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SPRING COMMUNITIES OF THE VEĽKÁ FATRA MTS (WESTERN CARPATHIANS) AND THEIR RELATIONSHIP TO CENTRAL EUROPEAN SPRING VEGETATION

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Abstract. The paper deals with the detailed phytosociological and ecological characteristics of spring communities (*Montio-Cardaminetea*) in the Veľká Fatra Mts (Slovakia, Central Carpathians). Due to its location on the edge of the high Central Carpathians and the variety of substrates, the recorded associations represent almost the complete range of variability of spring vegetation in the Slovak part of Western Carpathians. We found and studied nine plant communities, assigned to four alliances: *Cardamino amarae-Chrysosplenietum alternifolii*, *Caricetum remotae*, *Carici remotae-Calthetum laetae* (*Caricion remotae*), *Philonotido seriatae-Calthetum laetae*, *Brachythecio rivularis-Cardaminetum opicii* (*Cratoneuro filicini-Calthion laetae*), *Cochleario pyrenaicae-Cratoneuretum commutati*, (*Lycopodo europaei-Cratoneurion commutati*), *Cardamino opicii-Cratoneuretum falcati*, *Palustriella commutata* community and *Philonotido calcareae-Saxifragetum aizoidis* (*Cratoneurion commutati*). We also revised the classification of spring communities in Central Europe, using relevés from the Veľká Fatra Mts. Some new names and inverted names of associations are proposed: *Cardamino amarae-Cratoneuretum commutati ass. nov*., *Cochleario pyrenaicae-Cratoneuretum commutati* Th. Müller 1961 *nom. invers. propos*., and *Cardamino opicii-Cratoneuretum falcati* Szafer et Sokołowski 1927 *nom. invers. propos*.

Key words: *Montio-Cardaminetea*, spring vegetation, nomenclature, phytosociology, ecology

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INTRODUCTION

Plant communities of the class *Montio-Cardaminetea*, together with other types of spring vegetation, represent mostly small-scale growth dependent on flowing water. High cover values and diversity of bryophytes are typical features of their physiognomy. They differ in crenal habitat type, substrate conditions, chemical composition of the water, water temperature, flow, and intensity of woody species shading (cf. Valachovič 2001).

The issues of spring vegetation classification in Europe have been discussed by many authors (e.g., Hinterlang 1992; Zechmeister & Mucina 1994). Hadač (1983) focussed more closely on Slovakia. A complex survey of spring vegetation in Slovakia (Valachovič 2001) was based on many regional studies (e.g., Hadač & Soldán 1989; Fajmonová 1991; Valachovič & Janovicová 1999; Hájek 2000).

Although the non-forest vegetation of the Veľká Fatra Mts has been investigated in detail, almost no data on the spring communities have been published yet. Exceptions are some individual relevés (Bernátová *et al.* 1982: 145, 146). Research is yielding new knowledge about this specific vegetation type. Numerous syntaxonomical and nomenclatural discrepancies became apparent when the obtained relevés were studied and compared with the existing classification system of spring vegetation in the Slovak part of the Western Carpathians. For this reason we reviewed the original diagnoses of spring associations which have gradually (starting in 1923) been distinguished in the submontane to alpine regions of Central Europe. The objectives of this paper are to (*i*) replenish knowledge of spring vegetation in the submontane

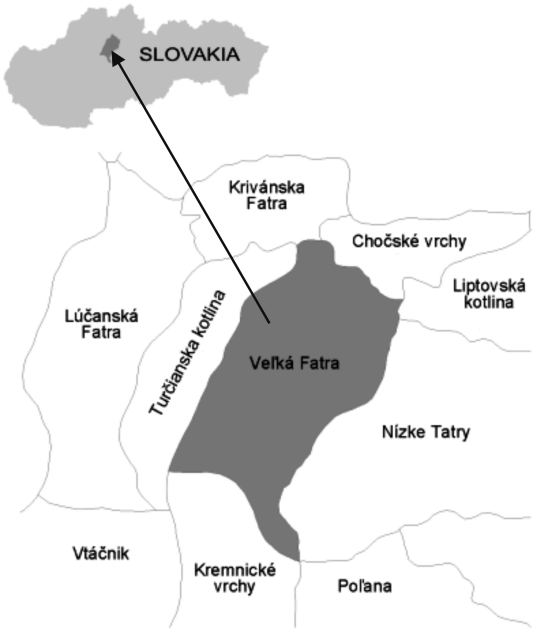

Fig. 1. Location of studied area in Slovakia.

and montane belts of Slovakia, (*ii*) contribute to a precise syntaxonomy and nomenclature of spring communities in the Western Carpathians, (*iii*) discuss their classification within higher syntaxa, based on altitudinal gradient or substrate types (cf. Hinterlang 1992; Zechmeister & Mucina 1994; Valachovič 2001), and (*iv*) discuss the relations between some Central European spring communities (their separateness or identity, incorrect application of association names, etc.).

Material and methods

Phytosociological relevés were made in 2006–2007 according to the guidelines of the Zürich – Montpellier School (Braun-Blanquet 1964) in the Veľká Fatra Mts (phytogeographical subdistrict 21c, cf. Futák 1980; Fig. 1). With the authors' agreement, we also used unpublished relevés of D. Bernátová (sampled in 1979, 1982–1985, 2006) and M. Valachovič (sampled in 1996, 1998). The majority of relevés were characterized according to the modified nine-degree Braun-Blanquet scale (Barkman *et al.* 1964); for some older relevés the seven-degree Braun-Blanquet scale was used. We stored all relevés in the Turboveg database (Hennekens & Schaminée 2001).

Eighty-seven relevés of spring communities from the Veľká Fatra Mts were analyzed. Transitional stands between low-altitude crenal communities of lime-rich habitats and calcareous fens were eliminated from the final presentation. To obtain comparable data for numerical classification, all relevés were transformed to the nine-degree ordinal scale (van der Maarel 1979). Value 2 was transformed to 2a. Values 2m, 2a and 2b were substituted by m, a and b in the phytosociological tables. Subspecies and some narrowly defined species were placed in broadly conceived taxa: *Alchemilla* sp. div. (*A. monticola*, *A. straminea*, *Alchemilla* sp.), *Carex flava* agg. (*Carex flava* s.str., *C. lepidocarpa*, *C. flava* agg.), *Galeobdolon luteum* s.l. (*G. luteum*, *G. montanum*), *Myosotis scorpioides* agg. (*M. laxiflora*, *M. scorpioides* s.l.), *Palustriella commutata* [var. *falcata* (Brid.) Ochyra], *Senecio nemorensis* agg. (*S. ovatus*, *S. nemorensis* agg.), and *Swertia perennis* (subsp. *alpestris*, subsp. *perennis*).

Numerical classification was done with HierClus from the SYN-TAX 2000 package (Podani 2001). Ordinal clustering of relevés with Goodman and Kruskal's gamma coefficient was employed. The resulting clusters represent floristically and ecologically well-differentiated syntaxa. Then the syntaxonomically uncertain relevés/clusters were compared with the original diagnoses of spring communities from Central Europe (Szafer *et al.* 1923; Gams 1927; Szafer & Sokołowski 1927; Koch 1928; Pawłowski *et al.* 1928; Aichinger 1933; Krajina 1933; Hadač *et al.* 1969; Philippi & Oberdorfer 1977; Rivola 1982). When only synoptic tables were given in the original publications, we could only compare them with synoptic tables made using our analyzed data.

The results of numerical classification were used for arrangement of phytocoenological tables processed with the FYTOPACK program (Jarolímek & Schlosser 1997). Taxa in synoptic tables are characterized by frequency of occurrence (%) and the mean value of cover-abundance in the relevant column (superscript). In columns with four or less relevés, only the presence of species is given. Headers of synoptic tables contain information on the number of relevés per column and the average number of taxa in a community. Abbreviated citations of the data sources for each column are listed below the table (name of author, year of publication, table number). Diagnostic taxa of individual communities are printed in bold. In choosing the diagnostic taxa of alliances and classes, we took the results of national and European syntheses into consideration (Zechmeister 1993; Zechmeister & Mucina 1994; Valachovič 2001).

