

PHYTOSOCIOLOGICAL EVALUATION AND MULTIVARIATE ANALYSIS OF THE HABITAT OF *LINUM DOLOMITICUM* BORBÁS (LINACEAE) II*

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Phytosociological study of *Linum dolomiticum* habitat has been carried out based on 135 relevés on the complete area of distribution. The habitat encompasses the following plant communities: *Seseli leucospermi-Festucetum pallentis*, *Stipo eriocauli-Festucetum pallentis*, *Seseli leucospermi-Brometum pannonicum*, *Festuco pallentis-Brometum pannonicum* and several transitions and degraded forms of these communities. These grasslands in part belong to the herb layer of the Pannonian karst white oak low woods. The vegetation was analysed statistically according to life form, phytogeographical area, phytosociological character, social behaviour type and ecological indicator values (preference categories) of the species. The habitat of *Linum dolomiticum* may be characterised by several types of coenotones and ecotones. With 17 tables and 2 figures.

Key words: coenotone, dolomite rock grasslands, ecotone, *Linum dolomiticum*, multivariate analysis, phytosociology

INTRODUCTION

Previous phytosociological study of the habitat of the endemic *Linum dolomiticum* was carried out by MÉSZÁROS-DRASKOVITS (1967), and multivariate analysis of the original relevés was published in the first part of our study (DOBOLYI 2003). As those investigations covered only a relatively small part of the full distribution area, their results are considered to be incomplete. As concluded by the earlier studies, the habitat of *Linum dolomiticum* belongs to the following plant communities: *Seseli leucospermi-Festucetum pallentis* Zólyomi 1958, *Stipo eriocauli-Festucetum pallentis* Zólyomi 1966 and *Seseli leucospermi-Brometum pannonicum* Borhidi 1996. However, more recent field experiences indicate that *Linum dolomiticum* occurs in other forms of associations such as closed dolomite rock grassland, degraded forms of rock steppes and karst white oak low woods (DOBOLYI 2001).

Purpose of the recent study is to provide a phytosociological analysis for the complete distribution area of *Linum dolomiticum*, i. e. to determine and characterise all vegetation types of the habitat of the species.

* Dedicated to Rózsa Mészáros-Draskovits

The present study is based on 135 phytosociological relevés: 45 of them were made and published by MÉSZÁROS-DRASKOVITS (1967) and 90 new relevés made by the author in the period of 2000–2003.

MATERIAL AND METHODS

Ninety new phytosociological relevés of 2 m × 2 m size were taken on the habitat of *Linum dolomiticum* so that the complete area of distribution and all types of vegetation be represented. Nomenclature of the plant names follows HORVÁTH *et al.* (1995). Cover values transformed to the scale 1 to 9 (VANDER MAAREL 1979) and the additional data of the new relevés are shown in Tables 3 to 8.

The multivariate data analyses and the phytosociological evaluation were based on both the new phytosociological relevés and the old ones taken by MÉSZÁROS-DRASKOVITS (1967) (135 relevés altogether). The variables in the analyses were the transformed cover values of the species. Numbering of the relevés in the present study is given in Table 1.

Five additional relevés were included in the multivariate analyses, which represent dolomite grassland communities marked by letters A to E (Table 2), which were compiled from the original descriptions (ZÓLYOMI 1958, BORHIDI 1996). These communities belong to the Bromo-Festucion pallentis Zólyomi 1966 alliance (BORHIDI 1996). These relevés served as reference in the comparisons made by classification and ordination methods indicating the place of the five relevant plant communities.

Table 1. Numbering of the relevés in the multivariate data analyses and in the phytosociological evaluation.

Number of the relevés in the multivariate data analyses	Origin of the relevés
1–20	MÉSZÁROS-DRASKOVITS (1967), Table 1, 1–20
21–45	MÉSZÁROS-DRASKOVITS (1967), Table 2, 1–25
46–50	additional relevés (ZÓLYOMI 1958, BORHIDI 1996)
51–140	new relevés

Table 2. Plant communities represented by the additional relevés.

Additional relevés		Plant community
Number	Mark	
46	A	<i>Seseli leucospermi-Festucetum pallentis</i> Zólyomi 1958
47	B	<i>Stipo eriocauli-Festucetum pallentis</i> Zólyomi 1958
48	C	<i>Chrysopogono-Caricetum humilis</i> Zólyomi 1958
49	D	<i>Seseli leucospermi-Brometum pannonici</i> Borhidi 1996
50	E	<i>Festuco pallenti-Brometum pannonici</i> Zólyomi 1958

The relevés were analysed by the following multivariate methods with SYN-TAX 2000 program packages (PODANI 2001).

1) hierarchical classifications

- distance optimising procedure: group average (UPGMA)
- global optimisation

2) ordinations

- centred principal component analysis (PCA)
- principal coordinate analysis (metric multidimensional scaling; PCoA)

The applied distance coefficients are Euclidean distance, Bray–Curtis-index and similarity ratio (PODANI 1997).

The classifications and ordinations resulted in six groups of separated relevés. These groups and the mentioned five plant communities were submitted to multivariate analyses again in order to determine the distances between the groups and the communities.

The groups of relevés were analysed statistically on the basis of the following species characteristics: life form, phytogeographical area (floral element) (HORVÁTH *et al.* 1995), phytosociological character, social behaviour type and ecological indicator values (preference categories) (BORHIDI 1993). The values of features characterising the groups of relevés were calculated according to percentage pro rata of plant mass, that is, the sum of the transformed cover values concerning one feature has been expressed in percentage of sum of all cover values of all species.

RESULTS

The results of multivariate analyses showed that six relatively homogeneous groups of relevés may be separated (78 relevés altogether). The groups are characterised with the floristical composition and dominant species, distribution of life forms, phytogeographical and phytosociological spectrum, social behaviour type of the species and environmental and ecological circumstances. Results of the statistical analyses of the groups are in Tables 9 to 17. The groups represent the characteristic vegetation types of *Linum dolomiticum* habitats. Some of them can be identified as belonging to the dolomite grassland communities.

Group I

Relevés: 1-14, 60, 63, 102, 136.

Characteristics of the group:

- typical exposure: N, NW, W (Table 8),
- low proportion of the total cover of vegetation,
- relatively low number of species,
- dominant species: *Festuca pallens*, *Helianthemum canum*, *Thymus praecox*,
- highest proportion (22.7%) of Chamaephyta (Table 9),
- highest proportion of Submediterranean and endemic species (Table 10),
- phytosociological composition is similar to group II (Table 11),

Table 3. Cover values of the species in the relevés of group II.

