* and *Quercus pubescens*. Considering other tree species, *Quercus cerris* plays a significant role, while *Pyrus pyraster, Sorbus torminalis* and *Tilia platyphyllos* may also occur. Stand age is hard to establish because of slow growth, but is estimated 80–120 years. A lower canopy layer is formed by suppressed trees with a cover of 20–35% and a height of 8–12 m.

The shrub layer is generally well-developed just like in thermophilous pubescent oak woodlands, but its cover is varying (25–70%) and its height is up to 4 m. The dominant species is *Cornus mas*. Other shrub species (*Crataegus monogyna, Crataegus oxyacantha, Euonymus verrucosus, Viburnum lantana,* etc.) are also present in smaller or bigger clusters or as individuals interspersed. The lower shrub layer (saplings) is negligible, although its cover occasionally reaches 30%. It is composed of young trees and shrubs.

The herb layer is almost closed in most cases, although it can be more open in some stands (60–100%). The species composition is more like that of oak-hornbeam woodlands than that of thermophilous pubescent oak woodlands, as plants characteristic of *Carpino-Fagetalia* (Fagetalia) have much higher abundance-dominance (A–D) values than Quercetea species do. This phenomenon is the result of the shading effect of the canopy and shrub layers, which creates relatively more humid and cooler microclimatic conditions on

mountain-tops, thus enabling plants to invade from northern slopes. The high abundance of *Allium ursinum* is especially conspicuous, since the plant, together with some accompanying species, forms an aspect in early spring in the surrounding oak-hornbeam and beech woodlands as well. *Melica uniflora* also frequently forms facies, while *Polygonatum latifolium* is rarely dominant. Some herb species dominate smaller areas (*Carex alba, Corydalis cava, Dentaria bulbifera, Glechoma hirsuta*) or occur only in clusters of various sizes (*Mercurialis perennis, Viola odorata*).

Differential species

The top-forests of the Mecsek Mts (*Aconito anthorae-Fraxinetum orni*) had previously (cf. Kevey and Borhidi 1998) been compared with five forest communities (*Tamo-Quercetum virgilianae, Potentillo micranthae-Quercetum dalechampii, Asperulo taurinae-Carpinetum, Helleboro odoro-Fagetum, Tilio tomentosae-Fraxinetum orni*), and the differential species between the associations had been listed. Results clearly showed that the top-forests were profoundly different from the adjacent communities. A similar comparison could of course be made for the forests of the Bakony Mts, but in view of the above results this seems unnecessary. Therefore, only the role of the differential species between the Mecsek and Bakony top-forests will be dealt with below.

Several species in the Bakony top-forests (*Veratro nigri-Fraxinetum orni*) represent the dissimilar phytogenetic aspects of the region: *Arum orientale* subsp. *besseranum*, *Berberis vulgaris*, *Bupleurum longifolium*, *Carex alba*, *Corydalis intermedia*, *Corydalis pumila*, *Daphne laureola*, *Lonicera xylosteum*, *Piptatherum virescens*, *Primula veris*, *Rosa pimpinellifolia*, *Scutellaria columnae*, *Smyrnium perfoliatum*, *Sorbus aria*, *Taxus baccata*, *Veratrum nigrum*. Species of similar importance are present in the Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*), too: *Aconitum anthora*, *Aremonia agrimonioides*, *Asperula taurina*, *Chaerophyllum aureum*, *Corydalis solida*, *Doronicum orientale*, *Helleborus odorus*, *Hepatica nobilis*, *Ruscus aculeatus*, *Ruscus hypoglossum*, *Scilla vindobonensis* subsp. *borhidiana*, *Scutellaria altissima*, *Stachys alpina*, *Tamus communis*, *Tilia tomentosa*, *Waldsteinia geoides* (cf. Table 5).

