Syntaxonomy and ecology of plant communities of the *Carici rupestris-Kobresietea bellardii* in the Western Carpathians

Anton Petrík[1], Zuzana Dúbravcová[2], Ivan Jarolímek[3], Ján Kliment[4], Jozef Šibík[3] & Milan Valachovič[3]

[1]*Botanical Garden, Comenius University, Botanická 3, SK-841 04 Bratislava, Slovakia; e-mail: petrika@rec.uniba.sk*
[2]*Department of Botany, Faculty of Natural Sciences, Comenius University, Révová 39, SK-811 02 Bratislava, Slovakia; e-mail: dubravcova@fns.uniba.sk*
[3]*Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 14, SK-845 23 Bratislava, Slovakia; e-mail: ivan.jarolimek@savba.sk, jozef.sibik@savba.sk, milan.valachovic@savba.sk*
[4]*Botanical Garden, Comenius University, SK-038 15 Blatnica, Slovakia, e-mail: kliment@rec.uniba.sk*

Abstract: We present a syntaxonomic account of the communities of the alliances of *Oxytropido-Elynion* Br.-Bl. 1949 and *Festucion versicoloris* Krajina 1933 from Western Carpathians. Both alliances comprise naked-rush, cushion form and dwarf-shrub heath communities typical of wind-exposed habitats occurring at the highest altitudes of the Tatra Mts. They represent a relic vegetation of the cold stages of the Pleistocene (probably Late Glacial Maximum) and they can be classified within the class of *Carici rupestris-Kobresietea bellardii* Ohba 1974. A set of relevés was subject to numerical-classification analysis. Floristics and ecology of the communities were characterised and the relationships to similar syntaxa were discussed.

The *Oxytropido-Elynion* is restricted to the extreme ridge positions in the highest altitudes of the Belianske Tatry Mts. Five associations were distinguished, such as the *Pyrolo carpaticae-Salicetum reticulatae*, the *Festuco versicoloris-Oreochloetum distichae*, the *Festucetum versicoloris*, the *Oxytropido carpaticae-Elynetum myosuroides* and the *Drabo siliquosae-Festucetum versicoloris*.

The *Festucion versicoloris* is limited to the mylonite zone of the alpine and subnival belt of the Vysoké Tatry and Západné Tatry Mts (and found as rare in the Nízke Tatry Mts). The stands of these communities prefer terraces of steep rocky faces and cliffs and stabilised small-grained screes below the cliffs. Within this alliance, three associations were described, including the *Agrostio alpinae-Festucetum versicoloris*, the *Silenetum acaulis* and the *Salicetum kitaibelianae*.

Key words: *Carici rupestris-Kobresietea*, Pleistocene, relic stands, syntaxonomy, Tatra Mts

Introduction

In the Western Carpathians the class *Carici rupestris-Kobresietea* Ohba 1974 has been distinguished only recently. Petrík et al. (2005) included into this class relic stands dominated by *Elyna myosuroides* from the ridges of the Belianske Tatry Mts (*Oxytropido carpaticae-Elynetum myosuroides*). The key character for classification of these stands to the *Carici-Kobriesetea* was the presence of numerous species considered relic from the past glacial periods. The communities of this class often occupy habitats representing suitable stands, which might have served as refuge during extremely cold periods of the Pleistocene.

Comparative study of the West Carpathian high-altitude communities (Dúbravcová et al., 2005) supported the ideas of recognizing the *Carici-Kobresietea* in this region. The idea by Ohba (1974) and later by Petrík et al. (2005) suggesting the inclusion of the *Festucion versicoloris* Krajina 1933 into this class was also sustained.

Detailed study of the alpine and subnival vegetation from twenties of the last century until today yielded substantial knowledge of these communities. In this paper we want to clarify the extent and content of the low-rank syntaxa of the class *Carici-Kobresietea.* The main aims are: 1) to find differences between individual communities and to determine their diagnostic (character and differential) species; 2) to clarify the distinction of the *Festucion versicoloris* and the *Oxytropido-Elynion* in the Western Carpathians, and finally 3) to investigate the nature of floristic differences between stands dominated by *Festuca versicolor* on base-rich bedrocks such as limestone and marly limestone and stands found on bedrock moderately acid to neutral (Allgäu-Schiefer shale, hornstone, mylonite, quartzite, and sandstone).

Material and methods

We collected 443 phytocoenological relevés of the communities typical of high-altitude, wind-exposed habitats and dominated by cushion and dwarf-shrub heath communities of the central (the highest) part of the Western Carpathians (mostly in Tatra Mts). Based on previous studies (PETRÍK et al., 2005; DÚBRAVCOVÁ et al., 2005) we selected a dataset of phytocoenological relevés typical for the *Carici rupestris-Kobresietea*. They were combined with further relevés from similar communities with uncertain delimitation and classification into a high-rank syntaxon. These communities include the *Saxifrago-Festucetum versicoloris* SILLINGER 1933, the *Saxifrago paniculatae-Festucetum versicoloris* (WALAS 1933) PAWŁOWSKI 1935, the *Seslerio tatrae-Festucetum versicoloris* PAWŁOWSKI et STECKI 1927 corr. KLIMENT et al. 2005. The latter community is usually classified within the *Elyno-Seslerietea*; we used this one as a reference group for this class.

All relevés were sampled using standard procedures of the Zürich-Montpellier School (BRAUN-BLANQUET, 1964), mostly using the modified 9-degree Braun-Blanquet's sampling scale (BARKMAN et al., 1964).

The nomenclature of the taxa generally follows the Checklist by MARHOLD & HINDÁK (1998), with notable exceptions of those taxa, where the author's citation has been also included. The subspecies (given without the species name) in the tables are marked with asterisks (*).

Original cover-abundance categories of the sampling scales used were transformed using the ordinal scale of VAN DEN MAAREL (1979). The taxa determined only at the level of genus were masked-out (except the genera *Alchemilla*, *Sphagnum* and *Taraxacum*). Some taxa were included within more broadly-defined units: *Agrostis rupestris* (*A. pyrenaica*), *Alchemilla* sp. (incl. *A. aculeata*, *A. colorata*, *A. erythropoda*, *A. fissa* GÜNTHER et SCHUMMEL, *A. flabellata*, *A. glabra*, *A. incisa*, *A. monticola*, *A. palmata*, *A. rhodocycla*, *A. straminea*), *Anthoxanthum alpinum* (*A. odoratum*), *Cardaminopsis arenosa* (*C. borbasii*), *Carex atrata* (*C. aterrima*), *C. sempervirens* [subsp. *silicicola*, subsp. *tatrorum* (ZAPAŁ.) PAWŁ.], *Cladonia arbuscula* (subsp. *mitis*), *C. pyxidata* (subsp. *pocillum*, subsp. *chlorophaea*), *Empetrum nigrum* (*E. hermaphroditum*), *Gentianella lutescens* (subsp. *carpatica*, subsp. *tatrae*), *Salix retusa* (*S. kitaibeliana*), *Schistidium apocarpum* agg. (*S. atrofuscum*, *S. boreale*, *S. trichodon*), *Sphagnum* sp. (*S. capillifolium*, *S. compactum*, *S. girgensoghnii*, *S. quinquefarium*), *Taraxacum* sp. (sect. *Alpestria*, sect. *Alpina*), *Thamnolia vermicularis* (subsp. *subuliformis*), *Trifolium repens* (*T. orbelicum*).

Numerical classification was performed using the program HIERCLUS from the SYN-TAX 2000 package (PODANI 2001). The Ward's and β-flexible method ($\beta = -0.25$) with Euclidean Distance and Wishart's similarity coefficients were used. The dendrograms obtained were evaluated by comparative analyses of phytocoenological tables. In the clustering using ß-flexible method (Wishart's coefficient) the relevés were classified into clusters representing floristically, physiognomically and ecologically well-differentiated communities. In the second step using of Ward's method and Euclidean Distance helps with classification of communities at the higher units. Results of numerical classification were used for rough orientation in analysed data. They were interpreted with consideration to supplementary information on ecology, phytogeography of individual taxa (e.g. arctic-alpine elements, endemic taxa) and relicness of habitats.

In the article only the associations with new relevant actualities are described in more detail.

Each taxon in synoptic table is characterised by the frequency (in %) and the mean value of abundance (upper index) calculated with the FYTOPACK program (JAROLÍMEK & SCHLOSSER, 1997). The individual columns contain also brief bibliographic references (for unpublished data only the names of authors are given), the number of relevés and their position in orographical units according to the map from the Database of Fauna of Slovakia, scale 1: 500 000. Diagnostically important taxa of individual syntaxa are given in bold.

Geological types of bedrock of the relevés localities were identified according to SEKYRA (1954) and SVOBODA et al. (1983).

The recognition of the diagnostic taxa of the high-ranked syntaxa follows the recent syntaxonomical revisions of Slovak high-mountains vegetations (KLIMENT et al., 2004, 2005; DÚBRAVCOVÁ et al., 2005; PETRÍK et al., 2005; ŠIBÍK et al., 2006). The meaning of abbreviations: art. = article according to the International Code of Phytocoenological Nomenclature [ICPN; WEBER et al. 2000), reg. = regional diagnostic taxon, transgr. = transgressive taxon (sensu WESTHOFF & VAN DER MAAREL, 1978).

Results

Class: ***Carici rupestris-Kobresietea bellardii* OHBA 1974**

Order: ***Oxytropido-Elynetalia* OBERDORFER ex ALBRECHT 1969**

Alliance: ***Oxytropido-Elynion* BR.-BL. 1949**

Relic species-rich naked-rush swards of wind-exposed ridges and ledges of the highest altitudes of the Alps, Apennines, Carpathians, Pyrenees and the mountains of the Balkan Peninsula.

Associations:

Pyrolo carpaticae-Salicetum reticulatae PETRÍK in PETRÍK et al. 2006

Festuco versicoloris-Oreochloetum distichae PAWŁOWSKI et STECKI 1927 corr. PETRÍK et al. 2006 nom. invers. propos.

Festucetum versicoloris DOMIN 1929

Oxytropido carpaticae-Elynetum myosuroides (PUŞCARU et al. 1956) COLDEA 1991

Drabo siliquosae-Festucetum versicoloris PETRÍK in PETRÍK et al. 2006

Alliance: ***Festucion versicoloris* KRAJINA 1933**

Phytocoenoses bound to the mylonite (granite enriched by oligoclase) zone of the upper alpine and subnival belt of the Tatra Mts; mostly developed on terraces of steep rocky cliffs and on stabilised small-grained screes located below these cliffs.

Associations:

Silenetum acaulis KRAJINA 1933

Agrostio alpinae-Festucetum versicoloris Pawłowski in Pawłowski et al. 1928 nom. invers. propos.
Salicetum kitaibelianae Krajina 1933

Descriptions of selected syntaxa

***Pyrolo carpaticae-Salicetum reticulatae* Petrík ass. nov. hoc loco**
Tab. 1, column 1; Tab. 2
Nomenclatural type: Tab. 2, r. 34 hoc loco, holotypus
Synonyms: *Dryadeto-Salicetum reticulatae* Domin 1925 (art. 2b), *Dryadeto-Salicetum reticulatae* Domin 1927 (art. 3f, 7), *Dryadeto-Salicetum reticulatae* Domin 1929 (art. 3f)
Non: *Salicetum retuso-reticulatae* Br.-Bl. in Br.-Bl. et Jenny 1926, As. *Salix reticulata-Dryas octopetala* Beldie 1967, *Salico reticulatae-Dryadetum* (Mc Vean et Ratcliffe 1962) Shimwell 1969

Characteristic taxa: *Arctous alpina* (reg.), *Carex atrofusca* (reg.), *Pyrola carpatica* (transgr.), *Tofieldia pusilla* (reg.)
Differential taxa: *Biscutella laevigata*, *Coeloglossum viride*, *Pinguicula alpina*, *Pritzelago alpina*, *Ranunculus thora*, *Saxifraga wahlenbergii*, *Selaginella selaginoides*, *Swertia perennis* subsp. *alpestris*, *Blepharostoma trichophyllum*, *Dicranum spadiceum*, *Isopterygiopsis pulchella*, *Meesia uliginosa*, *Polytrichum formosum*, *Sanionia uncinata*

Šibík et al. (2004) suggested that communities dominated by the creeping and prostrate dwarf shrubs *Dryas octopetala* and *Salix reticulata*, which Domin (1925, 1927, 1929) invalidly described as *Dryadeto-Salicetum reticulatae*, are a well-differentiated unit. The most similar communities were described from the Ukraine (Malynovski & Kricsfalusy, 2002) and from the Romanian Carpathians (Coldea, 1984, 1997) under the name *Achilleo schurii-Dryadetum* (Beldie 1967) Coldea 1984. These East Carpathian phytocoenoses differ from the West Carpathian ones by numerous taxa typical for specific geographical units and reflect specific and different development of vegetation in past (see also Petrík et al., 2005, Tab. 2).

We propose a name – the *Pyrolo carpaticae-Salicetum reticulatae* – for this unit, using *Pyrola carpatica* (a Carpathian endemic) as one of the aponymous species. *Saxifraga wahlenbergii*, a West Carpathian paleoendemic, is still another phytogeographically important species with high constancy found in this community.

The association is characterised by the co-dominance of *Dryas octopetala*, *Silene acaulis* and of arctic-alpine willow *Salix reticulata*. The presence of a group of arctic-alpine species, such as *Bistorta vivipara*, *Cerastium eriophorum*, *Minuartia sedoides*, *Pedicularis oederi* (see Tabs 1, 2) confirms the link to the arctic-alpine class of *Carici rupestris-Kobresietea*. In the well-developed moss layer (with average cover 55 %) *Hylocomium splendens* and *Rhytidiadelphus triquetrus* are the most abundant species.

The community occupies north-west- to north-east-facing windward slopes on marly limestone, less on limestone or dolomite with shallow to medium deep soils with high content of humus in upper horizon.

The association shows some syngenetic relationships to the *Arenario tenellae-Caricetum firmae* (the *Caricion firmae* Gams 1936), above all on substrata with higher content of calcium and in habitats with thinner soil layer. Numerous arctic-alpine elements suggest classification of the *Pyrolo carpaticae-Salicetum* to the *Carici rupestris-Kobresietea*, supporting the conclusions made by Šibík et al. (2004). Opposite side of variability reflects relation to the association *Festuco versicoloris-Oreochloetum*.

Based on floristic differences we distinguish two subassociations:

1) *Pyrolo carpaticae-Salicetum reticulatae biscutelletosum laevigatae* subass. nov. hoc loco (Tab. 2, rels 1–12; nomenclatural type: Tab. 2, r. 5, holotypus hoc loco) is typical of relatively shallow and more skeleton-rich soils. Higher number of calciphilous species, such as *Bellidiastrum michelii*, *Biscutella laevigata*, *Pinguicula alpina* and *Tofieldia calyculata* indicates relationships to the communities of the *Elyno-Seslerietea* or to the *Caricion firmae*. These species are also considered as differential of this subassociation, similarly as well as *Ranunculus thora*. Of the mosses, *Campylium chrysophyllum* is a good differential taxon.

2) *Pyrolo carpaticae-Salicetum reticulatae saxifragetosum moschatae* subass. nov. hoc loco (Tab. 2, rels 13–35; the nomenclatural type of this subassociation is identical with that of the association) represents typical stands of the association. They are supported by deeper soils than in the former subassociation, where the influence of the baserich bedrock is partially bufered. *Antennaria *carpatica* and *Saxifraga moschata* and also neutrophilous to acidophilous *Festuca supina*, *Luzula *mutabilis* and *Saussurea alpina* are the differential taxa of this subassociaton (see Tab. 2). The latter three of the species indicate a syntaxonomic link to the *Festuco versicoloris-Oreochloetum distichae*. *Blepharostoma trichophyllum*, *Campylium stellatum*, *Isopterygiopsis pulchella*, *Polytrichum formosum*, *Rhytidium rugosum*, *Timmia austriaca* and *Tritomaria quinquedentata* are the differential moss species of this subassociation.

The *Pyrolo carpaticae-Salicetum* is differed from the following association (*Festuco versicoloris-Oreochloetum distichae*) beside the above mentioned differential taxa also by presence or higher constancy of following species: *Bartsia alpina*, *Carex firma*, *Pedicularis verticillata*, *Ranunculus alpestris*, *Saxifraga aizoides*, *Campylium chrysophyllum*, *C. stellatum*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Entodon concin-*

Table 1. Comparison of associations from the alliance *Oxytropido-Elynion* (1–5) with other relevant alliances from the high mountains of the Western Carpathians (a brief synoptic table).
1: *Pyrolo carpaticae-Salicetum reticulatae*; 2: *Festuco versicoloris-Oreochloetum distichae*; 3: *Festucetum versicoloris*; 4: *Oxytropido carpaticae-Elynetum*; 5: *Drabo siliquosae-Festucetum versicoloris*; 6: *Oxytropido-Elynion*; 7: *Festucion versicoloris*; 8: *Caricion firmae*; 9: *Seslerion tatrae*.
1 – 7: *Carici rupestris-Kobresietea*; 8 – 9: *Elyno-Seslerietea*