	No. of relevés																				
	67	71	72	73	75	77	79	81	83	84	88	97	98	99	101	109	125	133	134	135	137
<i>Alyssum tortuosum</i> W. et K.	–	–	1	–	–	–	–	–	–	1	1	–	–	–	–	–	1	–	2	1	2
<i>Anthericum ramosum</i> L.	3	4	3	3	1	3	2	2	2	3	2	4	4	4	3	3	3	2	1	2	2
<i>Anthyllis vulneraria</i> L.	–	1	–	–	1	–	–	–	–	–	–	–	1	2	–	–	–	–	–	1	1
<i>Asperula cynanchica</i> L.	–	–	1	1	1	1	1	1	1	1	–	–	–	–	1	1	1	1	1	1	–
<i>Aster linosyris</i> (L.) Bernh.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Carex humilis</i> Leyss.	4	4	4	4	5	4	4	4	3	4	3	3	4	5	3	3	4	4	3	2	4
<i>Carex liparicarpus</i> Gaud.	–	3	4	3	3	5	3	4	3	3	–	4	1	–	2	–	–	1	–	–	1
<i>Cuscuta epithymum</i> (L.) Nath.																					
subsp. <i>kotschy</i> (Des Moul.) Arc.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
<i>Dianthus plumarius</i> L. subsp.																					
<i>regis-stephani</i> (Rapaics) Baksay	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	2	–	1	2	1	2
<i>Draba lasiocarpa</i> Roch.	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	1	1	1	1
<i>Epipactis atrorubens</i> (Hoffm.) Bess.	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	–
<i>Euphorbia cyparissias</i> L.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Euphorbia seguieriana</i> Necker	–	1	2	1	2	–	1	1	–	1	–	–	–	–	–	2	3	2	2	2	1
<i>Festuca pallens</i> Host	3	2	1	2	2	3	2	2	3	3	1	2	1	2	2	3	3	3	2	3	2
<i>Fraxinus ornus</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–
<i>Fumana procumbens</i> (Dun.) Gren.																					
et Godr.	2	2	3	2	1	2	–	–	–	1	3	1	2	2	2	3	–	2	1	2	2
<i>Galium verum</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
<i>Genista pilosa</i> L.	–	–	–	–	–	–	–	–	–	–	–	1	1	–	2	–	–	–	1	–	1
<i>Globularia punctata</i> Lap.	1	1	2	1	1	2	–	–	–	–	–	1	1	–	1	–	–	1	2	1	1
<i>Gypsophila fastigiata</i> L. subsp.																					
<i>arenaria</i> (W. et K.) Dom.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	1	2
<i>Helianthemum canum</i> (L.) Baumg.	3	5	4	4	4	4	4	4	4	4	5	5	5	5	3	4	4	4	4	3	3
<i>Inula ensifolia</i> L.	–	–	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Jovibarba hirta</i> agg.	2	–	1	–	–	2	–	1	2	2	–	1	1	1	–	1	2	1	1	2	1
<i>Juniperus communis</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
<i>Jurinea mollis</i> (L.) Rchb.	–	1	–	1	1	1	1	1	1	1	–	–	–	–	–	2	1	–	2	1	2
<i>Linum dolomiticum</i> Borbás	4	4	3	5	5	5	4	3	3	3	4	4	3	4	4	4	4	4	4	3	4
<i>Linum tenuifolium</i> L.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	–	1	2	1	1	1	2
<i>Minuartia setacea</i> (Thuill.) Hay.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	2

Table 3 (continued)

	No. of relevés																				
	67	71	72	73	75	77	79	81	83	84	88	97	98	99	101	109	125	133	134	135	137
<i>Onosma visianii</i> Clem.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
<i>Orphantha lutea</i> (L.) Kern.	1	–	1	–	–	1	1	1	–	–	–	–	–	–	–	–	1	–	1	–	–
<i>Paronychia cephalotes</i> (M. B.) Bess.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	2	2	3
<i>Peucedanum cervaria</i> (L.) Lap.	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Peucedanum oreoselinum</i> (L.) Mönch	–	–	–	–	2	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Poa badensis</i> Haenke	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
<i>Polygonatum odoratum</i> (Mill.) Druce	–	–	–	2	2	2	–	3	2	–	–	1	–	–	2	–	–	–	–	1	–
<i>Potentilla arenaria</i> Borkh.	–	–	1	2	–	2	2	2	3	3	3	–	–	–	2	2	3	3	3	2	2
<i>Pulsatilla grandis</i> Wender.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
<i>Sanguisorba minor</i> Scop.	–	–	–	–	–	–	1	2	2	3	2	–	–	–	–	1	3	2	2	2	2
<i>Scabiosa canescens</i> W. et K.	1	–	2	2	2	2	1	1	1	2	–	1	1	2	1	–	2	2	1	2	1
<i>Scorzonera austriaca</i> Willd.	1	–	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	1	1	1	1
<i>Sedum album</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
<i>Seseli leucospermum</i> W. et K.	–	3	3	2	1	1	2	2	2	1	2	1	2	2	2	–	1	2	2	3	2
<i>Silene otites</i> (L.) Wibel	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
<i>Stipa eriocalis</i> Borbás	3	–	–	–	3	–	–	–	–	–	2	1	2	3	2	1	3	3	1	2	4
<i>Teucrium montanum</i> L.	3	2	1	2	2	2	1	3	3	–	–	–	–	–	–	2	–	2	3	2	2
<i>Thalictrum minus</i> L. subsp. <i>pseudo-</i> <i>minus</i> (Borbás) Soó	–	–	–	–	–	–	–	–	–	–	–	3	2	2	–	–	–	–	–	–	–
<i>Thesium linophyllum</i> L.	–	–	–	1	–	–	–	–	–	2	–	2	1	–	1	–	1	–	1	–	1
<i>Thymus praecox</i> Opiz	1	4	2	2	2	3	3	2	3	3	2	3	2	2	2	3	3	3	2	2	2
<i>Veronica spicata</i> L. s. str.	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
<i>Viola rupestris</i> F. W. Schmidt	–	1	1	1	–	1	1	–	–	–	–	1	–	–	–	1	–	1	1	–	–

Table 4. Cover values of the species in the relevés of group V.

	No. of relevés								
	89	90	92	93	94	95	126	127	128
<i>Allium montanum</i> F. W. Schmidt	–	–	–	–	–	–	2	2	1
<i>Anthericum ramosum</i> L.	6	6	5	5	5	6	4	4	4
<i>Anthyllis vulneraria</i> L.	4	2	3	3	3	1	2	3	3
<i>Asperula cynanchica</i> L.	–	1	–	–	1	1	–	1	1
<i>Berberis vulgaris</i> L.	–	–	1	–	–	–	–	–	–
<i>Biscutella laevigata</i> L.	–	–	–	–	–	–	–	–	2
<i>Bromus pannonicus</i> Kummer et Sendtner	–	1	–	–	–	–	–	1	–
<i>Carex humilis</i> Leyss.	6	6	6	6	6	6	7	6	7
<i>Carex liparicarpos</i> Gaud.	–	2	–	–	–	–	1	–	1
<i>Chrysanthemum lanceolatum</i> Pers.	2	2	3	3	4	1	3	3	2
<i>Coronilla vaginalis</i> Lam.	–	–	4	–	–	–	–	–	–
<i>Cuscuta epithymum</i> (L.) Nath. subsp. <i>kotschyi</i> (Des Moul.) Arc.	–	–	1	–	–	–	–	–	–
<i>Daphne cneorum</i> L.	–	–	–	–	–	–	–	1	–
<i>Dianthus plumarius</i> L. subsp. <i>regis-</i> <i>stephani</i> (Rapaics) Baksay	–	–	–	1	–	–	–	–	–
<i>Epipactis atrorubens</i> (Hoffm.) Bess.	–	–	–	–	–	–	–	–	1
<i>Euphorbia seguieriana</i> Necker	–	–	–	–	–	1	–	2	–
<i>Fagus sylvatica</i> L.	–	–	–	–	–	–	–	–	1
<i>Festuca pallens</i> Host	4	2	3	2	1	–	3	3	3
<i>Fraxinus ornus</i> L.	1	–	1	1	1	3	6	3	6
<i>Genista pilosa</i> L.	4	5	4	5	5	6	4	3	3
<i>Gentiana cruciata</i> L.	–	1	–	–	–	–	–	–	–
<i>Globularia punctata</i> Lap.	–	3	–	–	1	1	3	3	3
<i>Helianthemum canum</i> (L.) Baumg.	4	3	4	5	4	3	4	4	4
<i>Helianthemum ovatum</i> (Viv.) Dun.	–	–	2	–	–	–	–	–	–
<i>Inula ensifolia</i> L.	4	–	–	–	1	3	1	1	–
<i>Juniperus communis</i> L.	–	–	–	–	–	1	–	1	–
<i>Jurinea mollis</i> (L.) Rchb.	1	2	3	2	1	2	2	3	1
<i>Linum dolomiticum</i> Borbás	4	5	5	5	5	5	6	5	6
<i>Linum tenuifolium</i> L.	1	1	2	–	–	–	–	1	1
<i>Peucedanum oreoselinum</i> (L.) Mönch	–	4	–	–	–	–	2	1	2
<i>Phyteuma orbiculare</i> L.	4	4	5	5	4	3	2	3	4
<i>Polygala amara</i> L.	–	1	–	–	–	–	–	–	–
<i>Polygonatum odoratum</i> (Mill.) Druce	–	–	–	–	–	–	–	1	–
<i>Potentilla arenaria</i> Borkh.	–	2	–	–	–	–	–	–	2
<i>Pulsatilla grandis</i> Wender.	1	–	–	–	–	–	–	–	–
<i>Quercus pubescens</i> Willd.	1	3	3	2	1	3	3	3	6
<i>Sanguisorba minor</i> Scop.	1	2	3	1	–	1	1	2	–
<i>Scabiosa canescens</i> W. et K.	3	–	–	5	4	4	–	–	–
<i>Seseli leucospermum</i> W. et K.	1	–	–	–	–	1	1	1	1
<i>Stipa eriocalis</i> Borbás	1	–	1	–	–	1	–	–	–
<i>Teucrium montanum</i> L.	1	–	–	–	1	2	2	2	2
<i>Thalictrum minus</i> L. subsp. <i>pseudominus</i> (Borbás) Soó	–	–	1	–	–	–	–	–	–

Table 4 (continued)

	No. of relevés								
	89	90	92	93	94	95	126	127	128
<i>Thesium linophyllon</i> L.	2	–	2	2	–	1	–	–	–
<i>Thymus praecox</i> Opiz	1	–	2	–	–	1	2	2	–
<i>Veronica spicata</i> L. s. str.	–	1	–	–	–	–	–	–	–
<i>Vincetoxicum hirundinaria</i> Medik.	–	1	–	–	–	–	–	–	–
<i>Viola rupestris</i> F. W. Schmidt	–	–	–	–	–	1	1	–	–

Table 5. Cover values of the species in the relevés of group VI.