Some differential species occur in both geographical landscape units, but display much higher constancy values in the Bakony Mts, or are completely missing from the Mecsek Mts. The most important ones are: *Acer platanoides*, *Brachypodium sylvaticum*, *Campanula trachelium*, *Carpinus betulus*, *Cotinus coggygria*, *Crataegus oxyacantha*, *Fraxinus excelsior*, *Galium odoratum*, *Melica nutans*, *Polygonatum latifolium*, *Primula veris*, *Pyrus pyraster*, *Rhamnus cathartica*, *Tilia platyphyllos*, *Viola cyanea*, *Viola hirta*, *Viola mirabilis*. Likewise, the top-forests of the Mecsek Mts also contain such differential species: *Arum maculatum*, *Cam-*

panula rapunculoides, *Corydalis solida*, *Filipendula vulgaris*, *Galium lucidum*, *Hepatica nobilis*, *Lactuca quercina* subsp. *sagittata*, *Lamium maculatum*, *Ligustrum vulgare*, *Lithospermum purpureo-coeruleum*, *Melittis carpatica*, *Muscari botryoides*, *Ornithogalum umbellatum*, *Polygonatum multiflorum*, *Primula vulgaris*, *Rosa arvensis*, *Stellaria holostea*, *Tamus communis*, *Tilia tomentosa*, *Waldsteinia geoides* (cf. Table 6).

The above data show that the number of differential species in both the Bakony and the Mecsek top-forests is great and very similar.

Statistical analyses

The top-forests of the Bakony and the Mecsek Mts were compared statistically, too. The most important conclusions are as follows.

Considering the frequency of characteristic species based on occurrence, elements of the Querco-Fagea (25.9%), Carpino-Fagetea (21%), and Quercetea pubescentis-petraeae s. l. (26.7%) groups play a prominent role; the ratios indicate the transitional character of top-forests. When comparing the Bakony and the Mecsek top-forests, the ratios of characteristic species appear very similar, which frequently happens in closely related community types. This relationship is also confirmed by the fact that numerous species have identical or similar K-values in the two top-forest associations. The only great difference occurs in the sub-Mediterranean Aremonio-Fagion and Quercion farnetto groups, which can be assigned to the southern exposure of the Mecsek Mts (cf. Table 3).

The results of statistical analyses (Table 4) using Borhidi's (1993, 1995) relative ecological values also indicate a relationship between the top-forests of the Bakony and the Mecsek Mts. The averages of the ecological values (T val., W val., R val., N val., L val., C val.), for example, are the same in many cases in both landscape units, or differ only by 0.2. As for the parameters themselves, the values are also similar, although the maximum points may be different considering the group frequency calculations based on occurrence and coverage data (see highlighted numbers in Table 4).

a) Considering the relative temperature figures (T), the share of broad-leaved forest belt species (T 5, T 6) based on occurrence data is the highest in both communities, although the Bakony Mts has a more montane character. Group frequency calculations based on coverage data, however, indicate the predominance of sub-Mediterranean (T 8) plants in both communities.

b) In the case of the relative moisture figures (W), results of group frequency calculations based on occurrence data show that the top-forests of both landscape units are dominated by plants of semi-humid habitats (W 5), while

calculations based on coverage indicate the dominance of xero-tolerant species.

c) As for soil reaction figures (R), the share of basifrequent plants (R 7) based on occurrence data is outstandingly high, while group frequency calculations based on coverage data show the dominance of plants of basiphilous sites (R 8).

d) The relative nitrogen figures (N) show the highest group frequency values based on occurrence in plants of submesotrophic (N 4) and mesotrophic (N 5) habitats. Calculations of group frequencies based on coverage data, however, gave different results. In the Mecsek Mts plants of submesotrophic habitats (N 4) were found to be dominant, while in the Bakony mountains both plants of submesotrophic habitats (N 4) and N-indicator species (N 8) had the highest values. The latter may be attributed to the large game population of the Bakony Mts.

e) Group frequency calculations for the relative light figures (L) according to both occurrence and coverage data refer to the dominance of halfshadow (L 5) and halfshadow-halflight (L 6) plants.

f) The distribution of relative continentality figures (C) is likewise unambiguous, reaching the highest value in the suboceanic species (C 4) for group frequency calculations based on both occurrence and coverage data.