Number of column			1	2	3	4	5	6	7	8	9
Number of crelevés			35	20	39	10	10	114	248	304	123
Average number of taxa			62	55	64	53	63	61	40	37	44
Diagnostic taxa of the associations											
	Pyrola carpatica	T1	**80**^{3}	45^{3}	5^{2}	.	.	**34**^{3}	1^{2}	12^{3}	1^{2}
ca	*Tofieldia pusilla* (reg.)	C1	**11**^{3}	.	.	.	.	4^{3}	.	.	.
ca	*Carex atrofusca* (reg.)	C1	**9**^{2}	.	.	.	.	3^{2}	.	.	.
	Arctous alpina (reg.)	C1	**6**^{5}	.	.	.	.	2^{5}	.	.	.
ac	*Saxifraga wahlenbergii*	D1,6	**91**^{2}	35^{2}	38^{2}	10^{2}	.	**48**^{2}	5^{2}	18^{2}	2^{2}
	*Swertia *alpestris*	D1,6	**91**^{3}	30^{3}	28^{2}	.	50^{3}	**47**^{3}	19^{2}	36^{2}	27^{3}
	Selaginella selaginoides	D1	**83**^{2}	20^{2}	13^{2}	10^{1}	.	34^{2}	12^{2}	46^{2}	35^{2}
	Sanionia uncinata (E_0)	D1	**80**^{3}	15^{2}	26^{3}	.	.	36^{3}	48^{3}	13^{2}	9^{2}
	Dicranum spadiceum (E_0)	D1	**54**^{3}	15^{3}	.	.	.	19^{3}	1^{3}	4^{2}	.
	Blepharostoma trichophyllum (E_0)	D1	**51**^{2}	.	.	.	.	16^{2}	8^{2}	5^{2}	1^{2}
	Coeloglossum viride	D1	**43**^{2}	15^{2}	.	.	.	16^{2}	10^{1}	2^{1}	10^{2}
cf	*Pinguicula alpina*	D1	**34**^{2}	.	3^{3}	.	.	11^{2}	3^{2}	**43**^{2}	6^{2}
	Ranunculus thora	D1	**29**^{3}	.	3^{1}	.	.	10^{3}	+^{2}	3^{2}	8^{3}
	Isopterygiopsis pulchella (E_0)	D1	**26**^{2}	.	.	.	.	8^{2}	1^{1}	.	.
	Meesia uliginosa (E_0)	D1	**26**^{2}	.	.	.	.	8^{2}	2^{2}	6^{2}	3^{2}
ES	*Biscutella laevigata*	D1	**23**^{2}	.	.	.	.	7^{2}	.	33^{2}	37^{2}
	Polytrichum formosum (E_0)	D1	**23**^{4}	.	.	.	.	7^{4}	1^{1}	.	.
Oe	*Dianthus glacialis*	T2	23^{2}	**75**^{2}	21^{2}	.	.	27^{2}	10^{2}	1^{2}	2^{2}
CC	*Festuca supina*	D2	43^{3}	**100**^{6}	56^{2}	40^{3}	40^{2}	57^{4}	84^{3}	5^{3}	7^{2}
CC	*Oreochloa disticha*	D2	23^{3}	**100**^{3}	23^{3}	20^{2}	40^{2}	38^{4}	76^{3}	1^{3}	6^{2}
	Bistorta major	D2	29^{2}	**100**^{4}	8^{2}	.	50^{2}	33^{3}	19^{2}	1^{3}	21^{3}
SH	*Luzula *obscura*	D2	23^{2}	**90**^{2}	13^{2}	.	.	27^{2}	54^{2}	.	2^{2}
	Cetraria cucullata (E_0)	D2	.	**75**^{3}	23^{2}	20^{2}	.	23^{2}	28^{2}	5^{2}	3^{2}
	Cladonia rangiferina (E_0)	D2	.	**75**^{3}	3^{2}	.	.	14^{3}	24^{2}	1^{3}	5^{2}
	Pleurozium schreberi (E_0)	D2	26^{3}	**75**^{4}	5^{2}	.	.	23^{3}	22^{3}	7^{2}	3^{4}
CK	*Potentilla crantzii*	D2	6^{2}	**70**^{3}	15^{2}	.	40^{4}	23^{3}	16^{2}	3^{2}	25^{3}
jt	*Senecio *carpathicus*	D2	3^{3}	**70**^{3}	.	.	.	13^{3}	6^{2}	.	1^{2}
NS	*Potentilla aurea*	D2	6^{2}	**65**^{3}	.	.	.	13^{3}	16^{2}	1^{2}	59^{3}
CC	*Avenula versicolor*	D2	9^{2}	**55**^{3}	15^{2}	10^{2}	.	18^{3}	36^{2}	.	18^{3}
	Cladonia gracilis (E_0)	D2	6^{2}	**55**^{2}	10^{2}	10^{2}	10^{2}	17^{2}	36^{2}	6^{2}	2^{2}
jt	*Hieracium alpinum*	D2	6^{2}	**45**^{2}	3^{2}	.	.	11^{2}	25^{2}	+^{2}	5^{2}
CC	*Pulsatilla scherfelii*	D2,7	.	**40**^{2}	.	.	.	7^{2}	**45**^{3}	+^{2}	7^{2}
	Salix hastata	D2	.	**25**^{3}	.	.	.	4^{3}	.	.	.
pc	*Crepis jacquinii*	D3,6	11^{2}	.	**41**^{3}	.	10^{2}	**18**^{3}	.	69^{3}	7^{2}
pt	*Delphinium oxysepalum*	D3	3^{2}	15^{2}	**41**^{2}	10^{2}	10^{3}	19^{2}	2^{2}	2^{2}	.
	Hypnum bambergeri (E_0)	D3	9^{3}	.	**36**^{3}	.	.	15^{3}	.	27^{3}	.
	Didymodon asperifolius (E_0)	D3	.	.	**28**^{3}	.	.	10^{3}	.	1^{3}	.
CK	*Elyna myosuroides*	C4	.	10^{3}	3^{2}	**100**^{6}	.	11^{5}	1^{4}	.	.
	Cladonia pyxidata (E_0)	D4	9^{2}	20^{2}	15^{3}	**100**^{3}	20^{2}	22^{3}	28^{2}	9^{2}	13^{2}
	Physconia muscigena (E_0)	D4	.	.	18^{2}	**80**^{2}	.	13^{2}	+^{2}	2^{2}	.
pc	*Primula *hungarica*	D4	.	.	13^{2}	**50**^{3}	.	9^{2}	.	45^{2}	7^{2}
	Toninia lobulata (E_0)	D4	.	.	18^{2}	**50**^{2}	10^{2}	11^{2}	+^{3}	4^{2}	.
	Fulgensia bracteata (E_0)	D4	.	.	.	**40**^{2}	.	4^{2}	.	6^{2}	.
	Draba siliquosa	C5	.	.	10^{2}	20^{3}	**100**^{3}	14^{3}	.	+^{2}	.
	Anthoxanthum alpinum	D5	3^{2}	15^{2}	10^{2}	10^{2}	**100**^{2}	17^{2}	27^{2}	+^{2}	50^{3}
	Parnassia palustris	D5	29^{2}	15^{2}	44^{2}	.	**100**^{3}	35^{2}	6^{2}	18^{2}	53^{2}
ES	*Astragalus australis*	D5,6	9^{2}	.	15^{2}	30^{3}	**90**^{3}	**18**^{3}	.	2^{2}	21^{4}
ES	*Helianthemum grandiflorum*	D5	.	10^{2}	26^{2}	.	**90**^{4}	18^{3}	1^{2}	12^{2}	69^{4}
Cv	*Linum extraaxillare*	D5	3^{2}	.	.	.	**90**^{4}	9^{4}	3^{3}	1^{1}	37^{3}
	Plagiothecium laetum (E_0)	D5	.	.	.	.	**80**^{2}	7^{2}	+^{2}	+^{2}	.
st	*Tephroseris capitata*	D5,6	6^{1}	.	13^{3}	20^{2}	**80**^{2}	**15**^{2}	.	+^{1}	**28**^{2}
	Poa nemoralis	D5	.	.	13^{2}	10^{2}	**70**^{3}	11^{3}	1^{2}	+^{2}	1^{3}
	Plagiobryum demissum (E_0)	D5	6^{2}	.	13^{2}	10^{2}	**70**^{2}	13^{2}	.	+^{2}	1^{3}
	Campylopus schimperi (E_0)	D5	.	.	10^{2}	.	**50**^{2}	8^{2}	3^{2}	.	.
	Plagiopus oederi (E_0)	D5	6^{2}	.	8^{3}	.	**50**^{3}	9^{3}	.	3^{3}	.
ES	*Carduus glaucinus*	D5	.	.	.	.	**30**^{3}	3^{3}	.	1^{2}	40^{3}
	Saxifraga adscendens	D5	.	.	.	.	**30**^{2}	3^{2}	+^{2}	.	1^{2}

Table 1. (continued)

Number of column			1	2	3	4	5	6	7	8	9
Oxytropido-Elynion											
	Androsace chamaejasme	C	71^{3}	75^{2}	97^{4}	100^{3}	100^{4}	$\mathbf{86}^{3}$	$+^{2}$	39^{2}	24^{2}
	Rhodax alpestris	C	63^{3}	60^{2}	79^{3}	50^{2}	10^{2}	$\mathbf{62}^{2}$	.	39^{3}	4^{3}
	Oxytropis halleri	C	20^{2}	10^{2}	74^{4}	70^{4}	30^{2}	$\mathbf{42}^{3}$	.	2^{2}	1^{5}
	Vulpicida tubulosus (E_0)	C	31^{2}	10^{2}	72^{2}	50^{2}	.	$\mathbf{40}^{2}$	2^{2}	28^{2}	1^{3}
	Comastoma tenellum (reg.)	C	26^{2}	20^{2}	44^{2}	70^{2}	60^{2}	$\mathbf{38}^{2}$	.	6^{2}	.
	Dactylina madreporiformis (E_0)	C	9^{2}	.	62^{2}	80^{3}	.	$\mathbf{31}^{2}$	.	13^{3}	.
	Oxytropis carpatica	C	14^{3}	.	49^{3}	50^{2}	13^{2}	$\mathbf{26}^{3}$	.	11^{3}	1^{3}
	Carex capillaris	C	9^{2}	20^{2}	36^{3}	40^{3}	60^{3}	$\mathbf{27}^{3}$	.	3^{2}	2^{2}
	Astragalus frigidus	C	14^{2}	20^{2}	21^{2}	10^{2}	50^{3}	$\mathbf{20}^{3}$	.	1^{3}	3^{4}
	Erigeron hungaricus	C	.	.	33^{2}	10^{2}	70^{2}	$\mathbf{18}^{2}$	$+^{3}$	1^{2}	7^{3}
	Astragalus norvegicus	C	9^{2}	.	13^{3}	.	40^{4}	$\mathbf{11}^{3}$	.	$+^{2}$	3^{3}
ES	*Galium anisophyllon*	D	94^{2}	95^{2}	97^{2}	80^{2}	100^{3}	$\mathbf{95}^{2}$	18^{2}	61^{2}	76^{2}
ES	*Ranunculus breyninus*	D	51^{2}	70^{3}	92^{4}	100^{3}	100^{4}	$\mathbf{77}^{3}$	14^{3}	27^{2}	54^{3}
	Myosotis alpestris	D	89^{2}	70^{2}	77^{2}	30^{2}	100^{3}	$\mathbf{77}^{2}$	13^{2}	9^{2}	28^{2}
	Poa alpina	D	77^{2}	65^{2}	87^{2}	60^{2}	50^{2}	$\mathbf{75}^{2}$	17^{2}	16^{2}	59^{3}
ac	*Salix reticulata*	D	100^{6}	75^{3}	54^{3}	.	.	$\mathbf{62}^{5}$	11^{3}	35^{3}	19^{3}
st	*Sesleria tatrae*	D	71^{2}	60^{3}	59^{2}	10^{2}	90^{2}	$\mathbf{61}^{2}$	1^{2}	30^{2}	$\mathbf{99}^{6}$
ES	*Phyteuma orbiculare*	D	57^{2}	30^{2}	64^{2}	20^{2}	90^{4}	$\mathbf{54}^{3}$	18^{2}	39^{2}	89^{3}
	Ditrichum flexicaule (E_0)	D	57^{3}	.	74^{3}	50^{3}	40^{3}	$\mathbf{51}^{3}$	4^{3}	64^{3}	4^{2}
	Mnium thomsonii (E_0)	D	77^{3}	.	44^{2}	30^{2}	60^{2}	$\mathbf{46}^{2}$	5^{2}	16^{2}	1^{3}
	Rhytidiadelphus triquetrus (E_0)	D	97^{4}	65^{3}	10^{2}	.	.	$\mathbf{45}^{3}$	19^{2}	21^{2}	7^{3}
	Saxifraga aizoides	D	63^{2}	.	64^{2}	10^{2}	20^{2}	$\mathbf{44}^{2}$	5^{2}	48^{2}	10^{3}
cf	*Carex firma*	D	69^{6}	10^{2}	49^{3}	20^{2}	10^{2}	$\mathbf{42}^{4}$	$+^{2}$	$\mathbf{97}^{7}$	15^{2}
cf	*Ranunculus alpestris*	D	83^{2}	5^{2}	44^{2}	10^{2}	.	$\mathbf{42}^{2}$	15^{3}	$\mathbf{82}^{3}$	3^{2}
ns	*Luzula sudetica*	D	54^{2}	60^{2}	31^{2}	.	50^{2}	$\mathbf{42}^{2}$	$+^{2}$	1^{2}	5^{2}
ES	*Euphrasia salisburgensis*	D	6^{2}	5^{2}	64^{2}	40^{2}	60^{2}	$\mathbf{33}^{2}$	2^{1}	31^{2}	31^{2}
st	*Cardaminopsis *tatrica*	D	51^{2}	45^{2}	15^{2}	.	30^{2}	$\mathbf{32}^{2}$	.	.	22^{3}
cf	*Arenaria tenella*	D	9^{2}	.	62^{3}	60^{3}	20^{2}	$\mathbf{31}^{3}$	2^{2}	$\mathbf{36}^{2}$	2^{1}
ES	*Thymus pulcherrimus*	D	.	.	51^{3}	10^{2}	70^{3}	$\mathbf{25}^{3}$	.	9^{2}	39^{3}
pc	*Draba aizoides*	D	11^{2}	5^{2}	46^{2}	40^{2}	.	$\mathbf{24}^{2}$	1^{2}	22^{2}	2^{2}
asa	*Bupleurum ranunculoides*	D	.	.	18^{2}	50^{3}	90^{3}	$\mathbf{18}^{3}$	.	5^{2}	3^{2}
as	*Aster alpinus*	D	.	.	18^{3}	40^{4}	70^{3}	$\mathbf{16}^{3}$	.	8^{3}	1^{2}
Festucion versicoloris											
	Salix retusa s. l.	C	43^{3}	35^{2}	15^{2}	10^{3}	.	25^{3}	$\mathbf{63}^{5}$	7^{2}	4^{2}
	Gentiana frigida	C	11^{2}	.	8^{2}	.	.	6^{2}	$\mathbf{40}^{2}$	.	.
	Erigeron uniflorus (reg.)	C	.	.	.	.	.	.	$\mathbf{19}^{2}$	$+^{2}$	2^{1}
	Saxifraga retusa	C	.	.	.	.	.	.	$\mathbf{16}^{2}$	.	.
	Pulsatilla vernalis	C	.	.	.	.	.	.	$\mathbf{3}^{2}$	.	.
fp	*Doronicum stiriacum*	D	9^{4}	35^{3}	15^{2}	.	10^{2}	15^{3}	$\mathbf{60}^{2}$	.	.
	Huperzia selago	D	17^{2}	.	8^{2}	.	.	8^{2}	$\mathbf{48}^{2}$	13^{2}	2^{2}
	Polytrichum piliferum (E_0)	D	.	.	.	10^{3}	.	1^{3}	$\mathbf{25}^{2}$	.	.
tf	*Cardaminopsis neglecta*	D	.	.	.	.	.	.	$\mathbf{25}^{2}$	.	.
aa	*Saxifraga bryoides*	D	3^{2}	.	10^{3}	10^{3}	.	5^{3}	$\mathbf{24}^{2}$	.	.
aa	*Poa laxa*	D	.	.	.	10^{2}	.	1^{2}	$\mathbf{23}^{2}$	.	.
SH	*Leucanthemopsis *tatrae*	D	.	.	.	.	.	.	$\mathbf{21}^{2}$	.	.
SH	*Salix herbacea*	D	.	.	.	.	.	.	$\mathbf{20}^{2}$	.	.
aa	*Oxyria digyna*	D	.	.	3^{2}	.	.	1^{2}	$\mathbf{18}^{2}$	.	.
	Callianthemum coriandrifolium	D	.	.	.	.	.	.	$\mathbf{15}^{2}$	.	1^{2}
	Novosieversia reptans	D	.	.	.	.	.	.	$\mathbf{15}^{3}$	.	.
Oxytropido-Elynetalia											
	*Festuca *versicolor* (reg.)		100^{5}	85^{4}	100^{6}	100^{5}	100^{8}	$\mathbf{97}^{5}$	$\mathbf{49}^{5}$	98^{4}	63^{5}
	Cerastium eriophorum	T6	89^{3}	95^{3}	97^{3}	90^{3}	100^{5}	$\mathbf{94}^{3}$	$\mathbf{30}^{2}$	15^{2}	8^{2}
	Minuartia sedoides	T6	94^{4}	95^{4}	95^{4}	80^{3}	40^{2}	$\mathbf{98}^{4}$	$\mathbf{41}^{3}$	33^{2}	7^{2}
	Minuartia pauciflora (reg.)	T6	97^{3}	55^{2}	97^{3}	40^{2}	60^{2}	$\mathbf{82}^{3}$	$\mathbf{22}^{3}$	25^{2}	3^{2}
	Ligusticum mutellinoides		91^{3}	95^{3}	74^{3}	70^{2}	20^{2}	$\mathbf{78}^{3}$	$\mathbf{45}^{2}$	5^{2}	7^{3}
	Carex fuliginosa	T6	83^{3}	55^{3}	85^{3}	60^{3}	40^{3}	$\mathbf{73}^{3}$	$\mathbf{31}^{2}$	8^{2}	.
	Saxifraga moschata		69^{3}	90^{3}	69^{3}	30^{2}	100^{3}	$\mathbf{72}^{3}$	$\mathbf{56}^{2}$	9^{2}	14^{2}
	Hedysarum hedysaroides (reg.)	T6	66^{4}	95^{3}	51^{3}	40^{2}	60^{3}	$\mathbf{63}^{3}$	$\mathbf{3}^{3}$	11^{2}	14^{3}
	Carex atrata		66^{3}	100^{3}	31^{2}	10^{2}	50^{3}	$\mathbf{54}^{3}$	$\mathbf{25}^{2}$	6^{2}	11^{2}
	Saussurea alpina (reg.)	T6	26^{2}	30^{3}	46^{3}	10^{3}	80^{4}	$\mathbf{37}^{3}$	$\mathbf{2}^{3}$	1^{2}	6^{2}
	*Antennaria *carpatica*		31^{3}	10^{2}	46^{2}	50^{2}	.	$\mathbf{32}^{2}$	$\mathbf{23}^{2}$	2^{2}	2^{2}
	Saxifraga oppositifolia		9^{2}	.	51^{3}	40^{3}	.	$\mathbf{24}^{3}$	$\mathbf{26}^{3}$	5^{2}	1^{2}
	Agrostis alpina		.	.	18^{3}	60^{4}	90^{3}	$\mathbf{19}^{3}$	$\mathbf{12}^{3}$	1^{3}	5^{2}
	Gentiana nivalis (reg.)	T6	6^{2}	5^{2}	26^{2}	20^{2}	30^{2}	$\mathbf{16}^{2}$	$+^{2}$	2^{2}	2^{2}
	Saussurea pygmaea		.	.	8^{2}	10^{1}	10^{2}	$\mathbf{4}^{2}$	$\mathbf{17}^{2}$	.	.