	No. of relevés									
	51	53	69	113	114	115	116	118	119	131
<i>Allium montanum</i> F. W. Schmidt	–	–	–	1	–	–	–	–	1	1
<i>Anthericum ramosum</i> L.	3	5	3	3	5	4	5	5	4	3
<i>Anthyllis vulneraria</i> L.	3	4	1	1	2	2	3	–	2	2
<i>Asperula cynanchica</i> L.	–	–	1	1	1	–	1	1	1	1
<i>Aster linosyris</i> (L.) Bernh.	–	–	–	–	2	1	1	–	–	–
<i>Biscutella laevigata</i> L.	1	1	1	–	–	1	–	1	1	2
<i>Brachypodium pinnatum</i> (L.) P. B.	–	–	–	–	1	–	–	–	–	–
<i>Bromus pannonicus</i> Kummer et Sendtner	6	5	2	8	7	7	7	8	8	7
<i>Campanula rotundifolia</i> agg.	–	1	1	1	1	–	1	–	–	–
<i>Carex humilis</i> Leyss.	6	5	7	3	6	5	5	6	6	5
<i>Chamaecytisus austriacus</i> (L.) Link	2	–	–	–	–	–	–	–	–	–
<i>Chamaecytisus hirsutus</i> (L.) Link	–	2	–	–	–	–	–	–	–	–
<i>Chrysanthemum lanceolatum</i> Pers.	1	–	1	2	–	–	–	3	–	–
<i>Cuscuta epithymum</i> (L.) Nath. subsp. <i>kotschy</i> (Des Moul.) Arc.	–	–	1	–	1	–	2	–	–	–
<i>Daphne cneorum</i> L.	1	1	–	–	2	–	1	–	–	1
<i>Dorycnium germanicum</i> (Gremli) Rikli	–	–	1	–	–	–	–	–	–	–
<i>Euphorbia cyparissias</i> L.	1	–	–	–	1	–	–	–	–	–
<i>Festuca pallens</i> Host	–	1	1	2	–	–	–	1	1	1
<i>Festuca rupicola</i> Heuff.	1	–	–	–	1	–	–	–	–	–
<i>Fraxinus ornus</i> L.	3	3	5	3	4	4	4	2	3	2
<i>Genista pilosa</i> L.	3	2	3	3	3	3	4	3	4	4
<i>Globularia punctata</i> Lap.	1	1	1	–	3	2	–	2	2	2
<i>Helianthemum canum</i> (L.) Baumg.	1	2	–	3	4	3	3	–	2	4
<i>Helianthemum ovatum</i> (Viv.) Dun.	–	–	1	–	–	–	–	–	1	2
<i>Hieracium bauginii</i> Schult. (agg.)	–	–	3	–	–	–	–	–	–	–
<i>Inula ensifolia</i> L.	6	6	–	3	–	–	–	–	–	1
<i>Inula hirta</i> L.	–	–	–	1	–	–	–	3	–	–
<i>Juniperus communis</i> L.	–	–	–	–	3	–	–	–	–	–
<i>Jurinea mollis</i> (L.) Rehb.	2	–	–	1	2	2	1	1	1	–
<i>Leontodon hispidus</i> L.	–	–	–	–	–	–	–	1	–	–
<i>Linum dolomiticum</i> Borbás	4	7	4	3	4	5	5	3	5	6
<i>Linum tenuifolium</i> L.	–	–	–	1	2	–	–	–	–	1
<i>Peucedanum oreoselinum</i> (L.) Mönch	–	–	4	–	–	–	–	–	–	–

Table 5 (continued)

	No. of relevés									
	51	53	69	113	114	115	116	118	119	131
<i>Phyteuma orbiculare</i> L.	3	2	5	4	2	4	4	3	4	3
<i>Pinus nigra</i> Arnold	–	–	5	–	–	–	–	–	–	–
<i>Polygala amara</i> L.	–	1	–	–	–	–	–	–	1	1
<i>Polygonatum odoratum</i> (Mill.) Druce	–	–	1	–	–	–	–	–	–	–
<i>Populus tremula</i> L.	–	–	1	–	–	–	–	–	–	–
<i>Potentilla arenaria</i> Borkh.	–	–	–	–	1	–	–	–	2	2
<i>Pulsatilla grandis</i> Wender.	1	3	–	–	–	–	–	–	–	–
<i>Quercus pubescens</i> Willd.	1	6	5	3	–	1	1	–	2	1
<i>Sanguisorba minor</i> Scop.	–	–	1	1	3	2	2	1	2	–
<i>Scabiosa canescens</i> W. et K.	–	1	–	3	3	3	3	4	–	2
<i>Scorzonera austriaca</i> Willd.	–	–	–	–	1	–	–	–	–	–
<i>Sorbus</i> × <i>semiincisa</i> Borbás	–	–	–	3	–	–	–	–	–	–
<i>Stachys recta</i> L.	–	–	–	–	1	–	–	–	–	–
<i>Stipa eriocalis</i> Borbás	–	–	–	–	–	–	–	–	–	2
<i>Teucrium chamaedrys</i> L.	–	–	–	–	3	–	–	–	–	–
<i>Teucrium montanum</i> L.	1	1	–	2	1	3	1	2	3	2
<i>Thalictrum minus</i> L.	–	–	–	–	–	–	–	–	–	–
subsp. <i>pseudominus</i> (Borbás) Soó	–	–	–	–	–	–	–	–	2	3
<i>Thesium linophyllum</i> L.	4	3	–	3	3	3	–	3	1	–
<i>Thymus praecox</i> Opiz	1	–	–	–	–	–	–	3	2	–
<i>Tilia cordata</i> Mill.	–	–	–	–	–	–	2	–	–	–
<i>Vincetoxicum hirundinaria</i> Medik.	1	–	–	1	1	1	1	1	–	–

- highest proportion of Specialists and Unique specialists (43.5%) (Table 12),
- highest proportion of the xerotherm species (Tables 13 and 14),
- lowest nitrogen preference (Table 16),
- highest continentality preference (Table 17).

Vegetation type: seems to be of secondary origin from open dolomite rock grasslands deriving from several dolomite grassland communities by degradation. The group falls close to *Seseli leucospermi-Festucetum pallentis* Zólyomi 1958 on the PCA diagram (Fig. 2).

Group II

Relevés: 67, 71–73, 75, 77, 79, 81, 83–84, 88, 97–99, 101, 109, 125, 133–135, 137 (Table 3).

Characteristics of the group:

- typical exposure: NW, W, SW (Table 8),
- lowest proportion of the total cover of vegetation (average: 33.8%),

Table 6. Cover values of the species in the remaining relevés.