The CANOCO 4.5 for Windows package (ter Braak & Šmilauer 2002) was used for DCA analyses. We used

percentage species data with logarithmic transformation, and rare species were not down-weighted. For ecological interpretation of major gradients, average Ellenberg indicator values of vascular plants (Ellenberg *et al.* 1992) were plotted on a DCA ordination diagram as supplementary variables.

Full names of identified communities are listed in Results. The author citations of syntaxa that are not the subject of descriptions in this work are given at their first mention in the text.

Nomenclature of bryophytes and vascular plants follows Kubinská and Janovicová (1998) and Marhold (1998); alpine species missing in these sources follow Ehrendorfer (1973). Subspecies names without the species name are asterisked (*) in tables and in the text if used repeatedly.

In descriptions of communities the following abbreviations are used: Art. – article of the *International Code of Phytosociological Nomenclature* (ICPN; Weber *et al.* 2000), ass. – association, const. – constant taxon (frequency of occurrence over 60%), dif., d. – differential taxon (d – used in tables), dom. – dominant taxon, incl. – inclusive, nom. invers. – nomen inversum, Recomm. – recommendation of ICPN, sp. div. – species diversae, subass. – subassociation, subdom. – subdominant taxon, syntax. syn. – syntaxonomic synonym. The following abbreviations are used for authors of relevés: DB – Dana Bernátová, JKl – Ján Kliment, JKo – Judita Kochjarová, MV – Milan Valachovič, RH – Richard Hrivnák.

The majority of relevés include information on water reaction (pH), temperature (t) and water conductivity (EC; 25°C), which were measured with a pH/Cond 340i device (WTW Co.).

Results

Syntaxonomy – list of detected communities

Montio-Cardaminetea Br.-Bl. et R. Tx. ex Klika 1948
Cardamino-Chrysosplenietalia Hinterlang 1992
Caricion remotae Kästner 1941
Cardamino amarae-Chrysosplenietum alternifolii Maas 1959
Caricetum remotae Kästner 1941
Carici remotae-Calthetum laetae Coldea 1978
Cratoneuro filicini-Calthion laetae Hadač 1983
Philonotido seriatae-Calthetum laetae (Krajina 1933) Coldea 1991
Brachythecio rivularis-Cardaminetum opicii (Krajina 1933) Hadač 1983
Montio-Cardaminetalia Pawłowski in Pawłowski *et al.* 1928
Lycopodo europaei-Cratoneurion commutati Hadač 1983
Cochleario pyrenaicae-Cratoneuretum commutati Th. Müler 1961 *nom. invers. propos*.
Cratoneurion commutati Koch 1928
Cardamino opicii-Cratoneuretum falcati Szafer *et* Sokołowski 1927 *nom. invers. propos*.
Palustriella commutata-community
Philonotido calcareae-Saxifragetum aizoidis Unar in Unar *et al*. 1985

Plant community characteristics

Cardamino-Chrysosplenietum alternifolii Maas 1959

Table 1, column 1; Table 2, relevé 1–15

Diagnostic taxa: *Caltha palustris* subsp. *laeta* (const.), *Cardamine amara* subsp. *amara* (const.), *Chaerophyllum hirsutum* (dif., const.), *Impatiens noli-tangere* (const.), *Myosotis scorpioides* agg. (const.), *Rumex obtusifolius* (dif.), *Stellaria nemorum* (const.); *Brachythecium rivulare* (const.), *Eurhynchium speciosum* (dif.), *Plagiochila asplenioides* (dif.), *Plagiomnium undulatum* (dif., const.), *Rhizomnium punctatum* (const.).

Springs surrounded by woodlands with more or less closed herb layer, dominated by *Cardamine *amara*, *Caltha *laeta* or *Chaerophyllum hirsutum*. Moss layer commonly consists of *Brachythecium rivulare*, *Plagiomnium undulatum*, *Rhizomnium punctatum*, *Conocephalum conicum* or *Palustriella commutata*. We recorded it at 500–920 m a.s.l. on various types of bedrock (granite, marly limestone, less frequently calcareous substrate). Soil depth (mud and organic debris) varies considerably; in some places the community occurs on rocky substrate (gravel or sand) with slow-flowing water. The measured physical characteristics (temperature, pH, water conductivity) are the most variable of all the investigated communities (Table 5).

We separated the shaded lowland stands of muddy springs dominated by *Caltha *laeta* located in piedmont (Table 2, relevé 1–4) into the subassociation *C.-Ch. calthetosum laetae* Hadač et Soldán 1989 (differential taxa: *Caltha *laeta*, *Athyrium filix-femina*, *Geum rivale*, *Rubus idaeus*, *Valeriana excelsa* subsp. *sambucifolia*, *Viola biflora*).

Table 1. Water-spring communities of the Veľká Fatra Mts. 1 – *Cardamino amarae-Chrysosplenietum alternifolii*; 2 – *Caricetum remotae*; 3 – *Philonotido seriatae-Calthetum laetae*; 4 – *Brachythecio rivularis-Cardaminetum opicii*; 5 – *Cochleario pyrenaicae-Cratoneuretum commutati*; 6 – *Cardamino opicii-Cratoneuretum falcati*; 7 – *Palustriella commutata*-community (1–2 – *Caricion remotae*; 3–4 – *Cratoneuro filicini-Calthion laetae*; 5 – *Lycopodo-Cratoneurion commutati*; 6–7 – *Cratoneurion commutati;* 1–4 – *Cardamino-Chrysosplenietalia*; 5–7 – *Montio-Cardaminetalia*).

Column number	1	2	3	4	5	6	7
Number of relevés	15	*2*	*3*	*1*	5	38	12
Average number of species	20	25	22	25	16	20	17
Cardamino amarae-Chrysosplenietum alternifolii							
Plagiomnium undulatum (E_0)	**73**^{4}	.	.	.	.	26^{3}	42^{2}
Plagiochila asplenioides (E_0)	**33**^{3}	.	.	.	.	8^{4}	.
Rumex obtusifolius	**20**^{2}	.	.	.	.	.	.
Eurhynchium speciosum (E_0)	**13**^{2}	.	.	.	.	.	.
Caricetum remotae							
Carex remota	.	***2***^{8}	.	.	.	.	.
Galium palustre	.	***2***^{2}	.	.	.	.	.
Festuca gigantea	.	***1***^{2}	.	.	.	.	.
Philonotido seriatae-Calthetum laetae							
Athyrium distentifolium	.	.	***3***^{2}	.	.	.	.
Pellia neesiana (E_0)	20^{3}	.	***3***^{4}	.	.	.	.
Dicranella palustris (E_0)	.	.	***1***^{3}	.	.	.	.
Rhizomnium magnifolium (E_0)	.	.	***1***^{7}	.	.	.	8^{3}
Brachythecio rivularis-Cardaminetum opicii							
*Cardamine *opicii*	.	.	.	***1***^{9}	.	.	.
Epilobium alsinifolium	.	.	.	***1***^{6}	.	5^{4}	.
Sphagnum squarrosum (E_0)	.	.	.	***1***^{6}	.	.	.
Philonotis seriata (E_0)	.	.	.	***1***^{2}	.	.	8^{3}
Cochleario pyrenaicae-Cratoneuretum commutati							
Cochlearia pyrenaica	.	.	.	.	**100**^{6}	.	.
Festuca heterophylla	.	.	.	.	**80**^{2}	.	.
Potentilla erecta	.	.	.	.	**80**^{2}	16^{2}	8^{1}
Galium mollugo agg.	.	.	.	.	**60**^{2}	.	17^{2}
Cardamino opicii-Cratoneuretum falcati							
Cortusa matthioli	.	.	.	.	.	**79**^{5}	25^{4}
*Arabis *subcoriacea*	.	.	.	.	.	**68**^{4}	.
Bellidiastrum michelii	.	.	.	.	.	**45**^{2}	.
Swertia perennis	.	.	.	.	.	**34**^{3}	.
Tofieldia calyculata	.	.	.	.	20^{2}	**32**^{2}	.
Equisetum palustre	.	.	.	.	20^{2}	**32**^{3}	.
Carex flacca	.	.	.	.	.	**24**^{2}	.
Soldanella carpatica	.	.	.	.	.	**16**^{2}	.
Pinguicula alpina	.	.	.	.	.	**13**^{2}	.
Silene pusilla	.	.	.	.	.	**5**^{6}	.
Caricion remotae							
Impatiens noli-tangere	**80**^{3}	***1***^{2}	.	.	.	.	.
Urtica dioica	**47**^{2}	***1***^{2}	.	.	.	.	.
Oxalis acetosella	**33**^{2}	***1***^{2}	.	.	.	3^{2}	8^{1}
Athyrium filix-femina	**33**^{2}	***1***^{1}	.	.	.	.	8^{1}
Epilobium roseum	**13**^{2}	***1***^{3}	.	.	.	.	.
Cardamine flexuosa	**13**^{2}	***1***^{3}	.	.	.	.	.
Cratoneuro filicini-Calthion laetae							
Rumex alpinus	7^{3}	.	***2***^{4}	***1***^{7}	.	.	.
Senecio subalpinus	.	.	***2***^{4}	***1***^{3}	.	.	.
Equisetum sylvaticum	.	.	***1***^{6}	***1***^{3}	.	.	.
Lycopodo europaei-Cratoneurion commutati							
Pinguicula vulgaris	.	.	.	.	**40**^{2}	8^{2}	8^{1}