Table 1. (continued)

Number of column		1	2	3	4	5	6	7	8	9
Carici rupestris-Kobresietea bellardii										
	Silene acaulis	100^{6}	90^{5}	97^{6}	90^{5}	60^{3}	$\mathbf{93}^{6}$	$\mathbf{76}^{4}$	44^{3}	18^{2}
	Bistorta vivipara	100^{4}	85^{4}	100^{4}	100^{3}	100^{4}	$\mathbf{97}^{4}$	$\mathbf{70}^{2}$	69^{2}	59^{3}
	Pedicularis oederi	100^{3}	75^{2}	95^{3}	40^{2}	100^{3}	$\mathbf{89}^{3}$	$\mathbf{53}^{2}$	43^{2}	24^{2}
	Lloydia serotina	74^{3}	60^{3}	95^{3}	90^{3}	90^{3}	$\mathbf{82}^{3}$	$\mathbf{58}^{2}$	18^{2}	2^{2}
	Dryas octopetala	91^{5}	50^{2}	38^{3}	10^{1}	.	$\mathbf{51}^{4}$	$\mathbf{6}^{4}$	78^{5}	15^{4}
	*Luzula *mutabilis*	29^{2}	45^{2}	56^{2}	40^{2}	80^{2}	$\mathbf{46}^{2}$	$\mathbf{44}^{2}$	$+^{2}$	2^{2}
	Carex rupestris	.	.	.	.	.	.	$\mathbf{1}^{2}$	4^{6}	.
Elyno-Seslerietea										
cf	*Saxifraga caesia*	6^{1}	.	.	.	.	2^{1}	.	$\mathbf{62}^{3}$	.
cf	*Salix alpina*	14^{3}	.	8^{4}	.	.	7^{4}	.	$\mathbf{44}^{3}$	21^{3}
cf	*Chamorchis alpina*	17^{2}	.	15^{2}	10^{2}	.	11^{2}	.	$\mathbf{21}^{2}$	2^{2}
cf	*Viola alpina*	.	5^{2}	.	.	.	1^{2}	.	$\mathbf{12}^{3}$	2^{3}
st	*Gentiana verna*	3^{2}	.	10^{2}	.	.	4^{2}	.	5^{2}	$\mathbf{31}^{2}$
st	*Astragalus alpinus*	3^{3}	5^{2}	5^{2}	10^{5}	40^{2}	8^{3}	.	$+^{2}$	$\mathbf{12}^{4}$
	Bellidiastrum michelii	20^{3}	.	10^{2}	.	10^{2}	11^{2}	6^{2}	40^{3}	64^{3}
	Scabiosa lucida	6^{2}	.	23^{2}	.	50^{2}	14^{2}	2^{2}	12^{2}	78^{3}
Asplenietea trichomanis										
Pc	*Saxifraga paniculata*	69^{4}	30^{2}	100^{5}	80^{4}	100^{3}	76^{4}	45^{3}	46^{2}	33^{3}
pc	*Trisetum alpestre*	.	.	26^{2}	60^{4}	20^{2}	16^{3}	$+^{2}$	41^{3}	7^{3}
pc	*Artemisia eriantha*	.	.	36^{2}	40^{2}	.	16^{2}	8^{2}	3^{2}	.
pc	*Campanula cochleariifolia*	.	.	21^{2}	30^{2}	.	10^{2}	.	46^{2}	2^{2}
pc	*Androsace lactea*	.	.	8^{3}	20^{2}	.	4^{2}	.	29^{2}	2^{2}
av	*Draba fladnizensis*	.	.	13^{2}	20^{2}	20^{2}	8^{2}	.	.	.
pc	*Leontopodium alpinum*	.	.	3^{2}	30^{3}	.	4^{2}	.	15^{2}	.
pc	*Draba dubia*	.	.	5^{2}	20^{2}	.	4^{1}	1^{2}	.	.
pc	*Draba tomentosa*	.	.	.	10^{2}	.	1^{2}	$+^{2}$	6^{2}	.
pc	*Draba×sturii*	.	.	.	10^{2}	.	1^{1}	.	.	.
Thlaspietea rotundifolii										
pt	*Pritzelago alpina*	34^{2}	5^{2}	13^{2}	.	.	16^{2}	$+^{2}$	9^{2}	1^{2}
pt	*Cerastium *glandulosum*	17^{3}	40^{2}	13^{2}	.	20^{3}	18^{2}	12^{2}	4^{2}	22^{2}
aa	*Saxifraga hieraciifolia*	37^{2}	75^{3}	15^{1}	.	.	30^{2}	17^{2}	1^{2}	1^{1}
aa	*Saxifraga androsacea*	31^{2}	10^{2}	.	.	.	11^{2}	17^{2}	1^{2}	2^{2}
aa	*Saxifraga carpathica*	.	.	3^{1}	.	.	1^{1}	8^{2}	.	.
aa	*Ranunculus glacialis*	.	.	.	.	.	.	8^{2}	.	.
Salicetea herbaceae										
ac	*Leontodon pseudotaraxaci*	20^{2}	.	44^{2}	10^{2}	30^{2}	25^{2}	15^{2}	7^{2}	20^{2}
fp	*Festuca picturata*	3^{3}	10^{2}	3^{5}	.	40^{2}	7^{3}	17^{3}	.	20^{4}
ac	*Sedum atratum*	.	.	10^{2}	10^{2}	.	4^{2}	.	2^{2}	3^{2}
Sh	*Sedum alpestre*	.	.	.	.	.	.	12^{2}	.	.
Caricion atrofusco-saxatilis										
	Kobresia simpliciuscula	.	5^{2}	3^{2}	20^{2}	.	4^{2}	.	9^{4}	.
	Juncus triglumis	3^{2}	.	.	.	.	1^{2}	.	$+^{2}$	.
Caricetea curvulae										
jt	*Juncus trifidus*	23^{3}	95^{4}	31^{3}	10^{2}	70^{2}	41^{3}	51^{2}	1^{2}	3^{2}
	Campanula alpina	57^{3}	95^{3}	31^{2}	10^{2}	.	46^{3}	68^{2}	4^{2}	6^{2}
	Primula minima	54^{3}	65^{3}	54^{2}	70^{3}	10^{2}	54^{3}	71^{2}	8^{2}	.
	Agrostis pyrenaica	.	35^{2}	3^{2}	.	.	7^{2}	26^{2}	.	8^{2}
jt	*Senecio *carniolicus*	.	.	.	.	.	.	10^{2}	.	.
Loiseleurio-Vaccinietea										
	Vaccinium vitis-idaea	46^{3}	45^{3}	10^{2}	.	.	25^{3}	33^{2}	31^{2}	32^{2}
	Vaccinium myrtillus	6^{2}	10^{2}	.	.	.	4^{2}	21^{2}	10^{2}	27^{3}
	Vaccinium gaultherioides	6^{2}	.	.	.	.	2^{2}	13^{2}	1^{2}	2^{4}
Mulgedio-Aconitetea										
tf	*Rhodiola rosea*	3^{2}	45^{2}	82^{2}	80^{2}	100^{4}	53^{2}	45^{2}	17^{2}	24^{2}
	Aconitum firmum	6^{2}	25^{2}	3^{1}	.	10^{2}	8^{2}	3^{2}	1^{2}	6^{2}
Cv	*Achillea *alpestris*	3^{2}	5^{2}	5^{2}	.	10^{5}	4^{3}	1^{2}	1^{2}	46^{3}
Cv	*Anemone narcissiflora*	9^{2}	10^{2}	.	.	30^{3}	7^{2}	29^{2}	2^{2}	35^{3}
Cv	*Solidago *minuta*	3^{1}	5^{2}	.	.	10^{2}	3^{2}	18^{2}	.	11^{2}
Cv	*Luzula luzuloides*	.	5^{2}	.	.	20^{2}	3^{2}	6^{2}	2^{2}	27^{3}
Cv	*Gentiana punctata*	.	.	.	.	.	.	12^{2}	.	2^{2}
Others										
	Campanula tatrae	57^{2}	85^{2}	90^{2}	80^{2}	100^{3}	79^{2}	58^{2}	9^{2}	37^{2}
	Carex sempervirens	49^{2}	40^{2}	36^{2}	20^{2}	100^{5}	45^{3}	46^{3}	14^{2}	96^{6}
	Viola biflora	26^{3}	15^{3}	8^{2}	20^{2}	50^{2}	19^{3}	26^{2}	11^{2}	21^{3}
	Bartsia alpina	66^{2}	.	38^{2}	10^{2}	70^{3}	40^{2}	49^{2}	55^{3}	55^{2}
	Thymus alpestris	9^{2}	.	56^{3}	60^{2}	50^{3}	32^{3}	26^{2}	4^{2}	38^{3}

Table 1. (continued)

Number of column	1	2	3	4	5	6	7	8	9
Pedicularis verticillata	46^2	10^2	46^2	.	80^2	39^2	48^2	44^2	45^2
Alchemilla spec. div.	6^2	15^2	28^2	.	70^2	20^2	18^2	1^2	47^3
Euphrasia tatrae	3^2	10^2	3^2	.	40^2	7^2	16^2	$+^2$	18^2
Soldanella carpatica	97^4	90^3	18^2	.	.	52^3	61^2	44^2	59^2
Botrychium lunaria	3^1	10^2	8^2	.	.	5^2	.	1^2	23^2
Ligusticum mutellina	3^3	30^2	3^2	.	.	7^2	27^2	2^2	41^3
Trollius altissimus	6^2	30^1	3^2	.	.	8^2	.	.	2^2
Cardaminopsis arenosa agg.	17^2	.	31^2	.	50^2	20^2	$+^2$	15^2	19^2
Ranunculus pseudomontanus	.	30^2	3^2	.	.	6^2	27^2	4^2	28^2
Gentianella lutescens	.	.	18^2	30^1	20^2	11^2	5^2	30^2	21^2
Tofieldia calyculata	14^3	.	.	.	.	4^3	1^2	34^3	5^3
Bryophytes & Lichens									
Cetraria islandica	91^2	95^4	51^2	20^2	20^2	66^3	64^3	46^2	23^3
Tortella tortuosa	63^3	10^2	87^3	80^2	100^3	67^3	36^2	79^4	49^4
Polytrichum alpinum	43^4	55^3	31^3	20^2	10^2	35^3	45^3	4^3	2^3
Rhytidium rugosum	43^3	55^2	41^3	30^3	60^2	45^2	24^2	34^3	7^3
Plagiochila porelloides	54^2	.	33^2	30^2	40^2	34^2	$+^2$	9^2	1^2
Entodon concinnus	43^2	.	56^2	30^2	10^2	36^2	1^2	21^2	1^2
Ctenidium molluscum	14^2	.	23^3	10^2	10^2	14^2	1^2	43^3	3^4
Cladonia sp.	3^2	15^2	36^2	.	50^2	19^2	10^2	10^2	3^2
Bryum sp.	26^2	5^2	18^2	.	20^2	17^2	2^2	7^2	2^2
Thamnolia vermicularis	40^2	40^2	85^2	90^2	.	56^2	37^2	33^2	3^2
Campylium stellatum	46^3	10^2	26^2	20^2	.	26^3	19^2	33^2	4^3
Cetraria nivalis	3^3	45^2	26^2	10^3	.	18^2	31^2	6^2	2^2
Alectoria ochroleuca	6^2	15^2	8^2	30^2	.	10^2	25^2	16^2	1^2
Hypnum cupressiforme	17^2	5^2	15^2	20^2	.	12^2	5^3	20^3	1^3
Cladonia coccifera	3^2	10^2	10^2	20^2	10^2	9^2	16^2	$+^3$	.
Timmia austriaca	40^2	5^3	10^2	.	10^2	18^2	4^2	1^4	.
Hylocomium splendens	100^6	90^6	21^3	.	.	54^6	42^3	36^4	8^3
Dicranum scoparium	31^4	50^3	3^3	.	.	18^3	17^3	10^3	2^3
Ptilidium ciliare	51^2	60^3	13^3	.	.	31^3	8^2	3^2	.
Racomitrium lanuginosum	17^4	5^2	5^2	.	.	8^3	22^2	18^3	.
Polytrichum strictum	3^6	25^4	13^3	.	.	10^4	5^2	1^3	.
Cladonia arbuscula	3^2	25^3	3^2	.	.	6^3	25^2	2^2	1^2
Myurella julacea	3^2	.	44^2	50^2	60^2	25^2	2^2	10^2	3^3
Distichium capillaceum	57^2	.	38^2	.	30^2	33^2	12^2	29^2	2^2
Schistidium apocarpum agg.	9^2	.	44^2	30^2	.	20^2	4^1	24^2	7^3
Racomitrium canescens	23^2	.	10^2	10^2	.	11^2	8^2	2^3	7^2
Encalypta alpina	6^2	.	26^2	50^2	70^2	21^2	4^2	17^3	.
Caloplaca cinnamomea	3^2	.	8^2	40^2	.	7^2	$+^2$	10^2	.
Didymodon giganteus	14^3	.	26^3	10^2	.	14^3	$+^2$	13^3	.
Megaspora verrucosa	6^2	.	10^2	20^2	.	7^2	.	13^2	.
Hypnum hamulosum	20^2	.	18^2	.	40^2	16^2	2^2	8^2	.
Cirriphyllum cirrosum	14^2	.	21^2	.	10^2	12^2	6^2	10^2	1^2
Solorina bispora	3^2	.	23^2	.	10^2	10^2	$+^2$	12^2	1^2
Tritomaria quinquedentata	37^2	.	21^2	.	.	18^2	4^2	2^3	.
Dicranum fuscescens	20^3	35^4	.	.	.	12^3	4^1	$+^1$	.
Polytrichum longisetum	11^3	25^4	.	.	.	8^3	.	$+^2$	.
Ctenidium procerrimum	3^2	.	41^2	40^2	.	18^2	$+^2$	20^3	.
Campylium chrysophyllum	26^3	.	8^2	.	.	11^2	$+^2$	7^2	2^2
Scapania cuspiduligera	23^2	.	10^2	.	.	11^2	.	1^2	.
Pohlia cruda	54^2	.	.	.	40^2	20^2	23^2	4^2	3^2
Cladonia uncialis	.	30^2	3^2	.	.	6^2	20^2	1^2	.
Psora decipiens	.	.	21^2	40^2	.	11^2	.	2^2	.
Squamarina gypsacea	.	.	13^2	30^4	.	7^3	.	11^2	.
Ochrolechia upsaliensis	.	.	3^2	40^2	.	4^2	.	1^2	.
Hypnum vaucheri	.	.	5^2	40^2	.	5^2	4^1	7^3	.

Explanations:
aa – *Androsacion alpinae*, ac – *Arabidion coerulae*; as – *Astero-Seslerion*; asa – *Astero-Seslerienion*; av – *Androsacion vandelii*; ca – *Caricion atrofusco-saxatilis*; CC – *Caricetea curvulae*; cf – *Caricion firmae*; CK – *Carici rupestris-Kobresietea*, Cv – *Calamagrostietalia villosae*; ES – *Elyno-Seslerietea*; fp – *Festucion picturatae*; fv – *Festucion versicoloris*; jt – *Juncion trifidi*; LV – *Loiseleurio-Vaccinietea*; NS – *Nardetea strictae*; ns – *Nardion strictae*; Oe – *Oxytropido-Elynetalia*; oe – *Oxytropido-Elynion*; Pc – *Potentilletalia caulescentis*; pc – *Potentillion caulescentis*; pt – *Papaverion tatrici*; SH – *Salicetea herbaceae*; Sh – *Salicetalia herbaceae*; st – *Seslerion tatrae*; tf – *Trisetion fusci*. C – characteristic taxon; D – differential taxon; T – transgressive taxon; reg. – regional diagnostic taxon, in another area it should have a different coenological status or it does not occur; + – occurence with frequency lower than 0.5 %.

nus, *Mnium thomsonii*, *Plagiochila porelloides*, *Pohlia cruda*, *Racomitrium canescens*, *Scapania cuspiduligera*, *Timmia austriaca*, *Tortella tortuosa* and *Tritomaria quinquedentata*.

***Festuco versicoloris-Oreochloetum distichae* PAWŁOWSKI et STECKI 1927 nom. corr. et nom. invers. propos. hoc loco**
Tab. 1, column 2
Original form of the name: *Disticheto-Varietum* PAWŁOWSKI et STECKI 1927 (art. 42, 43)
Nomenclatural type: PAWŁOWSKI et STECKI (1927, Tab. 6, r. 7), lectotypus
Synonyms: *Disticheto-Varietum* PAWŁOWSKI 1928 p. p. (art. 2b, 31), *Versicoloretum tatricum* PAWŁOWSKI 1935 p. p. min. (art. 34a)
Non: *Seslerio tatrae-Festucetum versicoloris* PAWŁOWSKI et STECKI 1927 corr. KLIMENT et al. 2005

Characteristic taxon: *Dianthus glacialis* (transgr.)
Differential taxa: *Avenula versicolor*, *Bistorta major*, *Festuca supina* (dom.), *Hieracium alpinum*, *Luzula alpinopilosa* subsp. *obscura*, *Oreochloa disticha* (subdom.), *Potentilla aurea*, *P. crantzii*, *Pulsatilla scherfelii*, *Salix hastata*, *Senecio abrotanifolis* subsp. *carpathicus*, *Cetraria cucullata*, *Cladonia gracilis*, *C. rangiferina*, *Pleurozium schreberi*

The *Oreochloo-Distichetum* is closed, two-layered cushion-sward community rich in species. The stands are typically dominated by species *Festuca supina* and *Silene acaulis*; *Oreochloa disticha* and *Minuartia sedoides* play role of subdominants. Numerous arctic-alpine and boreal species (e.g. *Bistorta major*, *B. vivipara*, *Carex atrata*, *Cerastium eriophorum*, *Hedysarum hedysaroides*, *Juncus trifidus*, *Ligusticum mutellinoides*, *Pedicularis oederi*, *Saussurea alpina* etc.) occur in this community – all with lower cover but high constancy. In the well-developed cryptogamic-layer, *Hylocomium splendens* has the highest cover and constancy. *Pleurozium schreberi*, *Polytrichum alpinum, P. strictum*, *Rhytidiadelphus triquetrus*, *Ptilidium ciliare* and lichens *Cetraria islandica*, *C. cucullata* and *Cladonia rangiferina* are also frequent.

The stands of this association most frequently occur on marl limestone, and only very rarely on limestone and dolomite in the alpine belt. They are found in extremely windy habitats, both on flat ridges or gentle slopes, less frequently in the scarp positions. Soils are medium deep to deep, with layer of raw humus on surface. The community has character of arctic-alpine high-mountain tundra.

Presence of acidophilous (sub)species, such as *Agrostis pyrenaica*, *Avenula versicolor*, *Campanula alpina*, *Juncus trifidus*, *Oreochloa disticha*, *Potentilla aurea*, *Pulsatilla scherfelii*, *Senecio *carpathicus* and the like, indicates relatively close syngenetical relationships to the acidophilous alpine communities of the *Juncion trifidi*.

We propose to correct and to invert the name of the association *Disticho-Varietum* described by Polish authors PAWŁOWSKI & STECKI (1927) to the name *Festuco versicoloris-Oreochloetum distichae*. The species *Festuca varia* do not occur in the Western Carpathians.