	No. of relevés																			
	52	54	55	56	57	58	59	60	61	62	63	64	65	66	68	70	74	76	78	80
	82	85	86	87	91															
<i>Alyssum montanum</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–
<i>Alyssum tortuosum</i> W. et K.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–
<i>Anthericum ramosum</i> L.	5	5	5	4	5	5	5	1	4	3	2	6	5	5	4	3	3	4	4	5
<i>Anthyllis vulneraria</i> L.	3	3	3	1	1	2	1	–	1	1	–	1	–	1	–	1	1	2	–	1
<i>Asperula cynanchica</i> L.	1	1	1	–	–	–	–	1	1	1	1	–	–	–	1	–	1	1	1	1
<i>Aster linosyris</i> (L.) Bernh.	–	–	1	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
<i>Berberis vulgaris</i> L.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Biscutella laevigata</i> L.	1	1	1	1	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–
<i>Briza media</i> L.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Bromus pannonicus</i> Kummer et Sendtner	5	5	4	3	–	1	3	–	–	5	–	–	–	–	–	2	–	–	–	–
<i>Campanula rotundifolia</i> agg.	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Carex humilis</i> Leyss.	5	–	6	6	5	6	6	3	7	8	2	6	6	5	4	7	5	5	5	3
<i>Carex liparicarpos</i> Gaud.	–	–	–	1	2	–	–	–	–	–	4	2	2	2	–	–	3	4	4	5
<i>Chrysanthemum lanceolatum</i> Pers.	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–
<i>Coronilla vaginalis</i> Lam.	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–
<i>Dianthus plumarius</i> L. subsp. <i>regis-stephani</i> (Rapaics) Baksay	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	1	–
<i>Dianthus pontederiae</i> Kern.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
<i>Dorycnium germanicum</i> (Gremli) Rikli	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Draba lasiocarpa</i> Roch.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
<i>Euphorbia cyparissias</i> L.	–	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–
<i>Euphorbia seguieriana</i> Necker	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	1	1	2	1
<i>Festuca pallens</i> Host	1	1	3	–	3	2	–	2	5	–	1	3	6	2	3	5	1	4	3	4
<i>Festuca rupicola</i> Heuff.	–	–	–	–	1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Fraxinus ornus</i> L.	2	–	2	–	7	2	3	–	1	–	–	–	–	2	1	2	–	–	–	–
<i>Fumana procumbens</i> (Dun.) Gren. et Godr.	–	–	–	1	1	–	–	1	–	–	2	1	–	2	2	–	3	2	3	2
<i>Galium verum</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
<i>Genista pilosa</i> L.	1	1	2	2	2	1	3	–	–	2	–	2	–	–	–	2	–	–	–	–
<i>Globularia punctata</i> Lap.	1	1	1	2	1	2	1	–	2	–	–	1	–	2	–	2	2	1	3	2
<i>Gypsophila fastigiata</i> L. subsp. <i>arenaria</i> (W. et K.) Dom.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–

Table 6 (continued)

	No. of relevés																									
	52	54	55	56	57	58	59	60	61	62	63	64	65	66	68	70	74	76	78	80	82	85	86	87	91	
<i>Helianthemum canum</i> (L.) Baumg.	1	3	1	2	4	2	1	3	2	1	3	4	1	3	3	3	4	5	4	5	5	4	4	—	4	
<i>Helianthemum ovatum</i> (Viv.) Dun.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	
<i>Inula ensifolia</i> L.	2	1	4	—	—	—	—	—	—	6	—	—	—	—	—	—	1	1	—	—	—	3	—	—	—	
<i>Jovibarba hirta</i> agg.	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	1	—	—	—	1	—	—	—	—	
<i>Juniperus communis</i> L.	—	—	2	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Jurinea mollis</i> (L.) Rchb.	1	1	1	1	1	1	2	—	1	—	—	—	—	1	1	—	1	1	—	—	2	1	—	—	1	
<i>Linum dolomiticum</i> Borbás	7	6	7	4	4	6	5	3	4	5	3	5	3	6	5	5	4	4	4	3	1	3	6	5	4	
<i>Linum tenuifolium</i> L.	—	—	—	—	1	1	1	1	—	—	1	—	—	1	1	—	1	—	—	1	1	1	1	—	—	
<i>Minuartia setacea</i> (Thuill.) Hay.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	
<i>Orphantha lutea</i> (L.) Kern.	—	—	—	—	—	—	—	—	1	—	—	1	—	1	—	—	—	—	1	1	—	1	—	—	—	
<i>Paronychia cephalotes</i> (M. B.) Bess.	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Peucedanum cervaria</i> (L.) Lap.	—	—	—	3	2	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Peucedanum oreoselinum</i> (L.) Mönch	—	—	—	—	—	—	—	—	—	1	—	—	5	—	—	1	2	2	—	2	2	—	—	—	2	
<i>Phyteuma orbiculare</i> L.	3	3	3	4	3	2	4	—	3	3	—	—	—	—	—	1	—	—	—	—	—	—	—	—	4	
<i>Pinus nigra</i> Arnold	—	—	—	—	1	—	3	—	1	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	
<i>Polygonatum odoratum</i> (Mill.) Druce	—	—	1	—	3	—	—	—	—	—	—	—	—	—	—	1	3	2	2	2	—	—	—	—	—	
<i>Potentilla arenaria</i> Borkh.	—	1	—	1	1	—	—	—	1	—	—	1	—	—	—	—	—	—	—	3	—	1	2	—	1	
<i>Pulsatilla grandis</i> Wender.	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	
<i>Quercus pubescens</i> Willd.	1	1	—	1	—	1	3	—	2	—	—	1	—	—	—	1	—	—	—	—	—	—	—	2	3	
<i>Sanguisorba minor</i> Scop.	—	1	1	—	—	1	3	—	—	1	—	—	—	—	—	1	—	—	—	1	2	1	1	1	—	
<i>Scabiosa canescens</i> W. et K.	1	2	1	—	—	1	2	1	2	2	—	3	—	1	1	1	3	4	3	3	2	4	2	1	—	
<i>Scorzonera austriaca</i> Willd.	—	1	—	—	—	—	—	1	—	1	—	1	—	1	—	—	—	—	—	—	2	—	—	—	—	
<i>Seseli leucospermum</i> W. et K.	—	1	—	—	—	—	—	1	—	—	3	—	—	—	—	—	1	1	1	1	2	2	2	—	—	
<i>Silene otites</i> (L.) Wibel	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	
<i>Stipa eriocalis</i> Borbás	—	—	—	1	1	2	—	—	—	—	1	2	4	—	3	2	—	5	3	—	6	4	3	—	2	
<i>Teucrium montanum</i> L.	2	2	1	1	1	—	1	1	2	1	—	3	1	2	3	1	2	2	2	1	4	3	4	—	—	
<i>Thalictrum minus</i> L. subsp. <i>pseudominus</i> (Borbás) Soó	—	—	—	1	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	1	
<i>Thesium linophyllum</i> L.	3	2	3	—	—	1	—	—	—	1	—	1	—	—	—	3	2	2	2	1	1	1	—	4	—	
<i>Thymus praecox</i> Opiz	—	1	—	—	—	—	—	1	2	—	1	—	—	1	—	1	2	1	3	4	4	2	3	—	1	
<i>Veronica spicata</i> L. s. str.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	1	—	
<i>Vincetoxicum hirsutaria</i> Medik.	1	1	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Viola rupestris</i> F. W. Schmidt	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	—	—	—	—	1	

Table 7. Cover values of the species in the remaining relevés.