Table 1. *Continued*

Column number	1	2	3	4	5	6	7
Primula farinosa	.	.	.	.	**40**^{3}	5^{2}	8^{4}
Parnassia palustris	.	.	.	.	**40**^{2}	.	8^{1}
Cratoneurion commutati							
Eucladium verticillatum (E_0)	.	.	.	.	.	3^{2}	17^{3}
Philonotis calcarea (E_0)	.	.	.	.	.	5^{4}	8^{7}
Cardamino-Chrysosplenietalia							
Myosotis scorpioides agg.	**60**^{3}	***1***^{5}	***3***^{4}	***1***^{3}	.	5^{2}	8^{2}
Stellaria nemorum	**80**^{4}	***1***^{2}	***3***^{3}	***1***^{3}	.	16^{2}	.
Chrysosplenium alternifolium	**47**^{4}	***2***^{2}	***2***^{4}	***1***^{2}	.	3^{2}	.
Ranunculus repens	**47**^{3}	***1***^{5}	***3***^{3}	***1***^{3}	.	.	.
Stellaria alsine	**7**^{3}	***2***^{2}	***1***^{2}	***1***^{3}	.	.	.
Veronica beccabunga	**27**^{4}	***2***^{4}	***2***^{4}	**.**	.	3^{2}	.
Epilobium montanum	**13**^{2}	***2***^{2}	***3***^{2}	**.**	.	.	.
Brachythecium rutabulum (E_0)	**20**^{4}	**.**	***2***^{3}	**.**	.	.	.
Montio-Cardaminetalia							
Palustriella commutata (E_0)	47^{5}	.	.	.	**100**^{9}	**100**^{8}	**100**^{8}
Bryum pseudotriquetrum (E_0)	13^{2}	.	.	*1*^{2}	**100**^{4}	**89**^{4}	**100**^{4}
Calamagrostis varia	.	.	.	.	**80**^{6}	**42**^{2}	**33**^{3}
Montio-Cardaminetea							
*Caltha *laeta*	73^{5}	*1*^{5}	*2*^{7}	*1*^{5}	.	61^{3}	33^{3}
Brachythecium rivulare (E_0)	87^{4}	*2*^{5}	*1*^{2}	.	40^{3}	34^{2}	8^{2}
*Cardamine *amara*	93^{5}	*1*^{5}	*3*^{6}	.	.	32^{3}	25^{2}
Rhizomnium punctatum (E_0)	67^{3}	*1*^{5}	*2*^{4}	.	.	24^{3}	33^{2}
Pellia endiviifolia (E_0)	7^{2}	*1*^{5}	.	.	20^{2}	5^{3}	25^{2}
Conocephalum conicum (E_0)	53^{4}	*1*^{3}	.	.	.	29^{3}	42^{3}
Cratoneuron filicinum (E_0)	27^{6}	*1*^{3}	.	.	.	21^{4}	8^{2}
Aneura pinguis (E_0)	27^{4}	.	*1*^{3}	.	.	5^{2}	8^{2}
Palustriella decipiens (E_0)	.	.	*1*^{7}	*1*^{2}	.	11^{3}	.
Philonotis fontana (E_0)	.	.	*1*^{3}	.	.	8^{4}	.
Scheuchzerio-Caricetea fuscae							
Carex flava agg.	7^{2}	.	.	.	60^{2}	32^{2}	25^{2}
Calliergonella cuspidata (E_0)	.	.	.	*1*^{2}	60^{2}	3^{2}	8^{2}
Carex nigra	.	.	.	*1*^{2}	.	3^{2}	.
Cirsium palustre	.	.	.	.	.	11^{2}	25^{2}
Juncus articulatus	.	.	.	.	.	8^{2}	25^{2}
Other taxa							
Plagiomnium affine (E_0)	20^{2}	*1*^{6}	*1*^{2}	*1*^{6}	.	3^{2}	.
Tussilago farfara	27^{2}	*1*^{5}	*2*^{3}	.	.	29^{2}	67^{3}
Prunella vulgaris	7^{2}	*1*^{2}	*1*^{2}	.	.	.	25^{2}
Equisetum arvense	27^{2}	*1*^{2}	.	.	20^{3}	32^{2}	58^{2}
Mentha longifolia	20^{3}	*1*^{2}	.	.	80^{3}	45^{4}	42^{4}
Eupatorium cannabinum	7^{3}	*1*^{2}	.	.	100^{5}	21^{2}	75^{3}
Agrostis stolonifera	7^{2}	*1*^{3}	.	.	20^{2}	42^{3}	50^{3}
Acer pseudoplatanus	33^{2}	*1*^{1}	.	.	.	39^{2}	75^{2}
Geranium robertianum	27^{2}	*2*^{2}	.	.	.	32^{2}	50^{2}
Petasites albus	20^{3}	*1*^{2}	.	.	.	26^{3}	33^{4}
Viola biflora	20^{5}	.	*2*^{4}	*1*^{2}	.	61^{3}	25^{3}
Chaerophyllum hirsutum	**80**^{4}	.	*2*^{5}	.	.	58^{3}	50^{4}
Crepis paludosa	33^{3}	.	*1*^{6}	.	.	**95**^{3}	8^{2}
Geum rivale	27^{2}	.	*1*^{2}	.	.	13^{2}	.
Senecio nemorensis agg.	20^{2}	.	*1*^{2}	.	.	18^{2}	.
Chiloscyphus pallescens (E_0)	20^{2}	.	*2*^{2}	.	.	.	8^{2}
Cardamine pratensis	7^{2}	.	.	*1*^{2}	.	39^{3}	25^{2}
Brachypodium sylvaticum	13^{2}	.	.	.	20^{1}	3^{2}	8^{2}
Picea abies	7^{1}	.	.	.	20^{1}	16^{1}	42^{2}

Table 1. *Continued.*

Column number	1	2	3	4	5	6	7
Petasites hybridus	20^3	.	.	.	.	8^3	8^5
Cirsium oleraceum	20^2	.	.	.	.	21^3	17^2
Mycelis muralis	13^2	.	.	.	.	29^2	33^3
Juncus effusus	7^2	2^3	1^2	.	.	.	.
Glyceria notata	7^2	2^3	.	.	.	3^2	17^2
Fissidens dubius (E_0)	7^2	.	.	.	.	5^2	8^2
Deschampsia cespitosa	.	.	2^4	1^2	80^4	34^3	8^5
Alchemilla sp. div.	.	.	2^3	1^3	.	3^2	17^2
Epilobium parviflorum	.	.	.	.	20^2	3^1	25^2
Linum catharticum	.	.	.	.	20^2	5^2	8^2
Sesleria albicans	.	.	.	.	40^6	18^2	.
Filipendula ulmaria	.	.	.	.	40^4	13^3	.
Leontodon hispidus	.	.	.	.	40^2	.	.
Plagiomnium elatum (E_0)	.	.	.	.	.	13^3	17^2
Valeriana tripteris	.	.	.	.	.	13^2	8^2
Petasites kablikianus	.	.	.	.	.	11^3	8^3