***Festucetum versicoloris* DOMIN 1929**
Tab. 1, column 3; Tab. 3
Nomenclatural type: DOMIN (1929: 8), lectotypus
Synonym: *Versicoloretum tatricum* PAWŁOWSKI 1935 p. p. min. (art. 34a)
Non: *Festucetum versicoloris* DOMIN 1933, *Seslerio tatrae-Festucetum versicoloris* PAWŁOWSKI et STECKI 1927 corr. KLIMENT et al. 2005

Differential taxa: *Cardaminopsis arenosa* agg.[1], *Crepis jacquinii*, *Delphinium oxysepalum*, *Dianthus glacialis*[1], *Helianthemum grandiflorum*[1], *Leontodon pseudotaraxaci*[1], *Luzula sudetica*[1], *Myosotis alpestris*[1], *Parnassia palustris*[1], *Pedicularis verticillata*[1], *Phyteuma orbiculare*[1], *Ranunculus alpestris*[1], *Salix reticulata*[1], *Saussurea alpina*[1], *Saxifraga aizoides*[1], *Scabiosa lucida*[1], *Sesleria tatrae*[1], *Swertia perennis* subsp. *alpestris*[1], *Thymus pulcherrimus*[1], *Didymodon asperifolius*, *Distichium capillaceum*[1], *Hylocomium splendens*[1], *Hypnum bambergeri*, *Sanionia uncinata*[1], *Solorina bispora*[1], *Tritomaria quinquedentata*[1]

Festucetum versicoloris is a cushion-sward community with open to nearly close canopy. It is very species-rich (64 taxa per relevé on the average). The dominanting *Festuca *versicolor* and *Silene acaulis* determine the physiognomy of the stands. *Bistorta vivipara*, *Minuartia sedoides*, *Ranunculus breyninus* and *Saxifraga paniculata* regularly attain higher values of cover. Occurrence of species *Oxytropis carpatica* and *O. halleri* is symptomatic for stands of this association. Species-rich and well-developed layer of cryptogams is build mainly by lichens such as *Dactylina madreporiformis*, *Thamnolia vermicularis* and *Vulpicida tubulosus*, and also by mosses *Entodon concinnus*, *Hypnum bambergeri*, *Ctenidium procerrimum* and *Schistidium apocarpum* agg.

This community occurs on slight to steep, mainly south- to west-facing, rocky slopes in the alpine belt of the Belianske Tatry Mts. It occupies very shallow to medium deep, humus-rich soils, sometime affected by solifluction, and having lightly alkalic to slightly acidic soil reaction on spotted shale (= Allgäu-Schiefer), marl limestone or rarely on neighbouring quartzite.

In habitats with shallow soil, the stands are similar in floristic composition and habitat conditions to the *Oxytropido carpaticae-Elynetum* and to some rocky-fissure communities. On deeper soils on less-inclined

[1] Differential taxa against the association *Oxytropido carpaticae-Elynetum*

Table 2. *Pyrolo carpaticae-Salicetum reticulatae* Petrík ass. nov. subass. *biscutelletosum laevigatae* subass. nov. (r. 1–12, frequency C1); subass. *saxifragetosum moschatae* subass. nov. (r. 13–35, frequency C2)

Number of relevé			000000000111 111111122222222222333333			
			123456789012 345678901234567890123 45			
Number of taxa			556445667665 766766756566566666566767	C1	C2	C
			451786043718 000265593435732048631 52	%	%	%
Diagnostic taxa of the association						
oe	*Pyrola carpatica*	T	**++1+.+1+++++ a1++11+1..1mm1++....11+**	92	74	80
ca	*Tofieldia pusilla* (reg.)	C	**........++.. ....m..........1**	17	9	11
ca	*Carex atrofusca* (reg.)	C	**.......... ..r..........1....+..**	0	13	9
	Arctous alpina (reg.)	C	**.......... ....31.....**	0	9	6
ac	*Saxifraga wahlenbergii*	D	**+11+++++a+++ +++1+.+r+.r+11.1+11a111**	100	87	91
	*Swertia *alpestris*	D	**a11+++1+a1rr 1bbba1b1.a+++b1+..+1++1**	100	87	91
	Selaginella selaginoides	D	**1+++++++1+++ ++111+1+.++++1+.....+1+**	100	74	83
	Sanionia uncinata (E_0)	D	**+b...+++++1. 1a1m1+1+++.+1111+111..+**	67	87	80
	Dicranum spadiceum (E_0)	D	**ba11a.111.1. b.11.1.....+..+1.m1.m**	75	43	54
	Coeloglossum viride	D	**++..1...++++ .+.r..++...+.11.....1**	58	35	43
	Meesia uliginosa (E_0)	D	**......+..... ++.++.....+....1...+..1**	8	35	26
Differential taxa of the subassociations						
cf	*Pinguicula alpina*	D	**+.++1+..+r++** ....1+.........1	75	13	34
	Ranunculus thora	D	**...+r+..++++** ...+.........b3........	58	13	29
ES	*Biscutella laevigata*	D	**...+++.++++++**	67	0	23
	Campylium chrysophyllum (E_0)		**1..++111++..** ....1.....	67	4	26
ES	*Belliadiastrum michelii*		**1+++a...+...** .1.....	50	4	20
	Tofieldia calyculata		**a+..1...+r..**	42	0	14
Oe	*Saxifraga moschata*		......++++.. **++a1a11b111+1...+1+a+++**	33	87	69
	Blepharostoma trichophyllum (E_0)	D	......++.... **+++++++.++1.+.1+...1.++**	17	70	51
	Campylium stellatum (E_0)		..... **1a1m.1+.+...+..m111b1bm**	0	70	46
CC	*Festuca supina*		..... **+.1.111b+a+11..+++.1...**	0	65	43
	Rhytidium rugosum (E_0)		...+.......+ **+.+.1.....+++..b+11+1+.**	17	57	43
	Timmia austriaca (E_0)		......1.+... **+++++.b++.....+.++.1**	17	52	40
	Tritomaria quinquedentata (E_0)		..... **++.+..1.1+1..+1....++++**	0	57	37
Oe	*Antennaria *carpatica*		..... **...+.1.+++aa.....++++**	0	48	31
CK	*Luzula *mutabilis*		..... **..+....++.r++...+.++.+.**	0	43	29
	Saussurea alpina		..... **r.+..a.1.+.+1.....++...**	0	39	26
	Isopterygiopsis pulchella (E_0)	D	..... **+++.+++++....+.....**	0	39	26
	Polytrichum formosum (E_0)	D	..... **..11..b...m+3.....1+**	0	35	23
Oxytropido-Elynion						
	Minuartia pauciflora (reg.)	T	111+111a1+1+ 1+aa1a1++11+a+.1aaa1a1a	100	96	97
	Minuartia sedoides	T	.1+abb1bb311 1.a1ab11a111a1+ba1+abab	92	96	94
	Cerastium eriophorum	T	+.11++111+++ +1a1aa+b+..+1a+11+111.a	92	87	89
	Carex fuliginosa	T	..1..++1r.ba 11+1+1++++a+1.1a1++1111	58	96	83
	Androsace chamaejasme	C	1.+..+++..11 ...+1m+++a111.m+1++.+11	58	78	71
	Rhodax alpestris	C	+.++11++.+11 ...++a...++1...+1.+.a+1	83	52	63
	Vulpicida tubulosus (E_0)	C	.....++ ...+.....+.+..11++.1+.	17	39	31
	Comastoma tenellum (reg.)	C	...r...+.+.. r.r.1.+.....++.....	25	26	26
	Astragalus frigidus	C	....+.....++.....1.1	0	22	14
	Oxytropis carpatica	C	....+.....+a...++.	0	22	14
	Astragalus norvegicus	C	+....+..... .....+.....	17	4	9
	Carex capillaris	C	....1.....+.+	0	13	9
	Dactylina madreporiformis (E_0)	C	....+.+..+..	0	13	9
	Gentiana nivalis (reg.)	T	.....++	17	0	6
ac	*Salix reticulata*	D	3aa1ab333baa 44b43bb33333a13bb33bbb3	100	100	100
	Rhytidiadelphus triquetrus (E_0)	D	a1111ama1b11 3am1b1m+11++11m1++m++b.	100	96	97
ES	*Galium anisophyllon*	D	++++++++++ +11+++b.+++++m+1++++1+.	100	91	94
	Myosotis alpestris	D	.+++..+++.rr +1++++1+++1++++1+++1+++	67	100	89
cf	*Ranunculus alpestris*	D	++++1+++++ +1++++.+..+.+..1++1m1+1	100	74	83
	Poa alpina	D	++.+.++.+.++ ++++++1+.+.+.+.++++++++	67	83	77
	Mnium thomsonii (E_0)	D	1+a.1+++11+. ++1+++m...1+.1+1.+1b1.+	83	74	77
st	*Sesleria tatrae*	D	++..+1.1++++ 11+1+11r++.+.11+....1.1	75	70	71
cf	*Carex firma*	D	343533ba4433 +.rbb1...+...1.1+...bbb	100	52	69
	Saxifraga aizoides	D	+++..+1+..++ ++.+.++.....+.1+++++11	67	61	63
ES	*Phyteuma orbiculare*	D	+1+++++++1.. +1.1+++.....11.....1.+	83	43	57
	Ditrichum flexicaule (E_0)	D	1.1.111+..+. .1+.1+....+....1m111b11	58	57	57
ns	*Luzula sudetica*	D	..++.+r+++.. ++.+++...+...1+....++++	58	52	54
st	*Cardaminopsis *tatrica*	D	.++.r++.+.++ +1.+..1++....++....+..+	67	43	51
ES	*Ranunculus breyninus*	D	+...++.+.... +1.+.1a++r.1+a....+.1.+	33	61	51
pc	*Draba aizoides*	D	.+..... ....+.....++....	8	13	11
cf	*Arenaria tenella*	D	....1+...r.	0	13	9
ES	*Euphrasia salisburgensis*	D	+.....+	17	0	6

Table 2. (continued)

Number of relevé		000000000111 111111122222222222333333 123456789012 345678901234567890123456			
Oxytropido-Elynetalia					
	*Festuca *versicolor* (reg.)	babaa11ba1aa 111bb3a+111a333ab1babaa	100	100	100
	Ligusticum mutellinoides	.+++.+++11++ +.11aa+a1b11ab1+r++++++	83	96	91
	Hedysarum hedysaroides (reg.)	a.1..111.... 3aabb3ab.+a3+..+1a..11a	42	78	66
	Carex atrata	..+.r+r1.+11 +..+11++.b.++aa.+.+.+.+	67	65	66
fv	*Salix retusa* s.l.	.11..1+..+++ +1....3.....1a1..b...1.	58	35	43
	Dianthus glacialis	.......+..rr +.r.+...++.....	25	22	23
	Oxytropis halleri	..... r.....+...+1.+.++.	0	30	20
fv	*Gentiana frigida*	....+.......+...1.r.	0	17	11
	Saxifraga oppositifolia	....+++....	0	13	9
Carici rupestris-Kobresietea					
	Silene acaulis	3b1ba3b3bb11 3343333b3bba4ab33b33333	100	100	100
	Bistorta vivipara	111++11+a1ma aabbabbaa1bbb1mmm11111a	100	100	100
	Pedicularis oederi	111+11111111 1aaa1111a+1111111111+11	100	100	100
	Dryas octopetala	1+ab313aa+44 1+1a1a1.+1b3a+.3b3.b13b	100	87	91
	Loydia serotina	1.+...++..1+ +11111111.a++..m11111m1	50	87	74
	Potentilla crantzii	....r.+.....	0	9	6
Others					
	Soldanella carpatica	111+a111ba++ mb1ma1bmmb+m1m11.+111++	100	96	97
Pc	*Saxifraga paniculata*	+..+.+b1.... 1111.++++.1+1..babbaa1b	42	83	69
	Bartsia alpina	.+1.a+++1+++ +++++.1...+++++.+.....+	83	57	66
CC	*Campanula alpina*	.+...+.11111 +...1+.++b1+a11.+..+...	58	57	57
	Campanula tatrae	.++...+..+.. +.1+++++++..+..+.++.1++	33	70	57
	Primula minima	..+....+.+11 ....++.++.b+m.1++..+++1	42	61	54
CC	*Carex *silicicola*	....1.++1+.. ++.++.+.++...11....+++.	42	52	49
LV	*Vaccinium vitis-idaea*	..++1.+...++ m..1.....1b1+.1.....++1	50	43	46
	Pedicularis verticillata	+++..++.+.++ ++.++++.......+.....1..	67	35	46
aa	*Saxifraga hieraciifolia*	.....rr+.... ..1+r..a1+r+1......+...	25	43	37
pt	*Pritzelago alpina*	r+1..1+.+1.. ++..........+.....+1...	58	22	34
aa	*Saxifraga androsacea*	..+...+.++.. .+++..m+1.........+....	33	30	31
	Bistorta major	.r.+...+.... .....11++1..+.+........	25	30	29
	Parnassia palustris	a+++.....+.. ...+.+.......++.....+..	42	22	29
	Viola biflora	+11.r+..1... ....1...b1........	50	13	26
jt	*Juncus trifidus*	.......+..++ ....1+..a.1....+...	25	22	23
CC	*Oreochloa disticha*	.........+.. ....1bb++1.1........	8	30	23
SH	*Luzula *obscura*	.........+.. ......++1r.++1.........	8	30	23
ac	*Leontodon pseudotaraxaci*	.1......1+.. .1.+..+......+.........	25	17	20
cf	*Chamorchis alpina*	.....+....++ ....+..........++	25	13	17
pt	*Cerastium *glandulosum*	..+....+.... ..1..111..............	17	17	17
	Huperzia selago	..+......+++ ....1..+.........	33	9	17
	Homogyne alpina	.+.......+.. ......a.+....am........	17	17	17
	Cardaminopsis arenosa agg.	......+..... ..+.......++......++...	8	22	17
cf	*Salix alpina*	+..+.+...... .....a.......b.........	25	9	14
pc	*Crepis jacquinii*	+...+....... ....+.......+.	17	9	11
Bryophytes & Lichens					
	Hylocomium splendens	b3baabbba3ba 33bb3b35b313bm3b13mbbb3	100	100	100
	Cetraria islandica	+++++1++++11 +++1+m++1+++..1.1++++++	100	87	91
	Tortella tortuosa	+.++++m1.... +++11+...+.+...mmm11b+.	58	65	63
	Distichium capillaceum	++1...+1.++. +.+++++...+.....++.b++b	58	57	57
	Pohlia cruda	..+...1.1.a. ++.++.++++++.+1...+..++	33	65	54
	Plagiochila porelloides	11.++++.+1.. ..+++.....+..++++.++..+	67	48	54
	Ptilidium ciliare	+++.+....+.. ....+.+++++++b.+..++.1.	42	57	51
	Entodon concinnus	1....+++a... +1+........+...++1+.++.	42	43	43
	Polytrichum alpinum	a1+.....1ba. b+...1+.bb....b..+1....	50	39	43
	Thamnolia vermicularis	..+..+.+..1. .....+..+.+....1++++++.	33	43	40
	Dicranum scoparium	.......1.a.. .1.1+....bm3mm.......+.	17	39	31
	Philonotis tomentella	..1...+.11.. 1.1+..............1+.1	33	26	29
	Thuidium philibertii	1.......... .1+..........+.++.+++	8	35	26
	Pleurozium schreberi	..........1+ 1.....1+.+.1.b3........	17	30	26
	Bryum sp.	..... .++++...1..+...+.+.1...	0	39	26
	Scapania cuspiduligera	......+..... 1..++........+.++..1...	8	30	23
	Racomitrium canescens	.+.......... ...+1+.........+1.+.+..	8	30	23
	Orthothecium rufescens	.......+.... ..+..........1+..1+.+	8	26	20
	Hypnum hamulosum	....+..+.1.+.+.+.+.	0	30	20
	Dicranum fuscescens	....1..1+..m...1.11.	0	30	20
	Hylocomium pyrenaicum	..... ++.++.+......11........	0	30	20

Table 2. (continued)

Number of relevé	000000000111 111111122222222222333333 123456789012 345678901234567890123456			
Scapania sp.	1+1+....+... ....+.........+....	42	9	20
Hypnum cupressiforme	.+.+.+...1+. ....+......	42	4	17
Racomitrium lanuginosum	....31m....+...1+	0	26	17
Lescuraea plicata	.... +.+.+.+...........+....	0	22	14
Cirriphyllum cirrosum	....1...........+++..+.	0	22	14
Ctenidium molluscum	....+..11.+...+	0	22	14
Didymodon giganteus	....1+m+...1	0	22	14
Polytrichum longisetum	....1.......1...1+..	0	17	11