	No. of relevés																								
	96	100	102	103	104	105	106	107	108	110	111	112	117	120	121	122	123	124	129	130	132	136	138	139	140
<i>Allium montanum</i> F. W. Schmidt	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	1	-	2	-	2	2	-	-	-	-
<i>Alyssum montanum</i> L.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1
<i>Alyssum tortuosum</i> W. et K.	-	-	-	1	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Anthericum ramosum</i> L.	4	6	1	5	2	4	3	3	3	6	2	5	5	6	6	6	3	4	2	2	4	1	3	2	3
<i>Anthyllis vulneraria</i> L.	1	-	-	-	2	1	1	1	1	2	1	3	4	3	3	3	3	3	-	1	2	-	2	3	2
<i>Asperula cynanchica</i> L.	-	-	1	1	1	-	-	-	-	1	1	1	-	1	-	1	1	3	1	-	-	-	-	-	-
<i>Aster linosyris</i> (L.) Bernh.	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	2	-
<i>Biscutella laevigata</i> L.	-	-	-	-	-	1	-	1	-	-	-	-	1	1	2	-	-	1	-	-	3	-	-	-	-
<i>Briza media</i> L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Bromus pannonicus</i> Kumm. et Sendtn.	-	-	-	-	-	-	-	-	-	-	-	5	7	6	6	5	1	6	-	6	6	-	-	-	-
<i>Campanula rotundifolia</i> agg.	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-	-	2	-	-	-	-
<i>Campanula sibirica</i> L.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Carex humilis</i> Leyss.	4	5	2	4	5	5	5	4	6	6	4	5	6	5	5	6	5	5	6	7	6	2	7	6	6
<i>Carex liparicarpus</i> Gaud.	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	4	-	3	2	-	3	-	-	1
<i>Chamaecytisus hirsutus</i> (L.) Link	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
<i>Chrysanthemum lanceolatum</i> Pers.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Coronilla vaginalis</i> Lam.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Cuscuta epithymum</i> (L.) Nath. subsp. <i>kotschy</i> (Des Moul.) Arc.	-	-	-	1	-	-	-	-	-	-	-	1	1	1	2	-	-	-	-	-	-	-	-	-	-
<i>Daphne cneorum</i> L.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	2	-	-	-	-	-
<i>Dianthus plumarius</i> L. subsp. <i>regis-</i> <i>stephani</i> (Rapaics) Baksay	2	1	-	-	-	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Dorycnium germanicum</i> (Greml.) Rikli	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1
<i>Draba lasiocarpa</i> Roch.	1	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Epipactis atrorubens</i> (Hoffm.) Bess.	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Euphorbia cyparissias</i> L.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	1	-	1	2	-
<i>Euphorbia seguieriana</i> Necker	1	1	1	1	1	1	1	-	-	1	-	-	-	-	-	-	1	1	2	-	-	1	1	-	-
<i>Fagus sylvatica</i> L.	-	-	-	-	-	-	-	7	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Festuca pallens</i> Host	3	3	1	2	4	3	3	3	4	4	5	3	1	-	-	1	5	-	4	1	2	1	-	1	2
<i>Fraxinus ornus</i> L.	-	-	-	2	3	3	-	6	-	2	-	-	4	5	4	2	-	1	-	4	2	-	-	-	-
<i>Fumana procumbens</i> (Dun.) Gren. et Godr.	2	2	-	2	2	2	2	1	3	-	-	-	-	-	-	-	-	-	2	-	-	1	-	1	1
<i>Galium verum</i> L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Genista pilosa</i> L.	-	2	-	2	3	-	-	-	-	3	-	4	3	2	1	-	1	4	-	3	3	-	-	-	-
<i>Globularia punctata</i> Lap.	1	1	-	2	2	-	-	-	-	1	-	-	2	3	-	-	5	1	1	3	2	-	3	3	3
<i>Gypsophila fastigiata</i> L. subsp. <i>arenaria</i> (W. et K.) Dom.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 7 (continued)

	No. of relevés																			
	96	100	102	103	104	105	106	107	108	110	111	112	117	120	121	122	123	124	129	130
	132	136	138	139	140															
<i>Helianthemum canum</i> (L.) Baumg.	4	4	2	5	4	3	4	1	4	4	4	3	3	4	4	4	5	4	5	6
<i>Helianthemum ovatum</i> (Viv.) Dun.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
<i>Inula ensifolia</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	3	–	–	–	–
<i>Jovibarba hirta</i> agg.	–	1	1	–	1	–	–	1	1	–	1	–	–	–	–	–	2	–	–	–
<i>Juniperus communis</i> L.	–	–	–	3	–	3	3	–	3	–	–	3	–	4	3	2	–	3	–	–
<i>Jurinea mollis</i> (L.) Rchb.	–	–	–	–	1	1	–	1	1	1	1	1	–	1	1	–	1	–	–	1
<i>Leontodon hispidus</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
<i>Linum dolomiticum</i> Borbás	5	3	2	4	4	4	4	3	5	6	6	6	4	6	6	6	4	4	4	5
<i>Linum tenuifolium</i> L.	–	–	–	1	1	1	–	1	1	–	–	1	–	1	–	–	1	–	–	1
<i>Minuartia setacea</i> (Thuill.) Hay.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
<i>Orphantha lutea</i> (L.) Kern.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–
<i>Paronychia cephalotes</i> (M. B.) Bess.	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
<i>Peucedanum oreoselinum</i> (L.) Mönch	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–
<i>Phyteuma orbiculare</i> L.	–	–	–	–	1	–	–	–	–	–	–	5	4	3	3	4	3	–	–	1
<i>Polygala amara</i> L.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
<i>Polygonatum odoratum</i> (Mill.) Druce	–	3	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
<i>Potentilla arenaria</i> Borkh.	1	–	–	1	–	1	1	2	5	3	3	2	1	–	–	–	2	–	3	2
<i>Pulsatilla grandis</i> Wender.	–	–	–	2	–	–	–	–	–	2	–	–	–	–	–	–	–	–	1	2
<i>Quercus pubescens</i> Willd.	–	–	–	–	1	3	4	4	–	1	–	–	2	2	–	–	2	2	–	–
<i>Sanguisorba minor</i> Scop.	–	–	–	–	–	–	1	–	–	–	–	–	1	2	–	–	–	2	–	–
<i>Scabiosa canescens</i> W. et K.	2	2	1	3	3	–	–	–	–	2	1	5	4	2	4	4	3	–	2	4
<i>Scorzonera austriaca</i> Willd.	–	–	–	–	1	2	1	1	–	1	–	–	–	1	–	1	–	–	1	–
<i>Seseli leucospermum</i> W. et K.	3	1	2	1	2	1	1	–	1	–	–	–	–	–	–	–	2	–	2	–
<i>Stipa eriocaulis</i> Borbás	–	3	1	–	–	–	–	–	2	–	–	–	–	–	–	–	3	–	3	2
<i>Teucrium montanum</i> L.	3	1	–	3	3	1	1	–	2	3	–	1	3	2	2	3	3	–	2	2
<i>Thalictrum minus</i> L. subsp. <i>pseudominus</i> (Borbás) Soó	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2
<i>Thesium linophyllon</i> L.	2	–	–	–	–	–	–	–	–	–	–	3	3	3	4	3	2	–	1	1
<i>Thymus praecox</i> Opiz	2	3	2	3	2	–	–	1	2	1	2	1	2	2	2	–	3	–	3	–
<i>Tilia cordata</i> Mill.	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
<i>Veronica spicata</i> L. s. str.	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–
<i>Vincetoxicum hirundinaria</i> Medik.	–	–	–	–	–	–	–	–	–	–	1	–	1	1	–	1	–	–	–	–
<i>Viola rupestris</i> F. W. Schmidt	–	–	–	–	–	1	1	1	1	2	2	1	1	–	–	–	–	–	–	–

Table 8. Additional data of the relevés.

No	Site	Date	Exposure	Angle of slope (°)	Total cover (%)
51	Iváni-hegy	24.05.2000	N	20	100
52	Iváni-hegy	24.05.2000	N	20	90
53	Iváni-hegy	24.05.2000	N	20	100
54	Iváni-hegy	24.05.2000	N	20	100
55	Iváni-hegy	24.05.2000	N	20	100
56	Iváni-hegy	20.06.2000	W	20	50
57	Iváni-hegy	20.06.2000	NW	25	50
58	Iváni-hegy	20.06.2000	NW	30	70
59	Iváni-hegy	20.06.2000	NW	45	85
60	Iváni-hegy	28.06.2000	W	30	10
61	Iváni-hegy	28.06.2000	NW	35	70
62	Iváni-hegy	28.06.2000	N	30	100
63	Iváni-hegy	28.06.2000	W	10	15
64	Iváni-hegy	28.06.2000	NW	30	75
65	Iváni-hegy	29.06.2000	SW	10	80
66	Iváni-hegy	29.06.2000	W	20	50
67	Iváni-hegy	29.06.2000	W	20	25
68	Iváni-hegy	29.06.2000	SW	30	30
69	Iváni-hegy	06.07.2000	NW	30	95
70	Iváni-hegy	06.07.2000	NW	45	90
71	Katalin-hegy	26.06.2001	NW	10	40
72	Katalin-hegy	27.06.2001	NW	10	40
73	Katalin-hegy	05.07.2001	NW	10	30
74	Katalin-hegy	05.07.2001	NW	20	55
75	Katalin-hegy	10.07.2001	NW	20	40
76	Katalin-hegy	10.07.2001	NW	20	65
77	Katalin-hegy	10.07.2001	NW	20	40
78	Katalin-hegy	10.07.2001	NW	20	70
79	Katalin-hegy	12.07.2001	NW	20	25
80	Katalin-hegy	12.07.2001	NW	20	70
81	Katalin-hegy	12.07.2001	NW	20	30
82	Katalin-hegy	12.07.2001	NW	20	80
83	Katalin-hegy	12.07.2001	NW	10	25
84	Katalin-hegy	12.07.2001	NW	5	35
85	Katalin-hegy	18.07.2001	NW	5	75
86	Katalin-hegy	18.07.2001	NW	5	50
87	Iváni-hegy	03.06.2002	NW	30	90
88	Iváni-hegy	03.06.2002	S	25	30
89	Iváni-hegy	03.06.2002	N	45	90
90	Iváni-hegy	03.06.2002	W	30	95
91	Iváni-hegy	03.06.2002	W	40	80
92	Iváni-hegy	12.06.2002	N	45	100
93	Iváni-hegy	12.06.2002	N	40	100
94	Iváni-hegy	12.06.2002	N	45	95
95	Iváni-hegy	12.06.2002	N	45	95