Despite the above similarities, the segregation of the Bakony and Mecsek top-forests is clearly shown by the results of cluster analysis (Podani 1993) based on species combinations. The 20–20 coenological relevés of the two geographical regions form two distinct groups in the dendrogram (Fig. 1). This segregation is in accordance with Pócs's (1966) hypothesis which states that "any relatively homogeneous coenological dataset made up of two or more samples can be considered as coming from one association if the number of common elements in the samples is greater than the number of distinguishing ones". In the dendrogram, relevés from the Mecsek and Bakony Mts are connected over the divergence value of 0.5, which means that dissimilarity is greater than similarity between the top-forests of the two regions. On the contrary, relevés taken in the Bakony mountains and also those taken in the Mecsek mountains are linked below the value of 0.5. Within these two principal groups several subgroups can be distinguished representing the sampling sites, that is, the mountain-tops and ridges. Their segregation can be explained by the varying site conditions (such as exposition, slope, elevation), and by geographical isolation.

Syntaxonomic classification of top-forests

The great number of differential species, and the results of traditional and multivariate statistical analyses prove that the two forest communities are

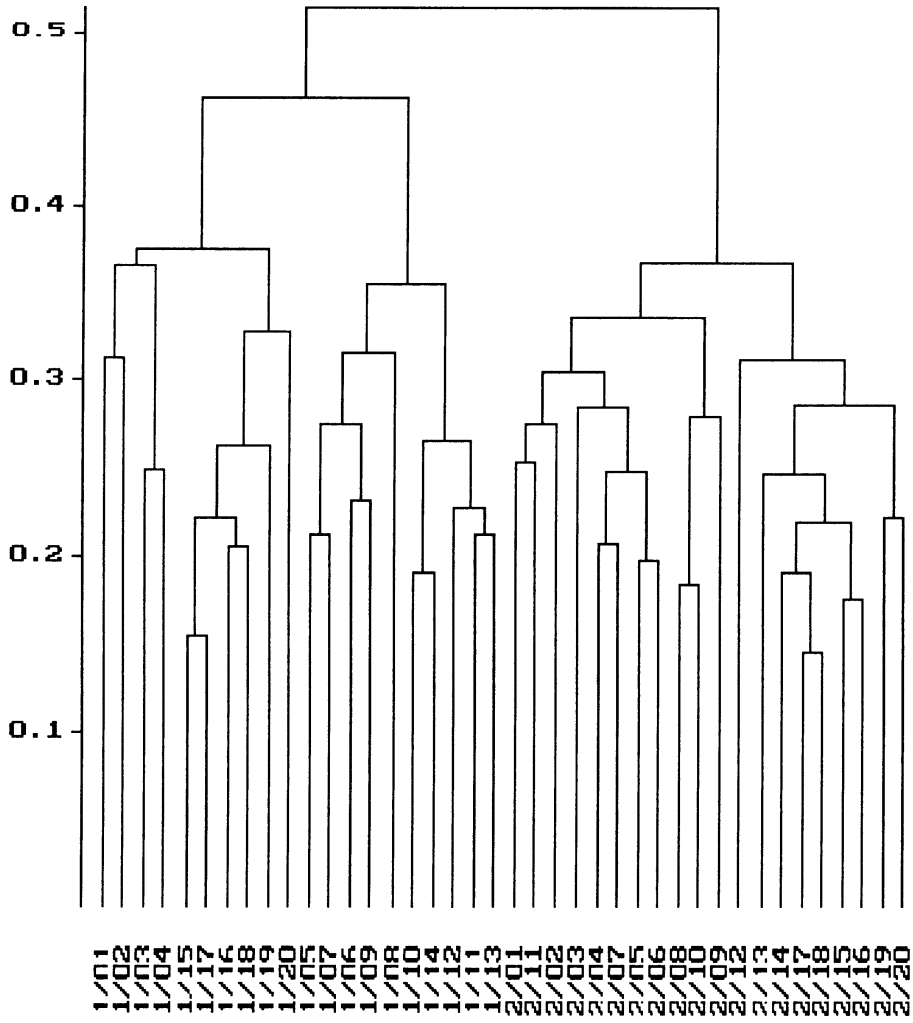

Fig. 1. Dendrogram of the Bakony and Mecsek top-forest. 1 = *Veratro nigri-Fraxinetum orni*, 2 = *Aconito anthorae-Fraxinetum orni*, 1–20 = serial numbers of the coenological relevés in the tables