Taxa occurring in 1–3 relevés:
E_1: *Achillea *alpestris* + (19); *Aconitum firmum* + (19), r (20); *Adoxa moschatellina* + (19); *Alchemilla* sp. r (20), + (21); *Anemone narcissiflora* r (10), + (21, 27); *Anthoxanthum alpinum* + (19); *Asplenium viride* r (10); *Astragalus alpinus* 1 (35); *A. australis* + (23, 24, 29); *Avenula versicolor* + (19, 21, 27); *Botrychium lunaria* r (18); *Cortusa matthioli* + (19); *Cystopteris fragilis* r (2); *Delphinium oxysepalum* + (20); *Doronicum stiriacum* 1 (21, 32), 2a (25); *Euphrasia tatrae* + (12); *Euphrasia* sp. + (11); *Festuca picturata* 1 (27); *Gentiana verna* + (27); *Hieracium alpinum* + (21), 1 (27); *Juncus triglumis* + (18); *Ligusticum mutellina* 1 (27); *Linum extraaxillare* + (26); *Phleum hirsutum* + (27); *Picea abies* r (3, 4, 9); *Pinus mugo* r (9), + (11, 12); *Potentilla aurea* + (21, 27); *Primula elatior* r (20); *Pseudorchis albida* + (35); *Rhodiola rosea* + (18); *Saxifraga bryoides* + (31); *S. caesia* r (11, 12); *Scabiosa lucida* + (5, 26); *Senecio *carpathicus* 1 (22); *Solidago *minuta* r (3); *Tephroseris capitata* r (26, 31); *T. crispa* + (19, 20); *Thymus alpestris* + (21, 26, 31); *Trollius altissimus* + (19, 22); *Vaccinium gaultherioides* + (23, 24); *V. myrtillus* + (9, 27); *Veronica alpina* + (2).
E_0: *Alectoria ochroleuca* + (11), 1 (12); *Aulacomnium palustre* 1 (10), + (19); *Barbilophozia attenuata* + (13, 21); *B. barbata* + (30); *B. kunzeana* + (14); *B. lycopodioides* 1 (19, 27); *B. quadriloba* + (20); *Barbilophozia* sp. + (9, 10); *Bartramia ithyphylla* + (21); *Biatorella* sp. + (9); *Bryoerythrophyllum recurvirostre* + (30); *Bryum capillare* + (18, 33, 34); *B. capillare* 1 (9); *B. pallescens* + (4, 10); *Caloplaca cinnamomea* + (5); *Catoscopium nigritum* + (4); *Cephalozia bicuspidata* + (23); *Cetraria ericetorum* + (12); *C. nivalis* 1 (12); *Cladonia arbuscula* + (10); *C. coccifera* + (9); *C. furcata* + (9); *C. gracilis* + (8, 9); *C. *pocillum* + (8, 9), 1 (12); *C. squamosa* 1 (12); *C. symphycarpa* + (5); *Cladonia* sp. + (10); *Dicranum acutifolium* 1 (17), 2b (19); *D. bonjeanii* + (35); *D. elongatum* 2m (21); *Distichium inclinatum* + (14, 31); *Drepanocladus revolvens* + (4), 1 (9); *Encalypta alpina* + (28, 29); *Heterocladium dimorphum* + (9, 26, 27); *Homalothecium philippeanum* (8); *Hypnum bambergeri* + (29), 1 (30, 33); *H. lindbergii* + (2); *H. recurvatum* + (3); *H. revolutum* + (30), 2m (31); *Meesia triquetra* + (2, 17), 1 (10); *Megaspora verrucosa* + (5, 8); *Micarea* sp. + (9); *Myurella julacea* + (34); *M. tenerrima* + (29, 31, 35); *Orthothecium chryseon* 2m (30); *Pannaria pezizoides* 1 (9); *Peltigera aphthosa* + (9); *P. leucophlebia* + (5, 10); *Plagiobryum demissum* + (31, 32); *Plagiomnium ellipticum* 1 (26); *P. rostratum* + (35); *Plagiopus oederiana* + (16, 35); *Pogonatum aloides* 2b (25), + (29); *Polytrichum strictum* 2b (3); *Pseudoleskeella catenulata* + (9, 31, 33); *Pseudostereodon procerrimum* + (18); *Racomitrium heterostichum* + (29); *Rhodobryum roseum* + (26); *Rhytidiadelphus squarrosus* + (14, 27), 1 (35); *Scapania aspera* + (25); *S. helvetica* + (18); *Schistidium atrofuscum* + (33); *S. boreale* + (29); *S. trichodon* + (30); *Solorina bispora* + (9); *Sphagnum* sp. + (25); *Tayloria froehlichiana* + (8); *T. lingulata* 1 (9, 32), + (19); *Thelopsis melathelia* + (8); *Thuidium abietinum* + (29); *Th. erectum* + (13, 29).
Explanations: see Tab. 1.

slopes with places this community shows floristic links to the *Festuco versicoloris-Oreochloetum distichae*. In the transitional zone between the alpine and subalpine belt on relatively sheltered habitats, stands showing transtitional features to the *Seslerio tatrae-Festucetum versicoloris* (the *Seslerion tatrae*) occur.

We propose to use the name *Festucetum versicoloris* Domin 1929 for the community with dominant subspecies *Festuca *versicolor* and with presence of species of genus *Oxytropis*. The community represents relic vegetation in alpine belt of the Belianske Tatry Mts. Domin (1933) described similar stands from the Southern Carpathians (Buçegi Mts). Due to differences in the evolution of the local floras, we prefer to consider the *Festuca versicolor* communities of the Western and Southern Carpathians as separate units.

Based on different ecology and floristic composition two subassociations are recognised:

1) *Festucetum versicoloris saxifragetosum oppositifoliae* subass. nov. hoc loco (Tab. 3, rels 1–28; nomenclatural type: Tab. 3, r. 24, holotypus hoc loco) typifies mainly open stands on steep (rarely moderate) slopes with garland soils in ridge positions of the Belianske Tatry Mts. More rocky habitats and openness of stands are well-indicated by differential species *Arenaria tenella*, *Artemisia eriantha*, *Campanula cochlearifolia*, *Carex capillaris*, *C. firma*, *Crepis jacquinii*, *Draba aizoides*, *Euphrasia salisburgensis*, *Saxifraga oppositifolia* and *Trisetum alpestre*. Mosses, such as *Ctenidium procerrimum*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Entodon concinnus*, *Hypnum bambergeri*, *Mnium thomsonii*, *Myurella julacea*, *Plagiochila porelloides*, *Schistidium apocarpum* agg., and lichen *Dactylina madreporiformis* differentiate this subassociation in the cryptogamic layer.

Stands of the subassociation on sunny rocky ridges with very shallow soil, ecologically and floristically similar to the *Oxytropido carpaticae-Elynetum*, are singled out as a **variant with *Aster alpinus*** (Tab. 3, rels 1–14), characterised by differential (sub)species *Aster alpinus*, *Bupleurum ranunculoides*, *Chamorchis alpina*, *Gentianella lutescens*, *Primula *hungarica*, *Sedum atratum* and *Psora decipiens*. The **variant with *Saxifraga wahlenbergii*** (Tab. 3, rels 15–28) is positively differentiated by hygrophilous scree species such as *Pritzelago alpina*, *Ranunculus alpestris*, *Saxifraga wahlenbergii* and moss *Campylium stellatum*.

Table 3. *Festucetum versicoloris* DOMIN 1929 subass. *saxifragetosum oppositifoliae* subass. nov. (r. 1–28, frequency C1); subass. *caricetosum atratae* subass. nov. (r. 29–39, frequency C2) variant with *Aster alpinus* (r. 1–14); variant with *Saxifraga wahlenbergii* (r. 15–28)

Number of relevé			00000000011111 11111222222222 23333333333				
			12345678901234 56789012345678 90123456789				
Number of taxa			67567646555566 66755665577686 67655677645	C1	C2	C
			70983595332945 27526669856394 78658760051	%	%	%
Differential taxa of the association						
pt	*Delphinium oxysepalum*	D	+r....++.+r.. ..+.+1..+..... .++.+1+.+..	36	55	41
	Didymodon asperifolium (E_0)	D	...a..+1....1+ ....++...1+ ..+.b.....	32	18	28
Differential taxa of the subassociations						
	Ditrichum flexicaule (E_0)		11.11+++1+++11 bba1.11a1a1a1+ ..+++.....	93	27	74
oe	*Dactylina madreporiformis* (E_0)		.++++++1+11+11 ++..11+11+++.. +.........	82	9	62
ES	*Euphrasia salisburgensis*		++++++++++++++ +++....++++.+ ...+1.+....	79	27	64
cf	*Arenaria tenella*		1+.11a11a1a1++ .1....++1+11++ ....+1	79	18	62
Oe	*Saxifraga oppositifolia*		........++++++ +a.a+11++++11+ ....+...	68	9	51
	Entodon concinnus (E_0)		.+.++.+++...++ +++..++.+1+++1 .+..1a.....	68	27	56
cf	*Carex firma*		..+...1++1+++3 ..+...++.+331+ ....+.a	61	18	49
	Myurella julacea (E_0)		++.+++....+.++ ..+.++++.+.+++	61	0	44
pc	*Draba aizoides*		....+++.++.... 11.1+m+1.++++. +.........+	57	18	46
	Schistidium apocarpum (E_0)		.+.+.+..++..+1 .++..++++.++.+ ..+........	57	9	44
	Pseudostereodon procerrimum (E_0)		.+.+1+.+.+..1+ 1.....1.+1++1+	57	0	41
pc	*Crepis jacquinii*	D	+11..+b+aab1.+ .....+.+.1+..1	57	0	41
	Mnium thomsonii (E_0)		1+.+........+. a+1+.+++.1++1. ++........	54	18	44
	Distichium capillaceum (E_0)		.+.1+...+..... 1.+++++.+++++.	54	0	38
pc	*Artemisia eriantha*		.....1..r1+r.+ +1..++.1++r...	50	0	36
	Plagiochila porelloides (E_0)		+++++..+..... ..+..+++...+++	46	0	33
oe	*Carex capillaris*		1a++11...+..b. ..1.+..1+..... ...1.....+.	43	18	36
	Hypnum bambergeri (E_0)	D	...+...a.....+ .+...+++.11a++ ..++.....	43	18	36
pc	*Trisetum alpestre*		+...+.+..1+++. .+......++....	36	0	26
pc	*Campanula cochleariifolia*		.....++.++...+ ....1.+1..	29	0	21
	Cetraria islandica (E_0)		....+..1..+.++ ++.+.....+... +1++++aa+++	32	100	51
Oe	*Carex atrata*		......r++...+. ....+..... +.++...+1+1	18	64	31
CC	*Campanula alpina*		.......+..... +.1++......... ++1+.+1..r.	18	64	31
ns	*Luzula sudetica*		+++....+..... .....+........ +++.+1++...	18	64	31
	Sanionia uncinata (E_0)		....+..1.....+. 1a+.+1a.+..	11	64	26
CC	*Oreochloa disticha*		....1+........+. b+11.+a....	11	55	23
	Soldanella carpatica		....+ +m..+..+++.	4	55	18
Oe	*Dianthus glacialis*		.... +.+.........+. m+...+1..+.	11	45	21
CC	*Avenula versicolor*		....+.......... .+.++++....	4	45	15
fp	*Doronicum clusii*		....+. +11..++....	4	45	15
CK	*Potentilla crantzii*		....+........ +.++...++..	4	45	15
aa	*Saxifraga hieraciifolia*		.... r............ rr...+r+...	4	45	15
	Pogonatum urnigerum (E_0)		....+........ 1+.1.++....	4	45	15
	Trifolium orbelicum		....+........ ++1..++....	4	45	15
SH	*Luzula *obscura*		.... .r+..++...1	0	45	13
st	*Tephroseris capitata*		....1..b+++..	0	45	13
	Polytrichum strictum (E_0)		.... .1++.+a....	0	45	13
	Ptilidium ciliare (E_0)		.... a+..+1a....	0	45	13
LV	*Vaccinium vitis-idaea*		....+...+1.r	0	36	10
Differential taxa of the variants						
as	*Aster alpinus*		111..+...1a1..	25	0	18
asa	*Bupleurum ranunculoides*		1+1++......++.	25	0	18
	Gentianella lutescens		.+.++..+.+++..	25	0	18
	Psora decipiens (E_0)		+..+++.....+++ .+............	29	0	21
cf	*Chamorchis alpina*		..1r.+...+..+. ....r...	21	0	15
pc	*Primula *hungarica*		.+.r.+.r.1....	18	0	13
ac	*Sedum atratum*		+..+.....+.+..	14	0	10
ac	*Saxifraga wahlenbergii*		.... 1++1.++..++1++ +1..r..r...	39	36	38
cf	*Ranunculus alpestris*		.........+...+ +m+1..++++mm++ ++......+..	50	27	44
pt	*Pritzelago alpina*		....+.+...+..++..	18	0	13
	Campylium stellatum (E_0)		......++...... ++1......++1+. ....+.....	32	9	26
Oxytropido-Elynion						
	Androsace chamaejasme	C	mbm1mm+1m.bm1+ m++mmmmam1++m1 b1bmmmm+aa1	96	100	97
	Rhodax alpestris	C	.a1+1++111++11 ..+.+.++.+11+a .+++b.a++11	79	82	79
	Oxytropis halleri	C	11+1a+....++a1 1+a.a1+b.1+.1a b1a13ba+...	75	73	74
	Vulpicida tubulosus	C	.++.++.b++1+1+ +1+.1+1+1+++1+ ++.+.....+.	86	36	72
	Oxytropis carpatica	C	1.....+aa11b.1 ......+++r+++1 .++....+...	57	27	49
	Comastoma tenellum	C	+++.+.+.....r. ..+...++.1..+. .+r+++1....	39	55	44

Table 3. (continued)

Number of relevé			00000000011111 11111222222222 23333333333 12345678901234 56789012345678 90123456789			
	Erigeron hungaricus	C	.+.r1...+..+1. ......+.....+. 1.+..++.+..	29	45	33
	Astragalus frigidus	C	1.........+... ....+.++ ....+...1.1	18	27	21
	Astragalus norvegicus	C	b.1........+.. ......+.+.....	18	0	13
	Pyrola carpatica	C	....++..	0	18	5
ES	*Galium anisophyllon*	D	++1++++11+11++ 1+++1a++.+++++ +11++1++a11	96	100	97
ES	*Ranunculus breyninus*	D	bab111aa1+a11+ b.++aa111b.+1+ a+b11b+.aa1	93	91	92
	Poa alpina	D	+1+.+++1+.+.++ ++.++1+11++.+1 +++++++1++1	82	100	87
	Myosotis alpestris	D	1+++..+++..... 1.+r1++.++++++ ++a+1m++++1	68	100	77
ES	*Phyteuma orbiculare*	D	11b11+...+.+++ .++......++.+. ++1++++11+.	54	91	64
	Saxifraga aizoides	D	11....1+++1++1 +++...1++a111+ .+..+...++.	75	36	64
st	*Sesleria tatrae*	D	+++.+++++.++.+ .....+.+...+.+ .+a+.+.a3++	54	73	59
ac	*Salix reticulata*	D	.+.....1..+..+ ..1+..+..+1++1 abb.a.b1b+a	43	82	54
ES	*Thymus pulcherrimus*	D	11...++.++a1+. +...+a.1.+.... .+.1++1.+..	50	55	51
	Rhytidiadelphus triquetrus (E_0)	D	....+ +1.....+...	4	27	10
Oxytropido-Elynetalia						
	*Festuca *versicolor*		433b3aa33a3b31 3bab3bbb33aa3b b133ba14445	100	100	100
	Cerastium eriophorum		a111+1a11++1++ a++11a1111++1+ 1aa++1.a111	100	91	97
	Minuartia pauciflora (reg.)		1a11+111+++.++ 1+++1a1a1111a1 b+++1+++111	96	100	97
	Minuartia sedoides		.+111111+++.11 a1baa11abaaaa1 a1a11+b+++1	93	100	95
	Carex fuliginosa		b11+1aa++.r.++ ++ab1.b1a111a1 +++1...+1a1	89	73	85
	Ligusticum mutellinoides		+++...+++..... 1+++aa+++++..+ b111+b1++11	64	100	74
	Saxifraga moschata		1++++1....+... +.+.+1+++1..1. 1b1+1b1+++1	57	100	69
	Hedysarum hedysaroides		1++.+.a....+.. 1.+...+.++..aa .1b+...+111	46	64	51
	Saussurea alpina (reg.)		1.1...1+++.+.. ...+ab..1+..1. ++1....+.+.	46	45	46
	*Antennaria *carpatica*		..+.+..+..+... ..+.+.++....++ ++++.++.1.+	36	73	46
	Gentiana nivalis		.+++++........ ..+.........+. ..r..++....	25	27	26
	Agrostis alpina		.+b.++.....+.. ..1.......... ...+.......	21	9	18
fv	*Salix retusa*		....+......+... ......1+.+1	7	36	15
	Saussurea pygmaea		....1r........ .....+.....	7	9	8
fv	*Gentiana frigida*		.... +..+........+.	11	0	8
Carici rupestris-Kobresietea						
	Bistorta vivipara		11a11b1111+a++ ++1+a11aaa+1am b1bam+m+a11	100	100	100
	Silene acaulis		b3a3b33bbb33b3 3b433b33333333 34333bb+1a.	100	91	97
	Pedicularis oederi		1a11a1++111aa+ 1++.a11a+1+11a a1a.1aa+1++	96	91	95
	Lloydia serotina		m.m1+m1+1+11+1 mmmmbm1amm11mm amm1mm1++.1	96	91	95
	*Luzula *mutabilis*		+1+.+..+....+. +..11.++.+.... 11++1+1+.+1	43	91	56
	Dryas octopetala		......++....++ ....+1++a ...+..1+a+b	32	55	38
	Elyna myosuroides		....+.........	4	0	3
Others						
Pc	*Saxifraga paniculata*		bb1bbb1a11abab 1a+bbb1abbbba3 bbbabbba1+1	100	100	100
	Campanula tatrae		111r+11+++++.+ a11++++++1+++. +++1+1++.+.	93	82	90
tf	*Rhodiola rosea*		a+1+++1+1++1.+ .++r+1+.+++++1 .+1.+a+.++.	89	64	82
CC	*Festuca supina*		....++..+...++ +11+1.+++++1.. b+.1.11+...	57	55	56
	Thymus alpestris		1.1+1..+1....+ ....+1+.+.1+++ 1++.11a+...	54	65	56
CC	*Primula minima*		..+++.......++ .+a1+.++.++.+. 1+.m+.+..+1	50	64	54
	Pedicularis verticillata		1+..+++a1+.1.. +.+......+++.+ ....+1.+	54	27	46
ac	*Leontodon pseudotaraxaci*		+++++......1.+ ++.......1+++. .+.+..+.+..	46	36	44
	Parnassia palustris		11++1......+.. ..+.+.......+. ..+++11+1.1	32	73	44
	Bartsia alpina		..1+.+++.+.... ..+.......+..+ +++1..+.+..	32	55	38
jt	*Juncus trifidus*		..+.......... .++1+.......+. a11++.a....	21	55	31
	Cardaminopsis arenosa agg.		+..+.......... ++...++..+..+. +++.+.....	29	36	31
	*Carex *silicicola*		.+a..+...+++.. ....+. .++++.+....	25	45	31
	*Swertia *alpestris*		+..+.......+.. +.+.......++++ ....++..	32	18	28
ES	*Helianthemum grandiflorum*		1++++.+....+.. ....+...+. ....+...	32	9	26
ES	*Scabiosa lucida*		1+.+......+++. ....+.++..	21	27	23
ES	*Astragalus australis*		.1+..1.....+.. ....+..... ....+...	18	9	15
st	*Cardaminopsis *tatrica*		....r.........++ 1+......+..	11	27	15
av	*Draba fladnizensis*		+...+.......... .+r+..........	18	0	13
	Alchemilla sp.		+.....+.+..... .+...+.....	11	18	13
	*Poa *carpatica*		....+......... .....+..+..... 1....1.....	11	18	13
pt	*Cerastium *glandulosum*		......+..... .+.....+..... .....++.1	7	27	13
	Selaginella selaginoides		....+.....+..... ......++1.1	4	36	13
	Anthoxanthum alpinum		....++1+....	0	36	10
Bryophytes & Lichens						
	Tortella tortuosa		+1+1b11++++.aa baa1++a1aba1aa .++++.++.1.	96	64	87
	Thamnolia vermicularis		+++.++.1.++.++ +1++11+++11+++ +1++++.+.++	86	82	85
	Rhytidium rugosum		...++.11..... 1.+.....+++.+1 ..+.ab+.1..	39	45	41

Table 3. (continued)