Table 8 (continued)

No	Site	Date	Exposure	Angle of slope (°)	Total cover (%)
96	Iváni-hegy	12.06.2002	NW	30	45
97	Iváni-hegy	26.06.2002	W	45	35
98	Iváni-hegy	26.06.2002	W	40	35
99	Iváni-hegy	26.06.2002	W	40	35
100	Iváni-hegy	26.06.2002	NW	45	50
101	Iváni-hegy	26.06.2002	W	20	25
102	Iváni-hegy	26.06.2002	W	40	5
103	Iváni-hegy	26.06.2002	S	20	65
104	Iváni-hegy	09.07.2002	NW	30	45
105	Iváni-hegy	09.07.2002	W	40	45
106	Iváni-hegy	09.07.2002	W	40	30
107	Iváni-hegy	09.07.2002	W	35	20
108	Iváni-hegy	09.07.2002	W	30	50
109	Iváni-hegy	09.07.2002	W	25	35
110	Iváni-hegy	09.07.2002	N	30	85
111	Iváni-hegy	09.07.2002	SW	25	65
112	Iváni-hegy	09.07.2002	W	30	90
113	Iváni-hegy	09.07.2002	N	15	100
114	Iváni-hegy	24.07.2002	N	15	100
115	Iváni-hegy	24.07.2002	N	25	100
116	Iváni-hegy	24.07.2002	N	25	100
117	Iváni-hegy	24.07.2002	N	25	100
118	Iváni-hegy	24.07.2002	N	20	100
119	Iváni-hegy	24.07.2002	N	25	100
120	Iváni-hegy	24.07.2002	N	20	100
121	Iváni-hegy	24.07.2002	N	25	100
122	Iváni-hegy	24.07.2002	N	20	100
123	Iváni-hegy	24.07.2002	N	50	70
124	Iváni-hegy	24.07.2002	N	40	90
125	Iváni-hegy	24.07.2002	S	20	40
126	Iváni-hegy	24.07.2002	NW	35	85
127	Iváni-hegy	24.07.2002	NW	35	75
128	Iváni-hegy	24.07.2002	NW	40	90
129	Fülkés-kő	11.06.2003	W	5	50
130	Fülkés-kő	11.06.2003	NW	40	95
131	Fülkés-kő	11.06.2003	NW	35	95
132	Fülkés-kő	11.06.2003	NW	40	95
133	Fülkés-kő	11.06.2003	SW	10	35
134	Kis-szénás	15.06.2003	SW	15	25
135	Kis-szénás	15.06.2003	SW	15	20
136	Kis-szénás	15.06.2003	SW	15	20
137	Iváni-hegy	25.06.2003	NW	35	65
138	Iváni-hegy	25.06.2003	NW	15	75
139	Iváni-hegy	25.06.2003	NW	15	80
140	Iváni-hegy	25.06.2003	W	20	55

- dominant species: *Anthericum ramosum*, *Carex humilis*, *Festuca pallens*, *Fumana procumbens*, *Helianthemum canum*, *Jovibarba hirta*, *Linum tenuifolium*, *Potentilla arenaria*, *Seseli leucospermum*, *Thymus praecox*,
- high proportion of Chamaephyta and Geophyta (Table 9),
- high proportion of Submediterranean and Pontic-Submediterranean species (Table 10),
- phytosociological composition is similar to group I (Table 11),
- high proportion of Specialists and Unique specialists (Table 12),
- high proportion of the xerotherm species (Tables 13 and 14),
- low nitrogen preference (Table 16),
- high continentality preference (Table 17).

Vegetation type: typical open dolomite rock grassland. The group falls close to *Seseli leucospermi-Festucetum pallentis* Zólyomi 1958 on the PCA diagram (Fig. 2), and according to the UPGMA classification, the similarity to this plant community is 0.7 (Fig. 1).

Group III

Relevés: 26, 32, 35–36, 39, 41–44.

Characteristics of the group:

- typical exposure: NE, N, NW (Table 8),
- the total cover of vegetation varies between 10 and 95%,

Table 9. Distribution of life form (ranking according to HORVÁTH *et al.* (1995) (expressed in percentage).

Life form	Groups of relevés					
	I	II	III	IV	V	VI
Mega-mesophanerophyta	0.9	0.5	1.8	1.1	8.9	10.0
Microphanerophyta	1.4	0.2	0.5	1.1	0.6	1.0
Nanophanerophyta	4.8	3.6	–	0.2	0.2	1.6
Chamaephyta	22.7	21.8	8.6	12.4	16.3	11.7
Geophyta	6.4	14.1	5.8	8.8	11.7	10.5
Hemikryptophyta	63.8	58.9	82.8	74.9	62.1	64.5
Hemitherophyta	–	–	0.5	1.1	–	–
Therophyta	–	0.9	–	0.4	0.2	0.7

- dominant species: *Anthericum ramosum*, *Bromus pannonicus*, *Campanula rotundifolia*, *Carex humilis*, *Festuca pallens*, *Genista pilosa*, *Phyteuma orbiculare*,
- the highest proportion of Hemicryptophyta (82.8%) (Table 9),
- the highest proportion of Illyric species (16.2%) (Table 10),
- the highest proportion (35.7%) of the Bromo-Festucion pallentis species, phytosociological composition is similar to group IV (Table 11),

Table 10. The phytogeographical spectrum of the groups of relevés (ranking according to Horváth et al. (1995) (expressed in percentage).

Area	Groups of relevés					
	I	II	III	IV	V	VI
Adventive	–	–	–	–	–	0.8
Cosmopolitan	0.5	–	1.8	0.9	–	–
Circumpolar	5.5	1.2	5.8	3.8	0.7	1.3
Eurasian	3.1	2.5	5.8	4.1	5.2	3
Continental	11.2	10.3	18.8	20.5	11.4	10.2
European	2.1	4.7	4.6	6.3	9.7	9.0
Central European	11.8	16.3	14.2	14.2	21.6	22.9
Central European-Alpin	3.1	2.3	0.3	0.9	–	–
Submediterranean	17.9	17.1	8.4	11.9	13.7	10.3
East-Submediterranean	0.9	0.5	1.5	0.9	4.1	5.4
Pontic	–	–	1.3	2.5	–	–
Pontic-Submediterranean	8.6	11.7	2.8	4.3	3.3	2.6
Pontic-Pannonian	1.2	2.3	–	–	2.0	3.6
Atlantic-Submediterranean	7.2	9.3	1.5	3.4	6.3	3.5
Subatlantic	1.2	0.7	2.8	5.6	7.2	5.2
Sarmatic	3.6	3.8	1.3	0.7	0.7	0.8
Illyric	–	–	16.2	4.3	0.4	10.7
Pannonian-Balkanean	2.4	1.9	2.0	2.3	3.2	1.6
Alpin-Balkanean	–	–	–	0.2	0.7	0.2
Carpathian endemic	1.9	0.8	0.8	0.4	–	–
Pannonian endemic	7.6	5.8	2.0	3.8	1.3	0.8
Local endemic	10.2	8.8	8.1	9.0	8.5	8.1

- high proportion of Competitors and Generalists (Table 12),
- the highest proportion (42.9%) of the NB3 species (plants of moderately oligotrophic habitats) (Table 16),
- relatively low continentality preference (Table 17).