vicariants. The community type *Veratro nigri-Fraxinetum orni* is found in the Transdanubian Mountain Range (Bakony and Keszthely Mts), while stands of *Aconito anthorae-Fraxinetum orni* are present in southern Transdanubia (Mecsek and Villány Mts).

Based on analyses (cf. Kevey and Borhidi 1998), the top-forests of the Mecsek mountains (*Aconito anthorae-Fraxinetum orni*) are classified among Turkey oak-sessile oak (*Potentillo micranthae-Quercetum dalechampii*), oak-hornbeam (*Asperulo taurinae-Carpinetum*) and rock woodlands (*Tilio tomentosae-Fraxinetum orni*), although their syntaxonomic position is slightly shifted towards pubescent oak woodlands (*Tamo-Quercetum virgilianae*) as well, owing to the composition of the canopy and shrub layers, and the sporadic occurrence of Quercetea-type of herbs. Consequently, they represent a transitional community type between mesophilous deciduous forests (Carpino-Fagetea = Fagetalia) and dry oak woodlands (Quercetea pubescentis-petraeae). The Bakony top-forests are likewise related to mountainous associations (*Quercetum petraeae-cerris*, *Carici pilosae-Carpinetum*, *Mercuriali-Tilietum*, *Orno-Quercetum pubescentis*), the equivalent community types of the ones found in the Mecsek Mts. Owing to their transitional character, syntaxonomic classification is difficult. However, as the Mecsek top-forests (*Aconito anthorae-Fraxinetum orni*) have recently been placed in the Orno-Cotinion group (cf. Borhidi and Kevey 1996), we put the Bakony top-forests (*Veratro nigri-Fraxinetum orni*) *in this group, too, as follows:*

Divisio: *Querco-Fagea* Jakucs 1967
Classis: *Quercetea pubescentis-petraeae* (Oberdorfer 1948) Jakucs 1960
Ordo: *Orno-Cotinetalia* Jakucs 1960
Alliance: *Orno-Cotinion* Soó 1960
Associatio: *Veratro nigri-Fraxinetum orni* Kevey (in Kevey and Borhidi 2001)

Abbreviations: AbP: Abieti-Piceea; Agi: Alnion glutinosae-incanae; AP: Alno-Padion; AQ: Aceri tatarico-Quercion; Ar: Artemisietea; Ara: Arrhenatheretea; ArF: Artemisio-Festucetalia pseudovinae; Arn: Arrhenatherion elatioris; Bra: Brometalia erecti; BrF: Bromo-Festucion pallentis; CeF: Cephalanthero-Fagion; CF: Carpino-Fagetea; Che: Chenopodietea; ChS: Chenopodio-Scleranthea; Cp: Carpinion; CyF: Cynodonto-Festucion; EP: Erico-Pinetea; Epa: Epilobietea angustifolii; EuF: Eu-Fagion; FB: Festuco-Bromea; FBt: Festuco-Brometea; FiC: Filipendulo-Cirsion oleracei; Fru: Festucion rupicolae; Fvl: Festucetalia valesiacae; GA: Galio-Alliarion; GU: Galio-Urticetea; Mag: Magnocaricetalia; Moa: Molinietalia coeruleae; MoA: Molinio-Arrhenatherea; MoJ: Molinio-Juncetea; NC: Nardo-Callunetea; OCa: Orno-Cotinetalia; OCn: Orno-Cotinion; PP: Pulsatillo-Pinetea; Prs: Prunion spinosae; Pru: Prunetalia; QF: Querco-Fagea; Qfa: Quercion farnetto; Qia: Quercetalia pubescentis-petraeae; Qp: Quercion petraeae; Qpp: Quercetea pubescentis-petraeae; Qrp:

Quercetea robori-petraeae; Sal: Salicion albae; Sea: Secalietea; Spu: Salicetea purpureae; TAc: Tilio-Acerion; Ulm: Ulmion; US: Urtico-Sambucetea; VP: Vaccinio-Piceetea.