Number of relevé	00000000011111 11111222222222 23333333333 12345678901234 56789012345678 90123456789			
Cladonia sp.	+++.a.....++.. +...+++.+..+++	50	0	36
Polytrichum alpinum	.... +.1+.+.+....+. b1+1+.+....	21	55	31
Didymodon giganteus	+1.+.......... 1+....1..b+1+.	36	0	26
Encalypta alpina	1..........+++ .1++..+.+1....	36	0	26
Cetraria nivalis	.......+...... ...+.+.....+.. ...+.+++.++	14	55	26
Cetraria cucullata	.......+.....+ .....1.+...... ..+..+.+.++	14	45	23
Ctenidium molluscum	......1....... ..1......11++1 ....+...	29	9	23
Solorina bispora	.+.+.+........ ..+....++++... ....+......	29	9	23
Collema sp.	...+.+.+...... .+....+.+11.+.	32	0	23
Cirriphyllum cirrosum	.+.+.......... .+...+...+..++ .+.........	25	9	21
Tritomaria quinquedentata	....+....+....++ ++...++....	14	36	21
Hylocomium splendens	....++........++ 1b.....++..	14	36	21
Cladonia symphycarpa	........++.... ....+..+ +...+.+....	14	27	18
Bryum sp.	....++.+.....+ ....+.+... ......+....	21	9	18
Hypnum hamulosum	....++........ +..+..+.+..... .....+.....	21	9	18
Physconia muscigena	....++..++.... ..+..+........ ..+........	21	9	18
Leptogium sp.	...+.+..++.+.. .+....+.......	25	0	18
Toninia lobulata	....1+....++.. ....++.+.	25	0	18
Cladonia pyxidata	11...1........ .... 1...1.....+	11	27	15
Lepidoma demissum	....+.++.+...... ..+...+....	14	18	15
Hypnum cupressiforme	....+..+...... .+.+........++	21	0	15
Phaeorrhiza nimbosa	.....+......+. ......++..+.+.	21	0	15
Toninia diffracta	........+++.++ ....+..	21	0	15
Toninia sp.	...+++.....+.. ......+...+...	21	0	15
Caloplaca stillicidiorum	.....+..++..+. ......+.......	18	0	13
Marsupella sprucei	...++..+...... ....+...+.....	18	0	13
Plagiobryum demissum	1++1.......... +..........	18	0	13
Polyblastia sp.	...+.......... .+......++.+..	18	0	13
Squamarina gypsacea	...+.......+++ ....+...	18	0	13
Cynodontium polycarpon	....1+11........ ..+........	14	9	13
Orthothecium rufescens	....11++.	14	0	10
Cladonia gracilis	....+++.1..	0	36	10

Taxa occurring in 1–3 (4) relevés:
E_1: *Achillea* **alpestris* + (36, 37); *Aconitum firmum* r (34); *Agrostis pyrenaica* + (35); *Alchemilla glabra* + (36), 1 (39); *A. incisa* + (36, 37); *A. rhodocycla* + (29, 31, 35); *Androsace lactea* 1 (15, 24), + 16); *Astragalus alpinus* 1 (12), + (14); *Bellidiastrum michelii* + (27, 28, 37), 1 (39); *Bistorta major* + (36, 37, 38); *Botrychium lunaria* r (9), + (12, 36); *Carex* **tatrorum* 1 (37, 39); *Cortusa matthioli* 1 (39); *Draba dubia* + (6), r (16); *D. siliquosa* 1 (1), r (3, 21), + (4); *Euphrasia tatrae* + (1); *Euphrasia* sp. + (4); *Festuca picturata* 2a (34); *Gentiana verna* + (2, 4, 8), 1 (39); *Gypsophila repens* + (5); *Hieracium alpinum* + (35); *Huperzia selago* + (17, 18, 30); *Kobresia simpliciuscula* + (7); *Leontopodium alpinum* + (10); *Ligusticum mutellina* + (36); *Luzula multiflora* + (37); *Oxyria digyna* + (16); *Phleum hirsutum* r (36); *Pinguicula alpina* 1 (39); *Ranunculus pseudomontanus* + (36); *R. thora* r (30); *Salix alpina* 1 (8, 38), 2a (36); *Saxifraga bryoides* 2a (18), + (20, 30), 1 (29); *S. carpathica* r (18); *Trollius altissimus* + (37); *Veronica aphylla* + (2, 11, 16); *Viola biflora* r (37), + (38), 1 (39). – **E_0:** *Alectoria ochroleuca* + (19, 38, 39); *Agonimia tristicula* + (25, 26, 28); *Anoectangium tenuinerve* + (23); *Aulacomnium palustre* + (34); *Baeomyces* sp. + (19); *Brachythecium glareosum* + (36); *Bryum caespiticium* + (7); *Caloplaca cinnamomea* + (5, 6, 24); *Caloplaca* sp. + (3, 6); *C. lucifuga* G. Thor 1 (9, 10); *Campylium chrysophyllum* + (20, 36), 1 (28); *C. halleri* + (14, 16); *Campylopus schimperi* + (3, 4, 13, 19); *Catapyrenium* sp. + (5, 11); *Catolechia wahlenbergii* + (2); *Ceratodon purpureus* + (20); *Cetraria ericetorum* + (35); *Cladonia arbuscula* + (36); *C. coccifera* + (19, 31, 32, 35); *C. furcata* 1 (8); *C. macroceras* + (24); *C. rangiferina* + (36); *C. uncialis* + (35); *Cornicularia muricata* + (30, 34); *Desmatodon latifolius* + (20); *Dicranum elongatum* 1 (29), + (33, 35); *D. scoparium* 1 (30); *Didymodon fallax* + (13, 31); *D. ferrugineus* + (26); *Diploschistes gypsaceus* + (16); *Encalypta ciliata* + (3, 26, 27); *E. microstoma* + (5); *E. rhaptocarpa* + (5, 6, 15); *Fulgensia schistidii* + (13); *Grimmia* sp. + (19); *Harpanthus scutatus* + (26, 34); *Hylocomium pyrenaicum* 1 (29); *Hymenostylium recurvirostre* + (1, 27), 1 (24); *Hypnum revolutum* + (14, 20); *H. vaucheri* + (17, 22); *Hypogymnia physodes* + (18); *Hypogymnia* sp. + (20); *Jungermannia atrovirens* + (2, 14, 22, 29); *Lecanora epibryon* + (13, 14, 27, 39); *Lepraria* sp. + (15, 16); *Lescuraea plicata* + (16, 30, 34, 35); *Lophozia bantriensis* + (5); *Megaspora verrucosa* + (8, 13, 14, 17); *Micarea* sp. + (19); *Ochrolechia upsaliensis* + (39); *Peltigera aphthosa* + (27); *Phaeorrhiza* sp. + (6); *Physcia caesia* + (13); *Placidiopsis* sp. + (16, 27); *Placynthium dolichoterum* + (13); *P.* sp. + (25); *Plagiobryum zierii* + (20, 27); *Plagiopus oederiana* 1 (15, 24), + (27); *Platismatia glauca* + (17); *Pleurozium schreberi* + (30, 36); *Pohlia rothii* (Corr. ex Limpr.) Broth. + (29); *P.* sp. 1 (1); *Protoblastenia terricola* + (21); *Pseudevernia furfuracea* + (17, 18), 1 (20); *Pseudoleskeella catenulata* + (13, 23, 25); *Psora* sp. + (9, 10); *Psoroma hypnorum* + (35); *Racomitrium canescens* + (8, 20, 33, 35); *R. lanuginosum* + (4, 33); *Rhytidiadelphus squarrosus* + (30); *Scapania curta* + (5); *S. cuspiduligera* + (8, 20, 21, 25); *S. subalpina* + (29); *Solorina saccata* + (14, 15); *S. spongiosa* + (11, 12); *Solorina* sp. + (13); *Stegonia latifolia* 1 (5), + (11, 12, 22); *Thelopsis melathelia* + (14, 16, 18, 26); *Thuidium abietinum* + (25, 27, 28), 1 (34); *Th. philibertii* + (27); *Timmia austriaca* + (1, 15, 16, 24); *Toninia opuntioides* + (13, 14); *T. sedifolia* + (25); *Trichostomum crispulum* + (12, 24, 26); *Xanthoria elegans* + (6, 16).

Explanation: see Tab. 1.

2) *Festucetum versicoloris caricetosum atratae* subass. nov. hoc loco (Tab. 3, rels. 29–39; the nomenclatural type of this subassociation is identical with that of the association) typifies nearly closed stands, usually with rich in mosses. They occur on moderately inclined rocky slopes and stabilised screes (sometimes with admixture of quartzite rubble) with relatively deeper soils. The group of differential species consists of acidophilous (sub)species such as *Avenula versicolor*, *Campanula alpina*, *Carex atrata*, *Dianthus glacialis*, *Doronicum stiriacum*, *Luzula *obscura*, *L. sudetica*, *Oreochloa disticha*, *Saxifraga hieraciifolia* and *Soldanella carpatica* as well as *Potentilla crantzii*, *Tephroseris capitata*, *Trifolium orbelicum* and *Vaccinium vitis-idaea*. *Cetraria islandica* represents the most constant lichen, while *Pogonatum urnigerum*, *Polytrichum strictum*, *Ptilidium ciliare* and *Sanionia uncinata* are the most common bryophytes in this community. Syntaxonomically, this subassociation shows similarities with the *Festuco versicoloris-Oreochloetum distichae*.

***Drabo siliquosae-Festucetum versicoloris* Petrík ass. nov. hoc loco**
Tab. 1, column 5; Tab. 4
Nomenclatural type: Tab. 4, r. 6, holotypus hoc loco

Characteristic taxon: *Draba siliquosa*
Differential taxa: *Anthoxanthum alpinum*, *Astragalus australis*, *Carduus glaucinus, Helianthemum grandiflorum*, *Linum extraaxillare*, *Parnassia palustris*, *Poa nemoralis* subsp. *carpatica*, *Saxifraga adscendens*, *Tephroseris capitata*, *Campylopus schimperi*, *Plagiobryum demissum*, *Plagiopus oederiana*, *Plagiothecium laetum*

The species *Draba siliquosa* has its coenological optimum in the Western Carpathians in nearly close sward communities. Large ecological and species differences of these ones from all relevant communities described so far were the reason for description of the new association *Drabo siliquosae-Festucetum versicoloris*.

The *Drabo-Festucetum versicoloris* is very species-rich community dominated by *Festuca *versicolor*, while *Cerastium eriophorum*, *Helianthemum grandiflorum*, *Linum extraaxillare* and *Rhodiola rosea* are also prominent. High constancy of *Agrostis alpina*, *Aster alpinus*, *Astragalus australis*, *Bupleurum ranunculoides*, *Erigeron hungaricus* and absence of creeping and prostrate dwarf shrubs such as *Dryas octopetala* and *Salix reticulata* are also significant features for this community. The moss layer has a high number of mosses and occasssional lichens, usually having low cover.

The *Drabo-Festucetum* prefers convex parts of relief on steep, south- to southwest-facing rocky slopes in the alpine belt of the Belianske Tatry Mts. It stands are found over shallow to medium deep, humus-rich and skeleton-poor soils supported by on spotted shale (Lias) and hornstone (Dogger) with typical step-microrelief resulting from accumulation of fine soil particles in tufts of the dominant grass.

Constant presence of *Anthoxanthum alpinum*, *Helianthemum grandiflorum*, *Linum extraaxillare*, *Parnassia palustris* and *Tephroseris capitata* reflects close relations of this association to the communities of the *Seslerion tatrae* and indicates its marginal position within the *Oxytropido-Elynion*.

Discussion and conclusions

Great number of co-occurring arctic-alpine geoelements, relic nature of the habitats in alpine and subnival belt of the highest mountains of the Western Carpathians (Tatra Mts), and floristic analyses and comparisions with existing literature served as reasons for classification of the studied communities into the arctic-alpine class of *Carici rupestris-Kobresietea*. These communities are distributed widely in the circumpolar arctic and boreal regions (Ohba, 1974) and they also occur in the Alps, Carpathians, Apennines, Pyrenees and some mountains ranges of the Balkans (Coldea, 1997; Grabherr, 1993; Malynovski & Kricsfalusy, 2002; Rivas-Martínez et al., 2002; Roussakova, 2000).

We found that the communities occurring at the highest altitudes of the Belianske Tatry Mts on neutral to moderately basic bedrock are different from the communities occurring in similar habitats on mylonite (neutral to moderately acid bedrock) in upper alpine to subnival belts of the Vysoké Tatry Mts (rarely Západné Tatry Mts). The former group of communities is classified as the alliance *Oxytropido-Elynion*, while the latter group belongs to the *Festucion versicoloris*. The *Festucion versicoloris* is differentiated by acidophilous taxa (*Doronicum stiriacum*, *Leucanthemopsis *tatrae*, *Oreochloa disticha*, *Pulsatilla scherfelii* etc.) as well as by some taxa typical for the mylonite zone (or subnival belt) of the Vysoké Tatry Mts, including *Cardaminopsis neglecta*, *Gentiana frigida*, *Poa laxa*, *Saxifraga bryoides*, *S. retusa*. It also lacks basiphilous taxa, such as *Carex firma*, *Hedysarum hedysaroides*, *Myosotis alpestris*, *Ranunculus breyninus*, *Rhodax alpestris* and *Sesleria tatrae* (see Tab. 1). The crucial difference between both groups of communities is the character of the geology.

Potential fusion of both alliances should be confusing. According to the ICPN, the name of the alliance described by Krajina (1933) should have a priority (art. 22). Forasmuch the *Festucion versicoloris* was described from marginal part of natural area of the *Carici rupestris-Kobresietea* and in addition, name-giving subspecies is Carpathian sub-endemit – *Festuca *versicolor*. Therefore, respecting sufficiency of differential taxa in these syntaxa with different geological bedrock, we suggested to use both names in the context mentioned in this article. Šoltés et al. (2001) solved similar situation between the *Oxycocco-*

Table 4. *Drabo siliquosae-Festucetum versicoloris* PETRÍK ass. nov.

Number of relevé			0000000001	
			1234567890	
Number of taxa			6664777755	C
			1329300173	%
Diagnostic taxa of the association				
	Draba siliquosa	C	1mmm111m1m	100
	Anthoxanthum alpinum	D	++++1++11+	100
	Parnassia palustris	D	1111+11111	100
ES	*Astragalus australis*	D	+.1+1a1111	90
ES	*Helianthemum grandiflorum*	D	bba1b1+.a+	90
Cv	*Linum extraaxillare*	D	1a+a11+ba.	90
	Plagiothecium laetum (E_0)	D	++..++++++	80
st	*Tephroseris capitata*	D	11+++.+1+.	80
	*Poa *carpatica*	D	.1++1+.31.	70
	Plagiobryum demissum (E_0)	D	++...+11++	70
	Campylopus schimperi (E_0)	D	.....+1+1+	50
	Plagiopus oederiana (E_0)	D	++b+.....	40
ES	*Carduus glaucinus*	D	1ar.....	30
	Saxifraga adscendens	D	.++.+.....	30
Oxytropido-Elynion				
	Androsace chamaejasme	C	mmm11mbmab	100
	Cerastium eriophorum	T	abab+babba	100
	Saussurea alpina (reg.)	T	1a+a+..11a	80
	Erigeron hungaricus	C	+.+.+++.++	70
	Comastoma tenellum	C	+++..+.+.+	60
	Carex capillaris	C	.1+...1++a	60
	Minuartia pauciflora	T	+.1+.+.+.+	60
	Hedysarum hedysaroides (reg.)	T	a++....+11	60
	Astragalus frigidus	C	++..a..11.	50
	Astragalus norvegicus	C	a1.....a+.	40
	Minuartia sedoides	T	.+...+.+.+	40
	Carex fuliginosa	T	......a1+1	40
	Gentiana nivalis (reg.)	T	.+..+.+...	30
	Oxytropis halleri	C	..+...++..	30
	Oxytropis carpatica	C	+.........	10
	Rhodax alpestris	C	.....+....	10
ES	*Galium anisophyllon*	D	+a1++1+1+1	100
ES	*Ranunculus breyninus*	D	a1a11a1ab1	100
	Myosotis alpestris	D	1111++1b1+	100
st	*Sesleria tatrae*	D	11++++11+.	90
ES	*Phyteuma orbiculare*	D	ba1aa11a1.	90
asa	*Bupleurum ranunculoides*	D	a1111.11+1	90
ES	*Thymus pulcherrimus*	D	+.1.1a.111	70
as	*Aster alpinus*	D	+..11a.111	70
	Mnium thomsonii (E_0)	D	++.++++...	60
ES	*Euphrasia salisburgensis*	D	..++r+++..	60
	Poa alpina	D	+.+..+++..	50
ns	*Luzula sudetica*	D	+.+..+.++.	50
	Ditrichum flexicaule (E_0)	D	..1..+11..	40
st	*Cardaminopsis *tatrica*	D	..+.+..+..	30
	Saxifraga aizoides	D	.+...+....	20
cf	*Arenaria tenella*	D	.+.......+	20
cf	*Carex firma*	D	..+.....	10
Oxytropido-Elynetalia				
	*Festuca *versicolor*		4443344433	100
	Saxifraga moschata		+1++++1a1+	100
	Agrostis alpina		+a++++.1a3	90
	Carex atrata		.1...+.a1+	50
	Ligusticum mutellinoides		.....+1	20
	Saussurea pygmaea		.....+	10
Carici rupestris-Kobresietea				
	Pedicularis oederi		1+1+++a111	100
	Bistorta vivipara		ab11a1+11a	100
	Lloydia serotina		.111++1111	90
	*Luzula *mutabilis*		++++.++11.	80
	Silene acaulis		..b..+++++	60
	Potentilla crantzii		.a..+...a1	40
Others				
	Campanula tatrae		+a++b1+111	100
tf	*Rhodiola rosea*		+a++b1bbbb	100
	Saxifraga paniculata		++b++1++11	100
CC	*Carex *silicicola*		+.a31ba1b+	90
	Pedicularis verticillata		11++++11..	80
	Bartsia alpina		1.11+.1+1.	70
jt	*Juncus trifidus*		...+++++11	70
	Alchemilla sp.		++.1...++.	50
	*Swertia *alpestris*		b1..+.++..	50
	Viola biflora		+1+...+.+.	50
	Thymus alpestris		1..b1.+1..	50
ES	*Scabiosa lucida*		1.1.++.+..	50
	Bistorta major		.+..+..+1+	50
	Cardaminopsis arenosa agg.		..++++...	50
st	*Astragalus alpinus*		+.+..+.1..	40
	Euphrasia tatrae		+++.+.....	40
CC	*Festuca supina*		...+..+.++	40
fp	*Festuca picturata*		...+1++...	40
CC	*Oreochloa disticha*		.....++1.+	40
Cv	*Anemone narcissiflora*		.1.1+.....	30
ac	*Leontodon pseudotaraxaci*		..++...+..	30
ES	*Carex *tatrorum*		aa.....	20
	*Primula *platyphylla*		1...1.....	20
pt	*Cerastium *glandulosum*		.1..1.....	20
pc	*Trisetum alpestre*		.....1+...	20
Bryophytes & Lichens				
	Tortella tortuosa		++a+++b11+	100
	Encalypta alpina		++1+++...+	70
	Myurella julacea		++.++++...	60
	Rhytidium rugosum		+++..++..+	60
	Cladonia sp.		.++.++...+	50
	Hypnum hamulosum		++....++..	40
	Plagiochila porelloides		+...1++...	40
	Pohlia cruda		...++..++.	40
	Trichostomum crispulum		++..1.....	30
	Desmatodon latifolius		.1.....11.	30
	Distichium capillaceum		..+.++....	30