Taxa with rare occurrence

Col. 1. E_1: *Abies alba* 13^2, *Acer platanoides* 7^2, *Aconitum variegatum* 7^1, *Aruncus vulgaris* 7^1, *Carex* sp. 7^2, *Circaea intermedia* 7^2, *Circaea* sp. 7^3, *Clinopodium vulgare* 7^1, *Cystopteris fragilis* 7^1, *Dryopteris dilatata* 7^2, *D. filix-mas* 7^1, *Epilobium* sp. 13^2, *Fagus sylvatica* 7^1, *Fraxinus excelsior* 7^2, *Galeobdolon luteum* 13^2, *Glyceria* sp. 7^6, *Lysimachia nummularia* 7^3, *Paris quadrifolia* 7^1, *Poa trivialis* 7^2, *Rubus idaeus* 13^2, *Sambucus nigra* 7^1, *Scrophularia nodosa* 7^1, *S. umbrosa* 7^1, *Valeriana* **sambucifolia* 20^3, *Veronica anagallis-aquatica* 7^3, *V. montana* 7^1; E_0: *Jungermannia sphaerocarpa* 7^2, *Mnium* sp. 7^2, *Plagiothecium nemorale* 7^2, *Pohlia wahlenbergii* 7^2, *Scapania aequiloba* 7^2, *S. undulata* 13^2, *Thuidium tamariscinum* 7^3.

Col. 2. E_1: *Galeopsis* sp. 1^1, *Rumex crispus* 1^1, *Taraxacum* sp. 1^1; E_0: *Atrichum undulatum* 1^2, *Pohlia* sp. 1^2.

Col. 3. E_1: *Acetosa arifolia* 1^2, *Geum urbanum* 1^2, *Glyceria* sp. 1^2; E_0: *Eurhynchium praelongum* 1^2, *Scapania undulata* 1^2.

Col. 4. E_1: *Dactylorhiza majalis* 1^2, *Eriophorum angustifolium* 1^2, *Glyceria fluitans* 1^2.

Col. 5. E_1: *Blysmus compressus* 20_2, *Carex hirta* 20^2, *C. panicea* 20^2, *Juncus inflexus* 20^2, *Poa palustris* 20^2, *Potentilla heptaphylla* 20^3, *Succisa pratensis* 20^2; E_0: *Drepanocladus revolvens* 20^5, *Plagiomnium rostratum* 20^2.

Col. 6. E_2: *Salix silesiaca* 3^2, E_1: *Acetosa pratensis* 3^1, *Aconitum variegatum* 5^1, *Arabis alpina* 11^2, *Asplenium viride* 5^2, *Briza media* 5^2, *Buphthalmum salicifolium* 3^1, *Campanula cochleariifolia* 5^2, *Cardaminopsis carpatica* 11^2, *Carex brachystachys* 11^2, *C. davalliana* 3^2, *C. digitata* 3^2, *C. firma* 3^2, *C. sempervirens* subsp. *tatrorum* 3^1, *Cirsium rivulare* 3^2, *Crepis jacquinii* 3^2, *Cystopteris fragilis* 11^2, *C. montana* 16^2, *Dactylorhiza fuchsii* 5^1, *D. majalis* 3^1, *Daphne mezereum* 3^2, *Dianthus nitidus* 3^2, *Epilobium* sp. 3^2, *Eriophorum latifolium* 8^2, *Festuca rubra* 8^2, *Galium anisophyllon* 3^2, *G. schultesii* 5^2, *Gymnadenia conopsea* 3^2, *Gymnocarpium robertianum* 3^1, *Hieracium bifidum* 3^2, *Huperzia selago* 3^2, *Juncus alpinoarticulatus* 5^3, *J. inflexus* 3^2, *Lonicera nigra* 3^2, *Lunaria rediviva* 3^2, *Melampyrum sylvaticum* 3^1, *Melica nutans* 3^1, *Myosotis sylvatica* 5^2, *Pimpinella major* 3^2, *Poa alpina* 3^2, *P. chaixii* 3^2, *P. palustris* 3^2, *P. trivialis* 13^2, *Polygala* **brachyptera* 3^2, *Primula elatior* 13^2, *Ranunculus breyninus* 3^1, *R. pseudomontanus* 5^2, *Rubus saxatilis* 3^2, *Salix caprea* 3^1, *S. cinerea* 5^2, *S. silesiaca* 16^2, *Scirpus sylvaticus* 3^2, *Valeriana* **sambucifolia* 3^2, E_0: *Amblystegium tenax* 3^2, *Brachythecium reflexum* 3^2, *Campylium stellatum* 3^2, *Ctenidium molluscum* 5^2, *Dicranum bonjeanii* 3^2, *Fissidens adianthoides* 5^2, *Lophocolea bidentata* 5^2, *Lophozia longiflora* 3^2, *Marchantia polymorpha* 3^2, *Orthothecium rufescens* 5^2, *Peltigera* sp. 3^2, *Preissia quadrata* 3^2, *Thuidium abietinum* 3^2, *Tortella tortuosa* 8^2, *Trichocolea tomentella* 8^3, *Warnstorfia exannulata* 3^3.

Col. 7. E_1: *Abies alba* 17^2, *Ajuga reptans* 8^2, *Carex hirta* 8^2, *C. paniculata* 8^2, *C. sylvatica* 8^2, *Carpinus betulus* 8^1, *Cerastium holosteoides* 8^1, *Cirsium rivulare* 8^5, *Cruciata glabra* 8^2, *Dryopteris carthusiana* 8^1, *Epilobium* sp. 8^5, *Equisetum fluviatile* 8^2, *Fraxinus excelsior* 17^1, *Hieracium lachenalii* 8^2, *H. murorum* 8^1, *Rumex* sp. 8^2, *Salix caprea* 8^2, *S. purpurea* 8^1, *Sambucus nigra* 8^2, *Sorbus aucuparia* 8^1, *Vicia cracca* 8^2; E_0: *Jungermannia atrovirens* 8^2, *Tortella tortuosa* 8^2.

In muddy forest springs we found some closed species-poor stands dominated by *Cardamine* **amara*, without the presence of any differential taxa of the association.

LOCALITY. SLOVAKIA. Harmanec, Racvalová valley, right branch, 845 m, E, 10°, 10 m^2, total cover 95%, E_1: 95%, E_0: 30%, 48°47′27.1″N/19°01′26.3″E, 20 June 2006, JKl.