Vegetation type: This group represents the *Seseli leucospermi-Brometum pannonicum* Borhidi 1996 (Fig. 2). According to the UPGMA classification, the similarity to this plant community is 0.9 (Fig. 1).

Group IV

Relevés: 17–20, 27, 29, 31, 33–34, 37, 56.

Characteristics of the group:

- typical exposure: N, NW, W (Table 8),
- the total cover of vegetation varies in range of 10 and 95%,

Table 11. Distribution of phytosociological characters (BORHIDI 1993) (expressed in percentage).

Phytosociological character	Groups of relevés					
	I	II	III	IV	V	VI
Sedo-Scleranthetea	–	0.2	0.3	–	–	–
Festuco-Brometea	13.6	13.6	11.7	12.2	11.3	14.1
Festucetalia valesiaca	34.5	38.8	33.2	39.2	37.5	31.8
Festucion valesiaca	–	0.3	–	–	0.2	0.7
Asplenio-Festucion pallentis	5.7	5.6	1.3	0.4	1.5	1.0
Bromo-Festucion pallentis	26.9	24.3	35.7	29.4	24.4	31.9
Festucetalia vaginatae	1.9	4.3	–	0.4	0.7	–
Festucion vaginatae	10.7	8.5	2.3	3.1	0.9	–
Molinio-Arrhenatheretea	–	–	0.8	0.2	0.2	–
Erico-Pinetea	–	–	–	–	–	0.8
Quercu-Fagetea	–	–	0.3	–	–	0.3
Quercetalia pubescentis-petraeae	–	2.8	1.0	2.3	6.7	4.1
Orno-Ostryon	1.2	0.5	1.3	0.9	8.4	7.1
Fagion sylvaticae	–	–	–	–	0.2	–
Prunetalia spinosae	–	–	0.3	0.4	0.2	–
Indifferent	5.5	1.1	11.8	11.5	7.8	8.2

- dominant species: *Anthericum ramosum*, *Carex humilis*, *Festuca pallens*, *Genista pilosa*, *Phyteuma orbiculare*,
- high proportion of Hemicryptophyta (Table 9),
- the highest proportion of Continental species (20.5%) (Table 10),
- phytosociological composition is similar to group III (Table 11),
- high proportion of Competitors and Generalists (Table 12),
- low nitrogen preference (Table 16).

Vegetation type: This group is close to *Seseli leucospermi-Brometum pannonici* Borhidi 1996 (Fig. 2), but *Bromus pannonicus* is not predominant.

Table 12. Distribution of the social behaviour types (Borhidi 1993) (expressed in percentage).

Social behaviour type	Groups of relevés					
	I	II	III	IV	V	VI
Unique specialists	10.2	8.8	8.1	9.0	8.5	7.6
Rare specialists	–	–	–	–	0.2	1.0
Unique generalists	–	–	–	–	–	0.5
Specialists	33.3	29.8	15.2	19.8	22.1	15.5
Competitors	17.4	14.8	43.7	35.6	30.9	35.2
Generalists	34.8	46.1	28.2	31.8	37.9	38.4
Natural pioneers	–	0.1	0.3	–	–	–
Disturbance tolerants	4.3	0.4	4.5	3.8	0.4	1.0
Introduced alien species	–	–	–	–	–	0.8

Table 13. Distribution of the temperature preference categories (Borhidi 1993) (expressed in percentage).

Temperature preference categories	Groups of relevés					
	I	II	III	IV	V	VI
1–3	–	–	–	–	–	–
4	1.4	0.2	0.3	0.7	0.4	0.5
5	5.0	2.6	12.1	7.4	2.0	4.6
6	25.0	32.4	39.4	48.2	48.9	43.6
7	30.5	28.8	16.2	20.3	22.5	17.9
8	36.4	35.0	32.0	23.4	26.2	33.4
9	1.7	1.0	–	–	–	–

Table 14. Distribution of the water preference categories (BORHIDI 1993) (expressed in percentage).

Water preference categories	Groups of relevés					
	I	II	III	IV	V	VI
1	48.3	47.0	16.2	21.2	20.6	16.6
2	23.8	23.5	19.8	24.3	20.6	17.3
3	24.0	26.2	53.6	45.5	47.4	57.1
4	3.6	3.3	8.1	7.9	6.9	7.4
5	0.3	–	1.3	0.7	4.5	1.6
6	–	–	–	–	–	–
7	–	–	1.0	0.4	–	–
8–12	–	–	–	–	–	–

Group V

Relevés: 89–90, 92–95, 126–128 (Table 4).

Characteristics of the group:

- typical exposure: N, NW, W (Table 8),
- the total cover of vegetation varies between 75 and 100%,
- dominant species: *Anthericum ramosum*, *Anthyllis vulneraria*, *Carex humilis*, *Chrysanthemum lanceolatum*, *Festuca pallens*, *Fraxinus ornus*, *Genista pilosa*, *Helianthemum canum*, *Jurinea mollis*, *Phyteuma orbiculare*, *Quercus pubescens*,
- Mega-mesophanerophyta, Chamaephyta and Geophyta species are of characteristic groups here (Table 9),
- the highest proportion of Subatlantic species (7.2%) (Table 10),
- phytosociological composition: the highest proportion of the Quercetalia pubescentis-petraeae and Orno-Ostryon species (Table 11),
- low nitrogen preference (Table 16).

Vegetation type: this group is considered a variant of the Pannonian karst white oak low woods. The herb layer is close to *Festuco-pallenti-Brometum pannonici* Zólyomi 1958 (Fig. 2), but *Bromus pannonicus* is almost absent.

Group VI

Relevés: 51, 53, 69, 113–116, 118–119, 131 (Table 5).

Characteristics of the group:

- typical exposure: N, (NW), (Table 8),

Table 15. Distribution of the reaction preference categories (BORHIDI 1993) (expressed in percentage).

Reaction preference categories	Groups of relevés					
	I	II	III	IV	V	VI
1–3	–	–	–	–	–	–
4	–	–	0.4	0.2	–	–
5	1.4	0.2	0.5	0.7	0.4	0.6
6	1.2	0.5	4.6	3.1	2.6	2.0
7	13.8	10.8	14.5	14.6	15.4	16.0
8	31.4	36.4	38.1	32.9	37.7	42.9
9	52.2	52.1	41.9	48.5	43.9	38.5

Table 16. Distribution of the nitrogen preference categories (BORHIDI 1993) (expressed in percentage).

Nitrogen preference categories	Groups of relevés					
	I	II	III	IV	V	VI
1	67.6	62.5	30.7	39.9	38.5	31.4
2	11.0	14.7	19.6	18.9	24.4	23.5
3	15.2	15.7	42.9	31.8	23.8	34.1
4	6.2	7.1	5.8	9.0	13.1	10.5
5	–	–	1.0	0.4	0.2	0.5
6–9	–	–	–	–	–	–

Table 17. Distribution of the continentality preference categories (BORHIDI 1993) (expressed in percentage).