Taxa occurring in 1–2 relevés:
E_1: *Achillea *alpestris* 2a (5); *Aconitum firmum* + (2); *Alchemilla erythropoda* + (5, 7); *Bellidiastrum michelii* + (5); *Bellardiochloa violacea* + (5); *Cortusa matthioli* 1 (2), + (5); *Crepis jacquinii* + (7); *Delphinium oxysepalum* 1 (8); *Doronicum stiriacum* + (10); *Draba fladnizensis* + (3, 7); *Festuca carpatica* + (5); *Gentianella lutescens* + (7, 10); *Geranium sylvaticum* + (5); *Gymnadenia conopsea* r (6); *Leucanthemum vulgare* agg. + (1); *Luzula luzuloides* + (4, 5); *Primula elatior* + (5); *P. minima* + (8); *Solidago *minuta* + (6); *Trifolium orbelicum* + (5). – **E_0:** *Apometzgeria pubescens* + (7); *Bryum elegans* + (3); *Bryum* sp. + (5, 8); *Caloplaca tiroliensis* + (7); *Cetraria islandica* + (5, 6); *Cirriphyllum cirrosum* + (3); *Cladonia coccifera* + (6); *C. furcata* + (2); *C. gracilis* + (6); *C. pyxidata* + (8), 1 (9); *Ctenidium molluscum* + (6); *Encalypta ciliata* + (7, 9); *E. rhaptocarpa* + (8); *E. streptocarpa* + (4, 8); *Entodon concinnus* + (7); *Lepidoma demissum* + (10); *Lepraria* sp. + (9); *Marsupella sprucei* + (10); *Micarea* sp. (+7); *Myurella tenerrima* + (6, 7); *Peltigera venosa* + (5); *Peltigera* sp. + (7, 9); *Placynthium* sp. + (6, 8); *Plagiopus oederi* var. *condensatus* (Brid.) Limpr. + (7); *Pohlia elongata* + (7); *Polytrichum alpinum* + (6); *Pseudoleskeella catenulata* + (7); *Solorina bispora* + (6); *Solorina* sp. + (7); *Thuidium abietinum* + (7); *Timmia austriaca* + (6); *Toninia lobulata* (+7); *Trapeliopsis flexuosa* + (10).
Explanations: see Tab. 1.

Empetrion hermaphroditi NORDHAGEN ex HADAČ et VÁŇA 1967 and the *Eriophorion vaginati* KRAJINA 1933.

The numerical classifications suggest that the *Festucetum versicoloris*, *Oxytropido-Elynetum* and *Drabo*

siliquosae-Festucetum versicoloris are relatively similar. The *Oxytropido carpaticae-Elynetum* represents the most typical community of the *Carici rupestris-Kobresietea* in the Western Carpathians, however it is developed only fragmentarily (cf. Petrík et al., 2005). The other two associations are more influenced by neighbouring vegetation (by communities of the alliances *Caricion firmae* and *Seslerion tatrae*). Based on results of numerical analyses, total floristic composition and relic type of habitats we classify these communities as individual associations within the one alliance *Oxytropido-Elynion*.

The *Salicetum kitaibelianae* seems to be the most aberrant syntaxon of the studied group. This community shows transitional characters (floristically and ecologically) of several high-rank syntaxa including the *Festucion versicoloris* and the*Loiseleurio-Vaccinion*. It occupies scree habitats below the steep rocky cliffs on mylonite or acidic granit bedrock. The dominant species *Salix kitaibeliana* represents microspecies from broadly defined group *Salix retusa* agg. We prefer to treat this community tentatively as member of the *Carici-Kobresietea* (the *Festucion versicoloris*), as suggested by the numerical classification and in accordance with its original classification by Hadač (1956).

Comparison of the communities dominated by *Festuca *versicolor* showed, that the *Seslerio tatrae-Festucetum versicoloris* (the *Seslerion tatrae*) differs from the *Festucetum versicoloris* (the *Oxytropido-Elynion*) by presence and/or higher constancy of *Anemone narcissiflora*, *Anthoxanthum alpinum*, *Avenula versicolor*, *Bellidiastrum michelii*, *Carex *tatrorum*, *Cerastium *glandulosum*, *Gentiana verna*, *Helianthemum grandiflorum*, *Homogyne alpina*, *Leontodon hispidus*, *Ligusticum mutellina*, *Oreogeum montanum*, *Parnassia palustris*, *Potentilla aurea*, *P. crantzii*, *Primula elatior*, *Ranunculus pseudomontanus*, *Scabiosa lucida*, *Selaginella selaginoides* and *Soldanella carpatica* (Kliment et al., 2005). On the other hand *Arenaria tenella*, *Artemisia eriantha*, *Carex fuliginosa*, *Cerastium eriophorum*, *Euphrasia salisburgensis*, *Ligusticum mutellinoides*, *Lloydia serotina*, *Luzula *mutabilis*, *Minuartia pauciflora* (Kit. ex Kanitz) Dvořáková (syn.: *M. gerardii* auct. carpat. non Willd.), *M. sedoides*, *Oxytropis carpatica*, *O. halleri*, *Primula minima*, *Ranunculus alpestris*, *Rhodax alpestris*, *Saussurea alpina*, *Saxifraga oppositifolia*, *Thymus alpestris*, *Dactylina madreporiformis*, *Ditrichum flexicaule*, *Thamnolia vermicularis* are either missing (or show very low constancy) in the *Seslerio-Festucetum*. Consequently these two types of communities strictly cannot be considered as identical.

The classification of the *Saxifrago-Festucetum versicoloris* Sillinger 1933 into a high-rank syntaxon is ambiguous. Our results suggest that this community is closest to the *Caricion firmae* (belonging to the *Elyno-Seslerietea*). It contains many common species, e.g. *Saxifraga aizoides*, *Ranunculus alpestris*, *Bistorta vivipara,* with other *Elyno-Seslerietea* communities and occupies also similar habitats. On the contrary, the absence of many diagnostic species of the *Caricion firmae*, such as *Carex firma*, *Dryas octopetala*, *Saxifraga caesia* etc. (cf. Šibík et al., 2004) contradicts its classification within the *Elyno-Seslerietea*. The *Saxifrago-Festucetum* is known from one alone locality in the Nízke Tatry Mts (cf. Sillinger, 1933). Based on its ecology we propose to classify it within the *Caricion firmae* with emphasize on its exceptionality and transition position among the *Caricion firmae*, and *Arabidion caerulae*.

The classification of the *Saxifrago paniculatae-Festucetum versicoloris* (Walas 1933) Pawłowski 1935 [basionym *Versicoloretum babiogorense* Walas 1933] is also disputable. The numerical analyses suggested it might be similar to the *Saxifrago-Festucetum versicoloris* or to the *Agrostio alpinae-Festucetum versicoloris*. In this community elements typical of the *Elyno-Seslerietea* (*Anemone narcissiflora*, *Bartsia alpina*, *Festuca *versicolor*, *Ranunculus breyninus*, etc.) as well as of the *Caricetea curvulae* (*Campanula tatrae*, *Huperzia selago*, *Polytrichum alpinum*, *Pulsatilla scherfelii*, *Ligusticum mutellina*, *Solidago *minuta*) are meeting. The geological substrate (sandstone) indirectly yields support to classification within the latter class. However due to limited extent of the data available we prefer to refrain from suggesting a conclusion at this stage.

Acknowledgements

The authors are grateful to Dana Bernátová and Anna Šoltésová for providing unpublished phytocoenological relevés and fieldwork collaboration. Laco Mucina and anonymous reviewers provided valuable suggestions on the manuscript. Our thanks go also to Iveta Gažiová for providing of less accessible publications. This work was supported by the grant agency VEGA no. 4041.

References

Barkman, J. J., Doing, H. & Segal, S. 1964. Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse. Acta Bot. Neerl. **13:** 394–419.

Beldie, A. 1967. Flora şi vegetaţia Munţilor Buşegi. Ed. Acad. Rep. Soc. Romãnia, Bucureşti, 578 pp.

Braun-Blanquet, J. 1964. Pflanzensoziologie. Grundzüge der Vegetationskunde. 3. Aufl. Springer Verlag, Wien, 865 pp.

Coldea, Gh. 1984. L'étude des pâturages basiphiles sousalpines des Monts Rodnei (Les Carpathes Orienthales). Contr. Bot., Cluj-Napoca, pp. 137–154.

Coldea, Gh. 1997. *Carici rupestris-Kobresietea bellardii* Ohba 1974, pp. 202 – 207. In: Coldea, Gh., Sanda, V., Popescu, A. & Ştefan, N. (eds), Les associations végétales de Roumanie. 1. Les associations herbacées naturelles, Presses Universitaires de Cluj, Cluj-Napoca.

Domin, K. 1925. Květena horského kotle mezi Žďárskou Vidlou a Havranem v Bielských Tatrách. Spisy Přír. Fak. Karlovy Univ., Praha, **1925/45:** 1–30.

Domin, K. 1927. *Tofieldia palustris* Huds., nová rostlina československé květeny. Věda Přír., Praha, **8:** 214–216.

DOMIN, K. 1929. Příspěvek k poznání vegetačních poměrů a květeny Malého Havranu v Bělských Tatrách. Spisy Přír. Fak. Karlovy Univ., Praha, **1929/101:** 3–18.

DOMIN, K. 1933. Die Vegetationsverhältnisse des Bucegi in den rumänischen Südkarpathen. Veröff. Geobot. Inst. Rübel **10:** 1–48. [Sep.]

DÚBRAVCOVÁ, Z., JAROLÍMEK, I., KLIMENT, J., PETRÍK, A., ŠIBÍK, J. & VALACHOVIČ, M. 2005. Alpine heaths in the Western Carpathians – a new approach to the classification. Ann. Bot. N. S., Roma, **5:** 153–160.

GRABHERR, G. 1993. *Carici rupestris-Kobresietea bellardii*, pp. 373–381. In: GRABHERR, G. & MUCINA, L. (eds), Die Pflanzengesellschaften Österreichs. Teil 2. Natürliche Waldfreie Vegetation, Gustav Fischer, Jena.

HADAČ, E. 1956. Rostlinná společenstva Temnosmrečinové doliny ve Vysokých Tatrách. Biol. Práce Slov. Akad. Vied, Bratislava, **2(1):** 1–78.

JAROLÍMEK, I. & SCHLOSSER, G. 1997. FYTOPACK – a system of programs to process phytocoenological tables. Biologia, Bratislava, **52:** 53–59.

KLIMENT, J., BĚLOHLÁVKOVÁ, R., BERNÁTOVÁ, D., JAROLÍMEK, I., PETRÍK, A., ŠIBÍK, J., UHLÍŘOVÁ, J. & VALACHOVIČ, M. 2005. Syntaxonomy and nomenclature of the communities of the alliances *Astero alpini-Seslerion calcariae* and *Seslerion tatrae* in Slovakia. Hacquetia **4(2):** 121–149.

KLIMENT, J., JAROLÍMEK, I., ŠIBÍK, J. & VALACHOVIČ, M. 2004. Syntaxonomy and nomenclature of the communities of the orders *Calamagrostietalia villosae* and *Adenostyletalia* in Slovakia. Thaiszia-J. Bot. **14(2):** 93–157.

KLIMENT, J. & VALACHOVIČ, M. (eds) 2006. Rastlinné spoločenstvá Slovenska. 4. Vysokohorská vegetácia. Veda, Bratislava, (in prep.).

KRAJINA, V. 1933. Die Pflanzengesellschaften des Mlynica-Tales in den Vysoké Tatry (Hohe Tatra). 2. Teil. Beih. Bot. Centralbl. **51:** 1–224.

MALYNOVSKI, K. & KRICSFALUSY, V. 2002. Plant communities of the Ukrainian Carpathian highlands. Uzhgorod, 244 pp.

MARHOLD, K. & HINDÁK, F. (eds) 1998. Zoznam nižších a vyšších rastlín Slovenska. Veda, Bratislava, 687 pp.

OHBA T., 1974. Vergleichende Studien über die alpine Vegetation Japans. 1. *Carici rupestris-Kobresietea bellardii.* Phytocoenologia, **1:** 331–401.

PAWŁOWSKI, B. 1928. Guide des excursions en Pologne. 1. partie. Guide de l'excursion botanique dans les months Tatras. Cinquième excursion phytogéographique internationale **1928:** 1–61.

PAWŁOWSKI B., 1935. Über die Klimaxassoziationen in der alpinen Stufe der Tatra. – Bull. Int. Acad. Polon. Sci., Cl. Sci. Math., Ser. B, Sci. Nath., pp. 115–146.

PAWŁOWSKI, B., SOKOLOWSKI, M. & WALLISCH, K. 1928. Die Pflanzenassoziationen des Tatra-Gebirges. Teil 7. Die Pflanzenassoziationen und die Flora des Morskie Oko Tales. Bull. Int. Acad. Polon. Sci., Cl. Sci. Math., Ser. B., **Suppl. 2:** 205–272.

PAWŁOWSKI, B. & STECKI, K. 1927. Die Pflanzenassoziationen des Tatra-Gebirges. IV. Teil: Die Pflanzenassoziationen des MiŠtusia-Tales und des Hauptmassivs der Czerwone Wierchy. Bull. Int. Acad. Polon. Sci., Cl. Sci. Math., Ser. B., **Suppl. 2:** 79–121.

PETRÍK, A., ŠIBÍK, J. & VALACHOVIČ, M. 2005. The class *Carici rupestris-Kobresietea bellardii* Ohba 1974 also in the Western Carpathians.Hacquetia **4(1):** 33–51.

PODANI, J. 2001. SYN-TAX 2000. Computer program for data analysis in ecology and systematics for Windows 95, 98 & NT. User's manual. Scientia Publ., Budapest, 53 pp.

RIVAS-MARTÍNEZ, S., DÍAZ, E. T., FERNÁNDEZ-GONZÁLEZ, F., IZCO, J., LOIDI, J., LOUSĂ, M. & PENAS, Á. 2002. Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomical checklist of 2001. Part 1, 2. Itinera Geobotanica, León, **15/1,2:** 5–922.

ROUSSAKOVA, V. 2000. Végétation alpine et sous alpine supérieure de la Montagne de Rila (Bulgarie). Braun-Blanquetia, Camerino, **25:** 1–132.

SEKYRA, J. 1954. Velehorský kras Bělských Tater. Nakladatelství Československé akademie věd, Praha, 148 pp.

SILLINGER, P. 1933. Monografická studie o vegetaci Nízkých Tater. Orbis, Praha, 339 pp.

SVOBODA, J. et al. 1983. Encyklopedický slovník geologických věd. II. Svazek. Academia, Praha, 851 pp.

ŠIBÍK J., KLIMENT J., JAROLÍMEK I., DÚBRAVCOVÁ Z., BĚLOHLÁVKOVÁ R. & PACLOVÁ L., 2006. Syntaxonomy and nomenclature of the alpine heaths (the class *Loiseleurio-Vaccinietea*) in the Western Carpathians. Hacquetia **5:** 37–71.

ŠIBÍK, J., PETRÍK, A. & KLIMENT, J. 2004. Syntaxonomical revision of plant communities with *Carex firma* and *Dryas octopetala* (alliance *Caricion firmae*) in the Western Carpathians. Polish Bot. J. **49(2):** 181–202.

ŠOLTÉS R., HÁJEK M. & VALACHOVIČ M. 2001. *Oxycocco-Sphagnetea*, pp. 275–296. In: Valachovič M. (ed.), Rastlinné spoločenstvá Slovenska. 3. Vegetácia mokradí. Veda, Bratislava.

VAN DEN MAAREL, E. 1979. Transformation of cover-abundance values in phytosociology and its effect on community similarity. Vegetatio **39:** 97–114.

WALAS, J. 1933. Roślinność Babiej Góry (Vegetation des Babia Góra-Gebietes in den Karpaten). Państwowa rada ochrony przyrody **2:** 1–68.

WEBER, H. E., MORAVEC, J. & THEURILLAT, J.-P. 2000. International Code of Phytosociological Nomenclature. Ed. 3. J. Veget. Sci. **11:** 739–768.

WESTHOFF, V. & VAN DER MAAREL, E. 1978. The Braun-Blanquet approach, pp. 287–399. In: Whittaker, R. H., Classification of plant communities. Dr. W. Junk, The Hague.

Received Dec. 12, 2005
Accepted May 4, 2006

Appendix:

Sources of data in Table 1:

1: ***Pyrolo carpaticae-Salicetum reticulatae*:** PETRÍK et al. (2006), Tab. 2, rels 1–35.

2: ***Festuco versicoloris-Oreochloetum distichae*:** 3 – PAWŁOWSKI & STECKI 1927, Tab. 6, rels 4, 6, 7, Belianske Tatry; 5 – PAWŁOWSKI (1935), Tab. 1, rels 16–20, Belianske Tatry; 12 – Petrík, ined., detto.

3: ***Festucetum versicoloris*:** PETRÍK et al. (2006), Tab. 3, rels 1–39.

4: ***Oxytropido carpaticae-Elynetum myosuroides*:** PETRÍK et al. (2005), Tab. 1, rels 1–10.

5: ***Drabo siliquosae-Festucetum versicoloris*:** PETRÍK et al. (2006), Tab. 4, rels 1–10.

6: ***Oxytropido-Elynion*:** PETRÍK et al. (2006), Tab. 1., columns 1–5.

7: ***Festucion versicoloris*:** (cf. KLIMENT & VALACHOVIČ, 2006)

8: ***Caricion firmae*:** (cf. KLIMENT & VALACHOVIČ, 2006)

9: ***Seslerion tatrae*:** (cf. KLIMENT & VALACHOVIČ, 2006)

Localities of relevés

Data on unpublished relevés (all made by A. PETRÍK in the Belianske Tatry Mts) or relevés from manuscripts are ordered as fol-

lows: the name and description of locality; altitude; exposition, inclination, geological bedrock, relevé area, total cover (TC), cover of layer E_1, cover of layer E_0, date, author of relevé. Published relevés are documented by abbreviated citation and localisation.