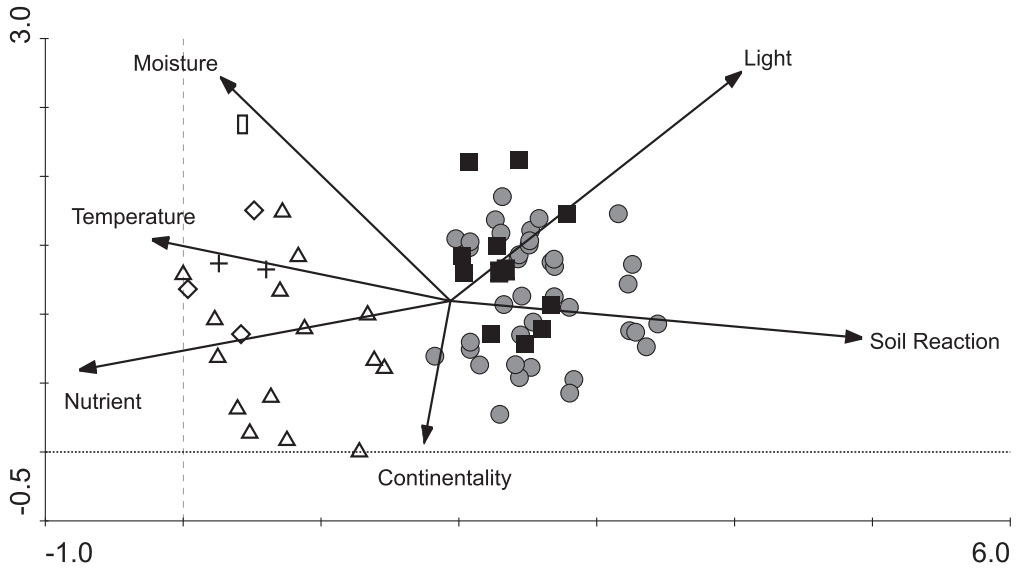

Fig. 2. DCA analysis of the phytosociological relevés (length of gradient = 3.932, cumulative percentage variance of species data in first two axis = 17.5, and species-environment relation = 51.9) and post-hoc correlated environmental variables – average Ellenberg's indicator values (empty symbols – *Montio-Cardaminetalia*, shaded symbols – *Cardamino-Chrysosplenietalia*; triangle – *Cardamino amarae-Chrysosplenietum alternifolii*, cross – *Caricetum remotae*, diamond – *Philonotido seriatae-Calthetum laetae*, rectangle – *Brachythecio rivularis-Cardaminetum opicii*, circle – *Cardamino opicii-Cratoneuretum falcati*, square – *Palustriella commutata* community). Correlation coefficients with the first two DCA axes: Light – 0.53 and 0.54; Temperature – -0.52 and 0.08; Continentality – -0.06 and -0.31; Moisture – -0.38 and -0.43; Soil reaction – 0.72 and -0.01; Nutrients – -0.66 and -0.21.

E_1: *Cardamine *amara* 5, *Stellaria nemorum* 2a, *Impatiens noli-tangere* 1, *Petasites albus* 1, *Epilobium roseum* +, *Urtica dioica* +, *Lamium maculatum* r.

E_0: *Palustriella decipiens* 2b, *Brachythecium rivulare* 2a, *B. rutabulum* +.

Caricetum remotae Kästner 1941

SYNONYM: *Caricetum remotae* Schwickerath 1944 (Art. 31)

PHANTOM NAME: *Caricetum remotae* Kästner (1939) 1942 (Passarge 1979: 789)

Table 1, column 2; Table 2, relevé 16–17.

DIAGNOSTIC TAXA: *Carex remota* (dom., const.), *Chrysosplenium alternifolium* (const.), *Epilobium montanum* (const.), *Festuca gigantea* (dif.), *Galium palustre* (dif., const.), *Geranium robertianum* (const.), *Glyceria notata* (const.), *Juncus effusus* (const.), *Stellaria alsine* (const.), *Veronica beccabunga* (const.); *Brachythecium rivulare* (const.).

A submontane forest spring community (450–560 m a.s.l.) distinctly dominated by *Carex remota*, rare in the studied area. We recorded it in two different habitats. A species-rich closed stand located in an old forest road with standing water (r. 16) characterized by a high presence of bryophytes as well as species characterizing the order and class. A classical forest spring stand (r. 17) was less closed. The presence of alliance species was high, with fractional cover of moss layer E_0. The slightly basic water contains small amounts of dissolved minerals.

Carici remotae-Calthetum laetae Coldea 1978

Growth showing clear floristic affinities to this association (cf. Coldea 1978, Table 2) was recorded on andesite bedrock in the southern part of the Veľká Fatra Mts:

LOCALITY: SLOVAKIA. Čremošné village, Hriadky (758 m a.s.l.), southwest slope above the road, muddy forest spring (Norway spruce plantation); 640 m a.s.l., SW, 20°, 25 m^2, total cover 75%, E_1: 75%, E_0: 5%, 48°50′22.7″N/18°54′28.9″E, 12 June 2007, JKo.

Table 2. Communities of the order *Cardamino-Chrysosplenietalia.*

Relevé number	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Number of species	30	19	21	24	21	16	16	22	15	17	16	18	20	23	16	30	20	22	16	28	25
Cardamino amarae-Chrysosplenietum alternifoii																					
Chaerophyllum hirsutum	.	b	3	.	1	.	3	a	+	+	b	+	+	r	1	.	.	3	+	.	.
Plagiomnium undulatum (E_0)	3	1	1	.	+	+	+	3	.	1	.	1	.	1	4	.	.	.	.	.	.
Plagiochila asplenioides (E_0)	+	.	.	.	+	+	a	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Rumex obtusifolius	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.
Eurhynchium speciosum (E_0)	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Cardamino amarae-Chrysosplenietum alternifoii subass. *calthetosum laetae*																					
*Caltha *laeta*	4	3	3	3	a	+	.	.	3	.	+	.	+	+	a	.	a	3	.	3	a
Athyrium filix-femina	+	+	+	1	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	.	.
Geum rivale	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
*Valeriana *sambucifolia*	.	+	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola biflora	3	a	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	a	+
Rubus idaeus	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caricetum remotae																					
Carex remota	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3	.	.	.	.
Galium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Festuca gigantea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Philonotido seriatae-Calthetum laetae																					
Athyrium distentifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Pellia neesiana (E_0)	.	a	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	4	1	+	.
Dicranella palustris (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Rhizomnium magnifolium (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.
Brachythecio rivularis-Cardaminetum opicii																					
*Cardamine *opicii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Epilobium alsinifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b
Sphagnum squarrosum (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b
Philonotis seriata (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Caricion remotae																					
Impatiens noli-tangere	+	+	+	1	+	.	a	.	a	1	1	1	r	r	.	.	+	.	.	.	.
Urtica dioica	.	.	.	r	.	.	r	r	r	+	+	+	.	.	.	.	+	.	.	.	.
Oxalis acetosella	.	+	+	+	.	r	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.
Epilobium roseum	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	1	.	.	.	.
Cardamine flexuosa	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.
Cratoneuro filicini-Calthion laetae																					
Rumex alpinus	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	a	+	3
Senecio subalpinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	a	1
Equisetum sylvaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	1
Cardamino-Chrysosplenietalia																					
Stellaria nemorum	1	1	a	+	.	.	b	+	1	a	+	b	.	1	1	+	.	1	1	1	1
Myosotis scorpioides agg.	+	1	.	1	+	.	.	.	.	.	+	a	+	a	a	a	.	1	+	b	1
Ranunculus repens	+	1	.	+	.	.	.	.	r	.	.	a	+	3	.	a	.	1	1	1	1
Chrysosplenium alternifolium	.	+	a	.	.	.	a	+	a	r	a	.	.	.	.	+	+	a	+	.	+
Veronica beccabunga	.	.	.	.	.	.	.	.	+	.	.	3	b	1	.	+	a	a	.	+	.
Brachythecium rutabulum (E_0)	.	.	.	b	+	.	.	.	.	.	.	a	.	.	.	.	.	.	+	1	.
Epilobium montanum	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	r	+	+	+	+	.
Stellaria alsine	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	+	.	.	+	1
Montio-Cardaminetea																					
*Cardamine *amara*	1	b	+	+	a	b	3	+	3	b	.	b	a	b	a	.	a	b	5	1	.
Brachythecium rivulare (E_0)	+	3	1	.	+	1	3	1	4	b	+	.	b	1	1	b	1	+	.	.	.
Rhizomnium punctatum (E_0)	.	3	1	a	+	+	+	1	+	1	.	.	.	.	1	a	.	a	.	+	.
Conocephalum conicum (E_0)	b	.	4	.	+	+	+	3	.	.	1	.	.	a	.	1	.	.	.	.	.
Palustriella commutata (E_0)	+	.	.	.	4	4	+	3	.	.	.	.	.	3	+	.	.	.	.	.	.
Cratoneuron filicinum (E_0)	b	.	.	.	.	.	.	.	.	4	4	.	1	.	.	1	.	.	.	.	.