Continentality preference categories	Groups of relevés					
	I	II	III	IV	V	VI
1	–	–	–	–	–	–
2	–	0.1	0.8	0.2	0.2	–
3	6.4	3.9	8.9	7.7	10.8	7.7
4	30.3	30.5	42.3	39.0	47.6	50.5
5	20.7	27.4	28.4	29.3	20.6	23.2
6	25.2	24.2	15.0	18.0	17.1	14.5
7	17.4	13.9	4.6	5.8	3.7	3.8
8	–	–	–	–	–	0.3
9	–	–	–	–	–	–

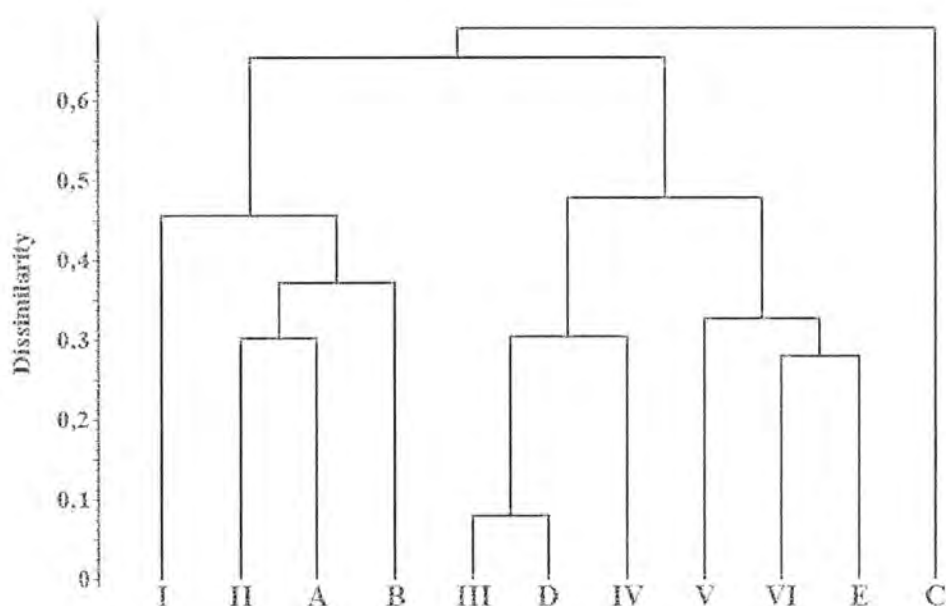


Fig. 1. Dendrogram of the groups of relevés based on average cover values. Method: distance optimising procedure, group average (UPGMA); distance coefficient: Bray–Curtis-index.

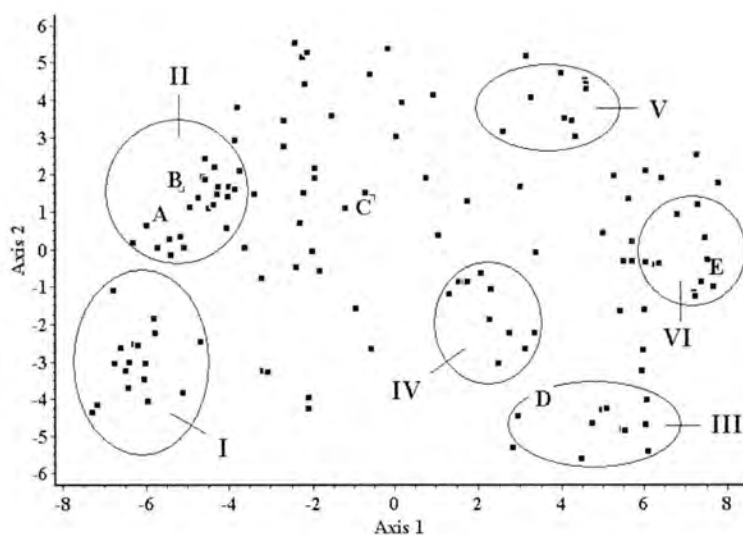


Fig. 2. Centred principal component analysis (PCA) of the relevés based on the transformed cover values. The first two dimensions explain ca 43% of the variance.

- the total cover of vegetation varies between 95 and 100%,
- dominant species: *Anthericum ramosum*, *Anthyllis vulneraria*, *Bromus pannonicus*, *Carex humilis*, *Fraxinus ornus*, *Genista pilosa*, *Helianthemum canum*, *Phyteuma orbiculare*, *Quercus pubescens*, *Teucrium montanum*,
- Mega-mesophanerophyta, Chamaephyta and Geophyta species are of characteristic groups here (Table 9),
- phytosociological composition: the proportion of the Quercetalia pubescentis-petraeae and Orno-Ostryon species is high (Table 11),
- high proportion of Competitors and Generalists (Table 12),
- low nitrogen preference (Table 16).

Vegetation type: the herb layer is very close to *Festuco pallenti-Brometum pannonici* Zólyomi 1958 (Figs 1 and 2). Based on the floristical composition and the phytosociological character this group is close to the Pannonian karst white oak low woods.

A number of the relevés cannot be included into any of the above groups, *i.e.* their pattern is diffuse in the abstract space of the variables (Fig. 2). These relevés represent transitions among the open and closed dolomite grassland communities or belong to degraded forms of those. According to the floristical composition and the principal component analysis, relevés No. 65, 138 and 139 are close to the *Chrysopogono-Caricetum humilis* community.

DISCUSSION

Results of this study have shown that *Linum dolomiticum* occurs in open and closed dolomite grasslands, the Pannonian karst white oak low woods and rarely in rock steppe. These vegetation types belong to the following plant communities: *Festuco pallenti-Brometum pannonici*, *Seseli leucospermi-Brometum pannonici*, *Seseli leucospermi-Festucetum pallentis*, *Stipo eriocauli-Festucetum pallentis*, *Cotino-Quercetum pubescentis* and in a small extent to *Chrysopogono-Caricetum humilis*. Some segments of the habitat are considered as being transitions among these communities.

According to the multivariate analyses *Stipo eriocauli-Festucetum pallentis* is very close to *Seseli leucospermi-Festucetum pallentis* (Figs 1 and 2). In the authors' opinion it would be more correct to consider this community a subassociation of *Seseli leucospermi-Festucetum pallentis*, as Zólyomi has originally described it (ZÓLYOMI 1958).

Distribution of *Linum dolomiticum* shows a special pattern: there are areas where its patches are of rather high density, and these alternate with large "empty"

areas where *Linum dolomiticum* does not occur at all. This pattern does not correspond to the phytosociological and ecological pattern of the habitat, *i.e.* both the dense and empty areas occur in all of the mentioned vegetation types and in their transitions. Evidently, the distribution of *Linum dolomiticum* – besides the basic composition of the whole plant community – also depends on other ecological factor(s).

Most typically, *Linum dolomiticum* occurs in northern and northwestern exposure (Table 8). This fact and characteristics of the vegetation do support the hypothesis that *Linum dolomiticum* is a pre-glacial or interglacial relic species.

Zólyomi's coenotone hypothesis, regarding the survival of relic species, seems to be also proven by the results of this study. *Ecotone* is a transitional zone between two (or more) habitats of contrasting ecological parameters, while coenotone refers to the characteristic vegetation of the ecotone. According to Zólyomi's theory, ecotone and coenotone play an important role in preserving relic species (ZÓLYOMI 1987). Biological relics often need special environmental circumstances for their survival and coenotone zones can ensure and maintain these circumstances for a number of species.

Physical and chemical characteristics of dolomite bedrock make it possible to develop surfaces of varied relief having very different microclimates within a relatively small area (ZÓLYOMI 1942). For this reason a series of ecotones and coenotones is found on dolomite hills. Dolomite hills have well defined vegetation, *e.g.* various forest types, first of all the Pannonian karst white oak low woods (*Cotino-Quercetum pubescentis*) and the Pannonian mixed karst woods (*Fago-Ornetum*) with characteristic grassland communities among them. Margins of these forests and their mosaics with grassland communities are typical coenotones. As it is obvious from Figure 2, the majority of the relevés does not clearly belong to any plant community of the known phytosociological categories. They represent transitions between two or more communities, *i.e.* they can be considered coenotones. *Linum dolomiticum* shows high vitality and spreading ability in these coenotone zones. Based on field experiences and the floristical composition of the relevés the following coenotones are recognisable on the habitat of *Linum dolomiticum* as vegetation transitions:

- open grassland – closed grassland,
- open grassland – Pannonian karst white oak low wood,
- open grassland – Pannonian mixed karst wood,
- closed grassland – Pannonian karst white oak low wood,
- closed grassland – Pannonian mixed karst wood.

Although *Seseli leucospermi-Bometum pannonici* is described as a new plant community (BORHIDI 1996), this type of vegetation can be considered a coenotone

(open grassland – closed grassland transition) rather than an independent association. Zólyomi's coenotone hypothesis is also supported by the simple fact of the occurrence of other relic species in the studied area, e.g. *Seseli leucospermum* and *Phyteuma orbiculare*.

* * *

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