Table 2. ***Pyrolo carpaticae-Salicetum reticulatae*:**

1. Tristárska dolina, right side, fixed scree cone below the rock cliffs; 1550 m; NW, 30°, limestone, 14 m^2, TC: 90 %, E_1: 80 %, E_0: 30 %, 7. 8. 1985.
2. Bujačí vrch, N slope above the end of valley of Tokárenský potok; 1750 m; NE, 30°, dolomite, 20 m^2, TC: 95 %, E_1: 90 %, E_0: 60 %, 20. 8. 1983.
3. Havran, NE slope of the ridge towards Podspády; 1800 m; N, 45°, limestone, 18 m^2, TC: 80 %, E_1: 60 %, E_0: 40 %, 5. 8. 1985.
4. Bujačí vrch, NE slope of the ridge between Babia dolina and Tokárenský potok; 1870 m; NE, 30°, dolomite, 12 m^2, TC: 100 %, E_1: 95 %, E_0: 10 %, 24. 7. 1981.
5. Hlúpy, left side of glen to Zadné Meďodoly, fixed scree on lateral slope of crest; 1750 m; NW, 35°, dolomite, 16 m^2, TC: 100 %, E_1: 100 %, E_0: 15 %, 1. 8. 1985.
6. Bujačí vrch, NW slope near the saddle between Bujačí vrch and Košiare; 1900 m; NW, 25°, dolomite, 15 m^2, TC: 100 %, E_1: 90 %, E_0: 25 %, 10. 9. 1984.
7. Zadné Jatky, N slope below Kamzíčia jaskyňa; 1980 m; NNE, 35°, limestone, 12 m^2, TC: 90%, E_1: 80 %, E_0: 40 %, 4. 8. 1992.
8. Saddle between Bujačí vrch and Košiare, N slope; 1910 m; N, 20°, dolomite, 16 m^2, TC: 95 %, E_1: 90 %, E_0: 50 %, 14. 8. 1986.
9. Bujačí vrch, N slope, wide glen in the end of Babia dolina; 1880 m; N, 35°, dolomite, 20 m^2, TC: 100 %, E_1: 95 %, E_0: 30 %, 24. 7. 1981.
10. Bujačí vrch, NW slope of ridge descending towards Alabastrová jaskyňa; 1830 m; NNW, 30°, dolomite, 25 m^2, TC: 100 %, E_1: 90 %, E_0: 50 %, 20. 8. 1983.
11. Bujačí vrch, N slope above Babia dolina; 1860 m; N, 30°, dolomite, 25 m^2, TC: 100 %, E_1: 90 %, E_0: 30 %, 10. 8. 1984.
12. Bujačí vrch, N slope of ridge descending towards Alabastrová jaskyňa; 1850 m; N, 30°, dolomite, 30 m^2, TC: 95 %, E_1: 90 %, E_0: 30 %, 11. 8. 1984; + D. Bernátová.
13. Hlúpy, N slope of ridge towards Zadné Jatky; 1970 m; N, 25°, marl, 25 m^2, TC: 100 %, E_1: 90 %, E_0: 50 %, 5. 8. 1992.
14. Hlúpy, N slope, right side of the wide glen descending towards Monkova dolina; 1870 m; N, 25°, marl, 20 m^2, TC: 100 %, E_1: 90 %, E_0: 60 %, 11. 8. 1991.
15. Ždiarska vidla, N slope, on NE slope towards Tristárska dolina, near old tourist path; 2000 m; N, 30°, marl, 25 m^2, TC: 100 %, E_1: 90 %, E_0: 30 %, 7. 8. 1992.
16. Ždiarska vidla, N slope, towards Tristárska dolina; 2020 m; NNE, 30°, marl, 16 m^2, TC: 90 %, E_1: 85 %, E_0: 50 %, 9. 8. 1987.
17. Zadné Jatky, N slope towards the valley of Riglaný potok; 1950 m; NNW, 15°, marl, 16 m^2, TC: 100 %, E_1: 90 %, E_0: 60 %, 15. 8. 1986.
18. Saddle between Bujačí vrch and Košiare, N slope; 1910 m; NNE, 20°, marl, 15 m^2, TC: 100 %, E_1: 90 %, E_0: 40 %, 23. 7. 1987.
19. Ždiarska vidla, N slope towards Tristárska dolina; 1950 m; NNE, 35°, marl, 16 m^2, TC: 100 %, E_1: 90 %, E_0: 70 %, 10. 8. 1987.
20. Zadné Jatky, N slope near the old tourist path; 1980 m; WNW, 20°, marl, 30 m^2, TC: 100 %, E_1: 70 %, E_0: 90 %, 5. 8. 1992.
21. Havran, NW slope of ridge towards Nový vrch; 1970 m; NW, 35°, marl, 20 m^2, TC: 90 %, E_1: 75 %, E_0: 40 %, 6. 8. 1985.
22. Havran, small plain below the top on the ridge towards Zadné Jatky; 2050 m; N, 20°, marl, 25 m^2, TC: 95 %, E_1: 80 %, E_0: 50 %, 30. 7. 1993.
23. Tristárska dolina, left side, about 15 m from stream, slightly elevated crest on valley bottom; 1650 m; NNE, 35°, spotted shale, 15 m^2, TC: 95 %, E_1: 70 %, E_0: 50 %, 15. 7. 1987.
24. Tristárska dolina, crest between two folds on the bottom of cirque; 1700 m; NE, 35°, spotted shale, 18 m^2, TC: 100 %, E_1: 90 %, E_0: 80 %, 17. 7. 1987.
25. Tristárska dolina, right side, fixed scree slope about 50 m below the rock walls; 1700 m; WNW, 30°, spotted shale + marl, 12 m^2, TC: 90 %, E_1: 80 %, E_0: 60 %, 18. 7. 1987.
26. Bujačí vrch, north slope, in depression near the top; 1940 m; NNE, 25°, dolomite, 12 m^2, TC: 95 %, E_1: 80 %, E_0: 60 %, 4. 9. 1984.
27. Bujačí vrch, north slope of the ridge towards Alabastrová jaskyňa, in small depression; 1830 m; NE, 20°, dolomite, 10 m^2, TC: 100 %, E_1: 70 %, E_0: 80 %, 7. 9. 1984.
28. Ždiarska vidla, N slope near the top; 2130 m; NNE, 35°, marl, 12 m^2, TC: 90 %, E_1: 70 %, E_0: 40 %, 25.7.1990.
29. Ždiarska vidla, N slope, garland soils on the ridge descending towards Tristárska dolina; 2020 m; NNW, 15°, marl, 16 m^2, TC: 60 %, E_1: 50 %, E_0: 30 %, 9. 8. 1987.
30. Havran, NW slope of the ridge descending towards Podspády; 2140 m; NNW, 20°, marl, 18 m^2, TC: 80 %, E_1: 70 %, E_0: 40 %, 31. 7. 1993.
31. Hlúpy, NW slope of the ridge towards Vyšné Kopské sedlo; 1960 m; NW, 35°, spotted shale, 16 m^2, TC: 80 %, E_1: 70 %, E_0: 50 %, 19. 7. 1986.
32. Ždiarska vidla, N slope towards Tristárska dolina; 2220 m; N, 30°, marl, 20 m^2, TC: 90 %, E_1: 70 %, E_0: 50 %, 25. 7. 1990.
33. Ždiarska vidla, N slope, near the top; 2140 m; NNE, 35°, marl, 20 m^2, TC: 90 %, E_1: 80 %, E_0: 40 %, 25. 7. 1990.
34. Havran, NE slope between two crests descending from the top towards NNE and NE; 1950 m; NNE, 30°, marl, 15 m^2, TC: 100 %, E_1: 90 %, E_0: 40 %, 16. 7. 1987.
35. Havran, as No. 34; 1830 m; N, 25°, marl, 18 m^2, TC: 100 %, E_1: 90 %, E_0: 50 %, 16. 7. 1987.

Table 3. ***Festucetum versicoloris*:**

1. Havran, SE slope of the ridge towards Ždiarska vidla; 2020 m; SSW, 50°, marl, 25 m^2, TC: 80 %, E_1: 80 %, E_0: 10 %, 1. 8. 1990.
2. Havran, SW slope below the ridge towards Nový vrch; 1980 m; SW, 50°, hornstone, 25 m^2, TC: 80 %, E_1: 75 %, E_0: 10 %, 8. 8. 1991.
3. Ždiarska vidla, S slope, ridge descending towards highest quartzite outcrop; 2040 m; W, 55°, hornstone, 12 m^2, TC: 70 %, E_1: 70 %, E_0: 5 %, 20. 8. 1990.
4. saddle between Havran and Nový vrch, rock cliffs on SW slope, close near the saddle; 1940 m; SSW, 65°, hornstone, 15 m^2, TC: 60 %, E_1: 50 %, E_0: 25 %, 6. 8. 1985.
5. Havran, SW slope, near the saddle between Havran and Nový vrch; 1950 m; SSW, 55°, hornstone, 25 m^2, TC: 80 %, E_1: 60 %, E_0: 30 %, 8. 8. 1991.
6. Ždiarska vidla, SW slope of the ridge descending towards Široké sedlo, close below its edge; 2000 m; S, 45°, spotted shale, 15 m^2, TC: 60 %, E_1: 60 %, E_0: 5 %, 5. 8. 1995.
7. Košiare, SW slope of the western top; 1940 m; WSW, 30°, marl, 10 m^2, TC: 80 %, E_1: 75 %, E_0: 10 %, 7. 8. 1999.
8. saddle between Bujačí vrch and Košiare, flat mountain ridge with garland soils; 1940 m; ENE, 10°, marl, 25 m^2, TC: 60 %, E_1: 50 %, E_0: 20 %, 16. 8. 1984.
9. Hlúpy, SE slope, near below the ridge, with partially garland arrangement of vegetation; 2000 m, S, 30°, marl, 25 m^2, TC: 50 %, E_1: 50 %, E_0: 5 %, 30. 7. 1993.
10. Havran, S slope, in the ridge towards Ždiarska vidla; 2080 m; S, 40°, marl, 25 m^2, TC: 60 %, E_1: 50 %, E_0: 10 %, 6. 8. 2004.
11. Havran, SE slope, habitat with partially developed garland soils; 2040 m; SSE, 45°, marl, 20 m^2, TC: 70 %, E_1: 70 %, E_0: 5 %, 31. 7. 1993.

12. Havran, S slope with indication of development of garland soils; 2010 m; S, 35°, marl, 30 m^2, TC: 70 %, E_1: 70 %, E_0: do 5 %, 6. 8. 2004.
13. Hlúpy, SE slope, isolated rock crest surrounded by closed sward stands; 1960 m; S, 45°, marl, 6 m^2, TC: 70 %, E_1: 60 %, E_0: 30 %, 4. 8. 1992.
14. Hlúpy, SW slope, complex of top cliffs near the ridge descending towards Široké sedlo; 2020 m; NW, 45°, marl, 8 m^2, TC: 70 %, E_1: 60 %, E_0: 20 %, 6. 8. 2002.
15. Ždiarska vidla, W slope above the end of Tristárska dolina; 2010 m; WSW, 55°, spotted shale, 15 m^2, TC: 80 %, E_1: 70 %, E_0: 40 %, 21. 8. 1990.
16. Ždiarska vidla, W slope above the end of Tristárska dolina; 2040 m; SW, 50°, hornstone, 20 m^2, TC: 60 %, E_1: 40 %, E_0: 30 %, 8. 8. 2003.
17. Ždiarska vidla, quartzite outcrops on SW slope of the ridge descending towards Široké sedlo; 1870 m; W, 60°, quartzite in touch with spotted shale, 16 m^2, TC: 80 %, E_1: 70 %, E_0: 25 %, 9. 8. 2003.
18. Hlúpy, SW slope, on quartzite outcrop near Vyšné Kopské sedlo; 1960 m; WNW, 45°, quartzite in contact with spotted shale, 6 m^2, TC: 80 %, E_1: 70 %, E_0: 10 %, 4. 8. 2001.
19. Hlúpy, the ridge of Vyšné Kopské sedlo; 1980 m; SW, 45°, hornstone, 12 m^2, TC: 90 %, E_1: 80 %, E_0: 20 %, 12. 8. 1991.
20. Hlúpy, SW slope, garland soils close above the quartzite outcrops; 1960 m; W, 30°, spotted shale, 25 m^2, TC: 70 %, E_1: 60 %, E_0: 20 %, 30.7.1992.
21. Ždiarska vidla, on SW slope of the ridge towards the Havran; 1980 m; W, 55°, spotted shale, 12 m^2, TC: 60 %, E_1: 50 %, E_0: 15 %, 6. 8. 1992.
22. Hlúpy, W slope of the ridge towards Vyšné Kopské sedlo; 1980 m; W, 50°, hornstone, 12 m^2, TC: 70 %, E_1: 60 %, E_0: 15 %, 30. 7. 1993.
23. Ždiarska vidla, slope below the top ridge towards Havran; 2130 m; WSW, 40°, marl, 25 m^2, TC: 70 %, E_1: 60 %, E_0: 15 %, 5. 8. 2004.
24. Ždiarska vidla, W slope above the end of Tristárska dolina; 2020 m; W, 60°, spotted shale, 20 m^2, TC: 70 %, E_1: 60 %, E_0: 40 %, 23. 8. 1990.
25. Hlúpy, NW slope, near the ridge descending towards Monkova dolina; 2010 m; W, 50°, marl, 25 m^2, TC: 80 %, E_1: 60 %, E_0: 25 %, 6. 8. 2002.
26. Hlúpy, NW slope, as 25; 2020 m; NW, 30°, marl, 15 m^2, TC: 70 %, E_1: 60 %, E_0: 20 %, 6. 8. 2002.
27. Ždiarska vidla, ridge towards the Havran, coarse rock steps on the front of the crest; 2020 m; W, 55°, spotted shale, 20 m^2, TC: 80 %, E_1: 70 %, E_0: 20 %, 2. 8. 1995.
28. Hlúpy, W slope of the ridge descending towards Monkova dolina with garland soils; 1920 m; WNW, 35°, marl, 30 m^2, TC: 70 %, E_1: 60 %, E_0: 15 %, 3. 8. 2004.
29. Hlúpy, SW slope, convex slope below the ridge towards Vyšné Kopské sedlo; 1980 m; WNW, 45°, hornstone, 25 m^2, TC: 95 %, E_1: 90 %, E_0: 40 %, 12. 8. 1991.
30. Hlúpy, SW slope above the quartzite outcrops; 1970 m; NW, 40°, hornstone, 25 m^2, TC: 90 %, E_1: 80 %, E_0: 30 %, 2. 8. 1999.
31. Hlúpy, SW slope, fixed scree below the quartzite outcrops; 1950 m; WSW, 30°, mixture of quartzite and spotted shale, 25 m^2, TC: 100 %, E_1: 95 %, E_0: 10 %, 1. 8. 1992.
32. Hlúpy, edge of ridge towards Široké sedlo; 1980 m; WSW, 45°, hornstone, 6 m^2, TC: 85 %, E_1: 80 %, E_0: 10 %, 28. 7. 1994.
33. Hlúpy, SW slope below the quartzite outcrops; 1945 m; W, 35°, mixture of quartzite and spotted shale, 15 m^2, TC: 90 %, E_1: 80 %, E_0: 30 %, 8. 8. 2002.
34. Hlúpy, ridge towards Vyšné Kopské sedlo, about 10 m above saddle; 1940 m; SW, 30°, mixture of quartzite and spotted shale, 25 m^2, TC: 100 %, E_1: 80 %, E_0: 40 %, 7. 8. 2002.
35. Hlúpy, SW slope below the quartzite outcrops; 1930 m; W, 30°, mixture of quartzite and spotted shale, 18 m^2, TC: 90 %, E_1: 60 %, E_0: 40 %, 10. 8. 2002.
36. Ždiarska vidla, close below the top; 2140 m; N, 30–40°, limestone and spotted shale, 200–300 m^2, TC: 80 %, 16.9.1924. (PAWLOWSKI & STECKI, 1927, tab. 4, rel. 10).
37. Ždiarska vidla; 2100 m; SE, 40°, marl limestone (Neocomian), 100 m^2. (PAWLOWSKI, 1935, tab. 1, rel. 3).
38. Jatky–Bujačí; 1950 m; ENE, marl limestone (Neocomian), 10 m^2, TC: 80 %. (PAWLOWSKI, 1935, tab. 1, rel. 6).
39. Havran; 1850 m (DOMIN, 1929: 8).

Table 4. ***Drabo siliquosae-Festucetum versicoloris*:**

1. SW slope between Muráň and Havran, small crest on slope; 1900 m; SW, 45°, hornstone, 20 m^2, TC: 100 %, E_1: 100 %, E_0: 5 %, 30. 7. 1990.
2. Ždiarska vidla, SW slope of the ridge towards Široké sedlo about 5 m below the crest, convex slope; 2010 m; WSW, 45°, hornstone, 15 m^2, TC: 90 %, E_1: 90 %, E_0: 5 %, 27. 7. 1990.
3. Ždiarska vidla, SW slope of the ridge towards Široké sedlo, side slope of the rock tower near the ridge; 2000 m; SE, 55°, hornstone, 15 m^2, TC: 90 %, E_1: 90 %, E_0: 5 %, 27. 7. 1990.
4. Ždiarska vidla, S slope, edge of the ridge descending towards the highest quartzite outcrop; 2010 m; SW, 50°, hornstone, 15 m^2, TC: 100 %, E_1: 100 %, E_0: 5 %, 1. 8. 1990.
5. Ždiarska vidla, S slope, small crest on slope western from the ridge descending towards the highest quartzite outcrop; 2000 m; SW, 45°, spotted shale, 20 m^2, TC: 90 %, E_1: 90 %, E_0: 5 %, 1. 8. 1990.
6. Ždiarska vidla, SE slope of the ridge descending towards the highest quartzite outcrop; 2030 m; SE, 60°, hornstone, 12 m^2, TC: 90 %, E_1: 90 %, E_0: 5 %, 20. 8. 1990.
7. Havran, SW slope, ridge above the Janovky; 1980 m; SSW, 50°, hornstone, 20 m^2, TC: 90 %, E_1: 90 %, E_0: 5 %, 8. 8. 1991.
8. SW slope between Muráň and Havran, ridge descending towards third quartzite outcrop from Štefanov žľab to Muráň; 1850 m; SW, 55°, hornstone, 10 m^2, TC: 90 %, E_1: 90 %, E_0: 20 %, 13. 8. 1991.
9. Havran, small crest on slope above 100 m towards the West from the glen on southern slope; 1990 m; S, 45°, hornstone, 20 m^2, TC: 100 %, E_1: 100 %, E_0: 10 %, 1. 8. 1994.
10. Ždiarska vidla, S slope, ridge descending to the highest quartzite outcrop; 1960 m; JZ, 60°, spotted shale, 20 m^2, TC: 80 %, E_1: 80 %, E_0: 20 %, 31. 7. 1990.