Table 2. *Continued.*

Relevé number	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	29	20	21
Bryum pseudotriquetrum (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Palustriella decipiens (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	+
Pohlia wahlenbergii (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Philonotis fontana (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Other taxa																					
Tussilago farfara	+	.	+	.	.	.	.	+	.	.	.	+	.	.	.	a	.	1	+	.	.
Crepis paludosa	a	a	.	1	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	b	.
Geranium robertianum	+	.	.	.	+	.	.	+	.	.	.	.	.	+	.	+	+	.	.	.	.
Acer pseudoplatanus	.	.	.	r	+	1	.	+	.	.	.	.	.	.	+	r	.	.	.	.	.
Equisetum arvense	+	.	+	.	.	r	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.
Chiloscyphus pallescens (E_0)	+	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.
Petasites albus	.	.	.	.	.	.	.	.	+	1	.	.	.	+	.	.	+	.	.	.	.
Plagiomnium affine (E_0)	.	.	.	.	.	.	.	.	.	.	+	.	+	1	.	b	.	.	+	.	b
Aneura pinguis (E_0)	.	.	.	.	.	.	.	.	.	.	a	.	+	a	+	.	.	.	1	.	.
Glyceria notata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.
Senecio nemorensis agg.	.	.	r	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.
Juncus effusus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	+	.
Deschampsia cespitosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	a	+
Cirsium oleraceum	1	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.
Scapania undulata (E_0)	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Mentha longifolia	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.
Petasites hybridus	.	.	.	.	.	.	.	.	.	.	.	.	a	+	+	.	.	.	.	.	.
Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.
Alchemilla sp. div.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	1
Abies alba	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulmus glabra	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycelis muralis	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Galeobdolon luteum s.l.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.

Taxa occurring in one or two relevés only

E_1: *Acer platanoides* + (6); *Acetosa arifolia* + (18); *Aconitum variegatum* r (3); *Agrostis stolonifera* + (11), 1 (16); *Aruncus vulgaris* r (13); *Brachypodium sylvaticum* + (1, 6); *Cardamine pratensis* + (1, 21); *Carex flava* agg. + (1); *C. nigra* + (21); *Carex* sp. + (14); *Circaea* ×*intermedia* + (15); *Circaea* sp. 1 (1); *Clinopodium vulgare* r (1); *Cystopteris fragilis* r (8); *Dactylorhiza majalis* + (21); *Dryopteris dilatata* + (3); *D. filix-mas* r (1); *Epilobium* sp. + (12, 13); *Eriophorum angustifolium* + (21); *Eupatorium cannabinum* 1 (13), + (17); *Fagus sylvatica* r (6); *Fraxinus excelsior* + (6); *Galeopsis* sp. r (17); *Geum urbanum* + (19); *Glyceria fluitans* + (21); *Glyceria* sp. 2b (13), + (18); *Lysimachia nummularia* 1 (15); *Paris quadrifolia* r (4); *Picea abies* r (5); *Poa trivialis* + (12); *Rumex crispus* r (16); *Sambucus nigra* r (5); *Scrophularia nodosa* r (1); *S. umbrosa* r (5); *Taraxacum* sp. r (16); *Veronica anagallis-aquatica* 1 (15); *V. montana* r (9).

E_0: *Atrichum undulatum* + (16); *Calliergonella cuspidata* + (21); *Eurhynchium praelongum* + (20); *Fissidens dubius* + (8); *Jungermannia sphaerocarpa* + (3); *Mnium* sp. + (14); *Plagiothecium nemorale* + (5); *Pohlia* sp. + (16); *Scapania aequiloba* + (7); *Thuidium tamariscinum* 1 (4).

Localities of relevés

Relevé data are ordered as follows: closest settlement, locality, altitude (m), exposition, inclination, sampled area (m^2), total cover (TC), cover of individual layers (E_1, E_0), geographic coordinates (WGS-84 system: northern latitude, eastern longitude), water physicochemical characteristics, date, author(s) of relevé (abbreviations explained in Methods). Missing data are indicated by a dash (–).

1. Liptovské Revúce, Suchá dolina valley, side valley located on right-hand side, 830 m, WNW, 18°, 15 m^2, TC: 98%, E_1: 98%, E_0: 80%, 48°53′14.1″, 19°07′44.5″, EC = 342 µS/cm, t = 11.5°C, pH = 7.90, 10 Aug. 2006, JKo & JKl.

2. Podsuchá, Vyšné Matejkovo valley, below boulder field, right bank of brook, 922 m, NNW, 25°, 18 m^2, TC: 85%, E_1: 60%, E_0: 85%, 48°59′52.6″, 19°14′26.6″, EC = 67 µS/cm, pH = 7.02, t = 11.7°C, 23 Aug. 2006, JKo.

3. Podsuchá, Vyšné Matejkovo valley, above right bank of brook, *ca* 790 m, NNE, 35°, 25 m^2, TC: 100%, E_1: 90%, E_0: 75%, 48°59′49.0″, 19°14′50.3″, EC = 89 µS/cm, t = 11.5°C, pH = 7.20, 23 Aug. 2006, JKo & JKl.

4. Podsuchá, Vyšné Matejkovo valley, below boulder field, right bank of brook, 922 m, N, 20°, 15 m^2, TC: 70%, E_1: 60%, E_0: 30%,

Table 2. *Continued.*

48°59′52.6″, 19°14′26.6″, EC = 67 µS/cm, t = 11.7°C, pH = 7.02, 23 Aug. 2006, JKl.

5. Harmanec, valley of Košiarsky potok stream (left tributary), 500 m, NE, 32°, 18 m^2, TC: 65%, E_1: 25%, E_0: 65%, 48°46′39.0″, 19°05′18.0″, EC = 1004 µS/cm, t = 8.1°C, pH = 7.58, 20 June 2006, RH, JKo & JKl.

6. Harmanec, Racvalová valley, right branch, *ca* 740 m, E, 25°, 20 m^2, TC: 75%, E_1: 30%, E_0: 75%, 48°47′23.8″, 19°02′09.8″, EC = 446 µS/cm, t = 7.1°C, pH = 7.84, 20 June 2006, JKo, RH & JKl.

7. Harmanec, Racvalová valley, right branch, *ca* 875 m, E, 18°, 12 m^2, TC: 75%, E_1: 70%, E_0: 60%, 48°47′26.3″, 19°01′23.2″, EC = 70 µS/cm, t = 5.2°C, pH = 6.7, 20 June 2006, RH, JKo & JKl.

8. Staré Hory, Košiar valley, 530 m, SSE, 20°, 7.5 m^2, TC: 80%, E_1: 15%, E_0: 80%, 48°50′00.6″, 19°05′52.0″, EC = 590 µS/cm, t = 9.3°C, pH = 7.94, 14 Sept. 2006, RH & JKo.

9. Harmanec, Racvalová valley, right branch, 850 m, TC, 10°, 10 m^2, E: 95%, E_1: 90%, E_0: 60%, 48°47′27.1″, 19°01′26.5″, 20 June 2006, JKo.

10. Harmanec, Racvalová valley, right branch, 845 m, SSE, 15°, 9 m^2, TC: 90%, E_1: 40%, E_0: 90%, 48°47′26.9″, 19°01′26.8″, 20 June 2006, RH.

11. Harmanec, Racvalová valley, right branch, below water dip, *ca* 770 m, ENE, 15°, 24 m^2, TC: 80%, E_1: 35%, E_0: 75%, 48°47′22.5″, 19°01′49.4″, EC = 145 µS/cm, t = 7.5°C, pH = 7.58, 20 June 2006, RH, JKo & JKl.

12. Podsuchá, Vyšné Matejkovo valley, small right tributary, 777 m, NNE, 20°, 10 m^2, TC: 90%, E_1: 90%, E_0: 10%, 48°59′54.7″, 19°15′12.2″, EC = 82 µS/cm, t = 11.0°C, pH = 7.02, 23 Aug. 2006, JKo & JKl.

13. Blatnica, Gaderská dolina valley, 200 m below mouth of Selenec valley, 609 m, –, 0°, 10 m^2, TC: 85%, E_1: 75%, E_0: 40%, –, t = 11.6°C, pH = 7.8, 18 Aug. 1996, MV.

14. Blatnica, Gaderská dolina valley, near bridge at beginning of valley, 534 m, –, 0°, 5 m^2, TC: 90%, E_1: 85%, E_0: 60%, 18 Aug. 1996, MV.

15. Blatnica, Gaderská dolina valley, 525 m, –, 0°, 3 m^2, TC: 70%, E_1: 50%, E_0: 70%, 19 Aug. 1996, MV.

16. Staré Hory-Polkanová, valley west of settlement, *ca* 450 m, E, 8°, 10 m^2, TC: 95%, E_1: 90%, E_0: 60%, 48°48′56.8″, 19°05′58.2″, EC = 192 µS/cm, t = 12.0°C, pH = 7.5, 14 Sept. 2006, JKo & RH.