*

Acknowledgements – Thanks are due to everybody who has supported our research with field experience or any other means: Mária Bús, Hilik Hegyi, Csaba Kelemen, Miklós Péti and Tamás Rakk.

REFERENCES

Barkmann, J., Moravec, J. and Rauschert, S. (1986): Code of phytosociological nomenclature. – *Vegetatio* **67**: 145–195.

Borhidi, A. (1961): Klimadiagramme und klimazonale Karte Ungarns. – *Ann. Univ. Budapest., Sect. Biol.* **4**: 21–250.

Borhidi, A. (1993): *A magyar flóra szociális magatartás típusai, természetességi és relatív ökológiai értékszámai.* – Janus Pannonius Tudományegyetem, Pécs.

Borhidi, A. (1995): Social behaviour types, the naturalness and relative ecological indicator values of the higher plants in the Hungarian flora. – *Acta Bot. Hung.* **39**: 97–181.

Borhidi, A. and Kevey B. (1996): *An annotated checklist of the Hungarian plant communities II.* – In: Borhidi, A. (ed.): Critical revision of the Hungarian plant communities. Janus Pannonius University, Pécs, pp. 95–138.

Borsy, Z.-né and Borsy, Z. (1955): Pollenanalitikai vizsgálatok a Nyírség északi részében. – *Acta Univ. Debrecen.* **2**: 271–280.

Braun-Blanquet, J. (1928): *Pflanzensoziologie.* – Berlin.

Csinády, G. (1953): *A bátorligeti láp pollenanalitikai vizsgálata.* – In: Székessy, V. (ed.): Bátorliget élővilága. Akadémiai Kiadó, Budapest, pp. 448–453.

Csinády, G. (1959): A csarodai láposodott folyómeder pollenanalitikai vizsgálata. – *Acta Univ. Debrecen.* **5**: 271–277. (1958).

Csinády, G. (1960): A kokadi láp palynológiai vizsgálata. – *Acta Univ. Debrecen.* **6**(2): 239–251. (1959–1960).

Horváth, F., Dobolyi, Z. K., Morschhauser, T., Lőkös, L., Karas, L. and Szerdahelyi, T. (1995): *Flóra adatbázis 1.2. Taxonlista és attribútum-állomány.* – Vácrátót, 267 pp.

Jakab, G. and Magyari E. (2000): Új távlatok a magyar lápkutatásban: szukcessziókutatás paleobryológiai és pollenanalitikai módszerekkel. – *Kitaibelia* **5**: 17–36.

Jakucs, P. (1960): Nouveau classement cénologique des bois de chênes xérothermes (Quercetea pubescenti-petraeae cl. nova) de l'Europe. – *Acta Bot. Hung.* **6**: 267–303.

Jakucs, P. (1967): Gedanken zur höheren Systematik der europäischen Laubwälder. – *Contributii Bot.*, Cluj **1967**: 159–166.

Járai-Komlódi, M. (1966a): *Palinológiai vizsgálatok a Magyar Alföldön a Würm glaciális és a holocén klíma- és vegetációtörténetére vonatkozóan.* – Kandidátusi értekezés, Budapest. (mscr.)

Járai-Komlódi, M. (1966b): Adatok az Alföld negyedkori klíma- és vegetációtörténetéhez I. – *Bot. Közlem.* **53**: 191–201.