17. Harmanec, Racvalová valley, main branch of valley, *ca* 560 m, S, 30°, 14 m^2, TC: 60%, E_1: 60%, E_0: 2%, 48°47′28.0″, 19°03′16.3″, EC = 151 µS/cm, t = 16.8°C, pH = 7.21, 20 June 2006, JKo, RH & JKl.

18. Podsuchá, Malá Smrekovica, south-facing slope above recreation area, 1387 m, SSZ, 5°, 15 m^2, TC: 90%, E_1: 90%, E_0: 75%, 49°00′02.2″, 19°12′06.3″, EC = 58 µS/cm, t = 6.9°C, pH = 6.76, 23 Aug. 2006, JKo & JKl.

19. Podsuchá, Vyšné Matejkovo valley, spring on right side above road, 1296 m, N, 20°, 15 m^2, TC: 95%, E_1: 95%, E_0: 5%, 48°59′45.3″, 19°12′34.0″, EC = 61 µS/cm, t = 6.6°C, pH = 6.91, 23 Aug. 2006, JKo & JKl.

20. Podsuchá, Malá Smrekovica, south-facing slope above recreation area, 1388 m, SW, 15°, 16 m^2, TC: 98%, E_1: 98%, E_0: 95%, 49°00′02.6″, 19°12′05.5″, EC = 69 µS/cm, t = 8.7°C, pH = 6.15, 23 Aug. 2006, JKo & JKl.

21. Podsuchá, Smrekovica, spring on northwest slope, 1337 m, NW, 10–25°, 15 m^2, –, E_1: 95%, E_0: 40%, 48°59′32.2″, 19°12′26.9″, EC = 46 µS/cm, t = 8.1°C, pH = 5.85, 4 July 2005, DB, JKl & P. Kučera.

E_1: *Carex remota* 3, *Caltha *laeta* 2b, *Ranunculus repens* 2a, *Poa trivialis* 1, *Veronica beccabunga* 1, *Cardamine *amara* +, *Chaerophyllum hirsutum* +, *Juncus effusus* +, *Myosotis scorpioides* agg. +, *Picea abies* juv. +, *Tussilago farfara* +, *Athyrium filix-femina* r, *Brachypodium sylvaticum* r.

E_0: *Amblystegium tenax* +, *Chiloscyphus pallescens* +, *Pohlia* cf. *wahlenbergii* +.

Philonotido seriatae-Calthetum laetae (Krajina 1933) Coldea 1991

SYNONYM: *Calthetum laetae* Krajina 1933 (Art. 31)

Table 1, column 3; Table 2, relevé 18–20.

DIAGNOSTIC TAXA: *Athyrium distentifolium* (dif., const.), *Caltha *laeta* (dom., const.), *Cardamine *amara* (const., subdom.-dom.), *Chaerophyllum hirsutum* (const., subdom.), *Chrysosplenium alternifolium* (const.), *Deschampsia cespitosa* (const.), *Epilobium montanum* (const.), *Myosotis scorpioides* agg. (const.), *Ranunculus repens* (const.), *Rumex alpinus* (const.), *Senecio subalpinus* (const.), *Stellaria nemorum* (const.), *Tussilago farfara* (const.), *Veronica beccabunga* (const.), *Viola biflora* (const.); *Brachythecium rutabulum* (const.), *Chiloscyphus pallescens* (const.), *Dicranella palustris* (dif.), *Pellia neesiana* (dif., const.), *Rhizomnium punctatum* (const.), *R. magnifolium* (dif.).

This closed forest spring community is dominated by *Caltha *laeta*, less frequently by *Cardamine amara* (subsp. *amara* and subsp. *opicii*). Some low plants occur in the lower herb layer (*Stellaria nemorum*, *Viola biflora*). Moss cover values vary from 5% to 95%. The association was detected in the supramontane belt of the studied area (1296–1388 m a.s.l.). The bedrock (granite gravel) was infiltrated by flowing water. Of all the evaluated communities, we recorded the lowest values of temperature, pH and water conductivity in this association as well as in the following one (Table 5). A relevé recorded in a soaked grassy clearing (Table 2, relevé 20) with *Dicranella palustris*, higher cover of *Deschampsia cespitosa* and numerous bryophytes (*Palustriella decipiens*, *Rhizomnium magnifolium*), represents a transition to the association *Caltho-Dicranelletum squarrosae* Hadač 1956.

Brachythecio rivularis-Cardaminetum opicii (Krajina 1933) Hadač 1983

Table 1, column 4; Table 2, relevé 21.

DIAGNOSTIC TAXA: *Cardamine amara* subsp. *opicii* (dif., dom.), *Epilobium alsinifolium* (dif.); *Philonotis seriata* (dif.), *Sphagnum squarrosum* (dif.).

We recorded a rather atypically developed stand of *Brachythecio rivularis-Cardaminetum opicii* at a spring surrounded by fragments of Norway spruce forest. The stand is located on a northwest slope of Smrekovica Mt. at 1337 m a.s.l. in the granite part of the mountains. Along with the diagnostic taxa, the community is characterized by the presence of *Rumex alpinus* and *Caltha *laeta. Plagiomnium affine* is one of the most abundant bryophytes.

Cochleario pyrenaicae-Cratoneuretum commutati Th. Müller 1961 *nom. invers. propos*.

Table 1, column 5.

DIAGNOSTIC TAXA: *Calamagrostis varia* (const.), *Carex flava* agg. (const.), *Cochlearia pyrenaica* (dif., const., subdom.), *Deschampsia cespitosa* (const.), *Eupatorium cannabinum* (const.), *Festuca heterophylla* (dif., const.), *Galium mollugo* agg. (dif., const.), *Mentha longifolia* (const.), *Potentilla erecta* (dif.); *Bryum pseudotriquetrum* (const.), *Calliergonella cuspidata* (const.), *Palustriella commutata* (dom., const.).

This is a relict association, very rare in the Veľká Fatra Mts as well as Slovakia as a whole. Detailed characteristics were published in Valachovič and Kochjarová (2000: 484–486, Table 2, relevé 1–5).

Cardamino opicii-Cratoneuretum falcati Szafer et Sokołowski 1927 *nom. invers. propos*.

PSEUDONYM: *Cratoneuro-Arabidetum bellidifoliae* sensu Hadač *et al.* 1969 non Koch 1928; *Cratoneuretum falcati* sensu Valachovič 2001 non Gams 1927

INCL. *Cratoneuro-Arabidetum bellidifoliae swertietosum perennis* Hadač 1983

Table 1, column 6; Table 3, relevé 1–38; Table 4, column 3c.

DIAGNOSTIC TAXA: *Arabis soyeri* subsp. *subcoriacea* (dif., const.), *Belliadiastrum michelii* (dif.), *Caltha *laeta* (const.), *Carex flacca* (dif.), *Cortusa matthioli* (dif., const., subdom.), *Crepis paludosa* (dif., const.), *Equisetum palustre* (dif.), *Pinguicula alpina* (dif.), *Silene pusilla* (dif.), *Soldanella carpatica* (dif.), *Swertia perennis* (dif.), *Tofieldia calyculata* (dif.), *Viola biflora* (const.); *Bryum pseudotriquetrum* (const.), *Palustriella commutata* (incl. var. *falcata*) (dom., const.).

In spring and early summer, the stands of the association are very colorful due to the presence of some flowering plants in the lower herb layer: *Cortusa matthioli*, *Arabis *subcoriacea* (syn.: *A. bellidifolia* Crantz, *A. jacquinii* Beck), *Swertia perennis* and *Viola biflora*. The moss *Palustriella commutata* dominates in the well-developed ground layer (together with var. *falcata* in some stands). The community occurs by fast-flowing springs at the bottom of mountain valleys (516–950 m a.s.l.; Table 5), and less frequently on mountain slopes (1200–1330 m a.s.l.; Table 5). The bedrock type is limestone or dolomite (e.g., calcareous gravel, tufa cascades, steep rocky glens). In stands of the more shaded variant with *Mycelis muralis* (r. 17–38), some forest species (*Geranium robertianum*, *Mycelis muralis*, *Senecio nemorensis* agg., *Stellaria nemorum*) and species of shaded rocky habitat (*Cardaminopsis carpatica*, *Carex brachystachys*, *Cystopteris fragilis*, *C. montana*) are present. The typical variant occurs in sunny stands. This feature differentiates the two variants.