Járai-Komlódi, M. (1968): The late glazial and Holocene flora of the Hungarian Great Plain. – *Ann. Univ. Budapest.*, Sect. Biol. **9–10**: 199–225.
Járai-Komlódi, M. (2000): A Kárpát-medence növényzetének kialakulása. – *Tilia* **9**: 5–59.
Járai-Komlódi, M. and Simon, T. (1971): Palynological studies on swamps of the Zemplén mountains. – *Ann. Univ. Budapest.*, Sect. Biol. **13**: 103–113.
Kevey, B. (1979): *Az Allium ursinum növényföldrajzi jellemzése, különös tekintettel magyarországi elterjedési viszonyaira.* – Egyetemi doktori értekezés (mscr.), Debrecen.
Kevey, B. (1993): *A Szigetköz ligeterdeinek összehasonlító-cönológiai vizsgálata.* – Kandidátusi értekezés tézisei, Pécs.
Kevey, B. (1997): *A Nyugati-Mecsek szurdokerdei (Scutellario altissimae-Aceretum (Horvát A. O. 1958) Soó et Borhidi in Soó 1962).* – In: Borhidi, A. and Szabó, L. Gy. (ed.): Studia Phytologica Jubilaria. Dissertationes in honorem jubilantis Adolf Olivér Horvát Doctor Academiae in annoversario nonagesimo nativitatis 1907–1997. Pécs, pp. 75–99.
Kevey, B. and Borhidi, A. (1998): Top-forest (Aconito anthorae-Fraxinetum orni) a special ecotonal case in the phytosociological system (Mecsek Mts, South Hungary). – *Acta Bot. Hung.* **41**: 27–121.
Kevey, B. and Borhidi, A. (2001): Egy új erdőtársulás a Bakonyban (Veratro nigri-Fraxinetum orni). – *Bakonyi Természettud. Múz. Közlem.* **17**: 37–54. (1998)
Kintzler, O. (1936): Pollenanalytische Untersuchung von Mooren des westlichen pannonischen Beckens. – *Beih. Bot. Centralbl.* **54**: 515–546.
Oberdorfer, E. (1948): Gliederung und Umgrenzung der Mittelmeervegetation auf der Balkanhalbinsel. – *Ber. Geobot. Forschungsinst. Rübel* **3**: 84–111.
Pócs, T. (1966): Statisztikus matematikai módszer növénytársulások elhatárolására. – *Acta Acad. Paed. Agriensis.*, Nov. Ser. **4**: 441–454.
Podani, J. (1993): SYN-TAX 5.0: Computer programs for multivariate data analysis in ecology and systematics. – *Abstr. Bot.* **17**: 289–302.
Soó, R. (1960): Magyarország erdőtársulásainak és erdőtípusainak áttekintése. – Az Erdő **9**: 321–340.
Soó, R. (1964, 1966, 1968, 1970, 1973, 1980): *A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve I–VI.* – Akadémiai Kiadó, Budapest.
Vozáry, E. (1957): Pollenanalytische Untersuchung des Torfmoores "Nyírestó" im Nordosten der ungarischen Tiefebene (Alföld). – *Acta Bot. Hung.* **3**: 123–134.
Weber, H. E., Moravec, J. and Theurillat, J.-P. (2000): International Code of Phytosociological Nomenclature. 3rd ed. – *J. Veg. Sci.* **11**: 739–768.
Zólyomi, B. (1936): Tízezer év története virágporszemekben. – *Term. tud. Közl.* **68**: 504–516.
Zólyomi, B. (1952): Magyarország növénytakarójának fejlődéstörténete az utolsó jégkorszaktól. – *MTA Biol. Oszt. Közlem.* **1**: 491–530.
Zólyomi, B. (1958): *Budapest és környékének természetes növénytakarója.* – In: Pécsi, M. (ed.): Budapest természeti képe. Budapest, pp. 511–642.
Zólyomi, B. (1980): Landwirtschaftliche Kultur und Wandlung der Vegetation im Holozän am Balaton. – *Phytocoenologia* **7**: 121–126.
Zólyomi, B. (1987): *Degree and rate of sedimentation in Lake Balaton*. – In: Pécsi, M. (ed.): Pleistocene environment in Hungary. Contributions of the INQUA Hungarian National Committee to the XIIth INQUA Congress, Budapest, pp. 57–79.
Zólyomi, B. (1995): Opportunities for pollen stratigraphic analysis of shallow lake sediments: the example of Lake Balaton. – *GeoJournal* **36**(2–3): 237–241.