Table 3. Communities of the alliance *Cratoneurion commutati*. 1–19 – *Cardamino-Cratoneuretum*, typical variant, 17–38 – *C.-C.*, *Mycelis muralis*-variant; 39–50 – *Palustriella commutata*-community.

Relevé number	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Number of species	12	20	10	17	21	25	10	20	08	21	17	99	91	21	20	08	16	84	48	12	48	90	20	94	49	11	64	44	91	16	25	26	16	28	97	17	18	77	70	41	14	22	24	48	00	10
Cardamino opicii-Cratoneuretum falcati																																																		
Crepis paludosa	+	+	1	1	+	+	1	1	1	+	+	1	+	1	1	+	3	1	1	+	+	a	+	+	1	+	1	a	+	.	.	+	1	1	1	+	a	a	+	.	.	.	.	.	.	.	.	.	.	.	.
Cortusa matthioli	.	.	.	.	b	1	1	1	+	r	+	+	a	3	3	+	4	b	a	+	1	3	1	1	3	3	a	3	a	3	1	a	.	.	.	.	+	3	.	b	.	.	.	.	.	a	.	.	.	+
*Arabis *subcoriacea*	.	.	+	+	.	.	1	b	.	1	+	a	.	.	b	a	a	1	+	.	a	a	+	1	.	+	a	b	a	1	a	a	+	3	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bellidiastrum michelii	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	r	+	1	+	r	.	1	+	.	.	+	+	.	r	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Swertia perennis	+	.	b	.	.	.	.	.	.	+	1	.	.	.	.	1	.	.	.	1	.	.	1	+	.	.	.	.	a	.	.	1	a	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tofieldia calyculata	r	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+	1	+	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum palustre	.	.	+	.	.	+	+	.	.	.	.	.	+	+	1	.	.	.	+	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex flacca	.	r	.	.	.	.	.	.	.	.	+	+	.	.	.	.	1	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soldanella carpatica	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinguicula alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene pusilla	.	.	a	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycelis muralis-variant																																																		
Geranium robertianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	r	+	.	+	+	.	.	.	+	+	r	.	.	+	1	r	+	.	.	.	+	+	.	.	1	+	.
Plagiomnium undulatum (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	+	.	.	.	.	.	1	.	.	1	.	.	+	+	+	+	1	+	.	+	.	.	.	.	.	+	+	+	+	.	.	.	.	.
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	r	+	.	+	+	r	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	+	a	+	r	.
Senecio nemorensis agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	+	.	.	.	.	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria nemorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cystopteris montana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arabis alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	a	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex brachystachys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardaminopsis carpatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cystopteris fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cratoneurion commutati																																																		
Philonotis calcarea (E_0)	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.
Eucladium verticillatum (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.
Montio-Cardaminetalia																																																		
Palustriella commutata (E_0)	4	4	4	3	3	5	a	4	5	3	4	4	4	4	5	5	1	4	4	4	5	3	3	5	4	5	4	5	4	4	4	5	5	4	a	4	4	3	4	4	a	3	5	4	4	4	5	3	4	4
Bryum pseudotriquetrum (E_0)	b	b	a	4	3	1	4	b	a	a	1	.	1	+	+	1	a	1	.	a	a	a	.	+	1	a	a	1	1	1	a	1	.	1	1	1	+	b	+	1	a	3	1	1	a	1	1	b	1	1
Calamagrostis varia	.	.	+	+	+	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+	.	.	+	.	.	.	+	1	1	.	r	.	+	.	r	+	+	.	a	.	.	.	.	.	+	+	+	.	.	.
Montio-Cardaminetea																																																		
*Caltha *laeta*	1	+	.	+	.	+	b	1	.	+	.	.	1	1	3	.	+	.	+	.	3	+	+	1	.	.	.	.	+	.	.	1	+	.	b	a	+	1	.	a	r	.	.	.	+	+	.	.	.	.
Conocephalum conicum (E_0)	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	b	.	.	.	.	r	+	1	.	b	b	.	+	.	.	.	.	.	.	+	+	+	a	+	.

*Cardamine *amara*	+	1	.	.	.	a	.	a	a	.	+	.	.	.	.	.	b	.	r	+	.	.	.	.	+	.	.	.	1	.	.	.	.	.	a	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.
Brachythecium rivulare (E_0)	.	.	+	+	.	+	+	1	.	.	.	.	.	.	.	+	+	1	a	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.
Rhizomnium punctatum (E_0)	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	1	+	b	1	+	.	+	.	.	.	.	.	+	+	+	.	.	.
Cratoneuron filicinum (E_0)	3	.	1	+	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	+	.	.	.
Pellia endiviifolia (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	+	.	.	.	.	.	.	.	+	1	.	.
Palustriella decipiens (E_0)	.	+	.	.	.	+	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Philonotis fontana (E_0)	.	.	.	.	.	.	.	b	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium alsinifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aneura pinguis (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.
Philonotis seriata (E_0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Scheuchzerio-Caricetea fuscae																																																		
Carex flava agg.	.	+	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	+	.	.	.	+	.	.	.	1	+	.	.	.
Cirsium palustre	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	+	.	.	r	.	.	.	.	.
Juncus articulatus	.	.	.	.	.	.	.	.	1	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	+	.	.	.
Pinguicula vulgaris	.	.	r	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Eriophorum latifolium	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Primula farinosa	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	m	.	.	.	.	.	.	.	.	.
Other taxa																																																		
Chaerophyllum hirsutum	.	+	.	+	+	b	.	1	a	+	+	.	1	1	.	1	3	.	.	1	1	.	+	1	1	.	.	.	1	+	+	.	.	.	.	+	+	.	.	1	+	.	.	b	a	.	.	a	.	1
Viola biflora	.	.	.	.	a	+	b	+	.	+	+	.	.	+	.	r	3	a	1	+	1	.	+	+	1	.	.	.	+	.	.	.	1	+	+	1	+	+	1	.	.	.	.	.	+	1	.	.	.	.
Acer pseudoplatanus	.	r	r	.	+	.	.	.	.	+	+	.	.	.	.	+	.	.	.	r	.	.	+	+	r	.	+	.	.	.	.	.	+	r	.	+	r	.	+	+	.	+	+	.	.	+	r	+	+	+
Mentha longifolia	a	+	+	b	.	b	1	a	b	a	a	.	+	+	.	.	.	+	3	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	b	1	1	1	.	.
Agrostis stolonifera	+	1	.	.	.	.	.	+	1	+	1	+	.	.	.	a	1	+	.	1	1	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	+	+	1	a	+	1	.	.	.
Tussilago farfara	.	.	+	.	1	.	1	+	.	.	+	.	.	.	+	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	+	.	.	.	.	+	3	a	a	1	r	+
Equisetum arvense	+	+	+	+	+	+	.	.	+	.	r	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	1	1	.	.	1	+	+	+	.	.
Cardamine pratensis	.	.	.	.	1	1	1	.	.	+	+	.	.	.	.	r	.	.	.	+	.	.	+	1	.	.	.	.	.	.	.	1	1	a	+	+	1	.	+	.	.	.	.	.	1	r	.	.	.	.
Eupatorium cannabinum	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	+	+	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	a	a	.	+	+	1	+	r
Petasites albus	.	.	.	+	b	1	.	.	.	+	.	.	a	1	.	.	.	.	+	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	a	a	.	1	.	.	.	.	.	.
Deschampsia cespitosa	.	.	.	.	1	1	1	+	+	1	a	a	+	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	a	.	.	.	.	.	.	.	.	.
Picea abies	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	+	.	.	.	.	r	.	.	.	r	.	r	r	.	.	+	.	.	+	.	.	+	.
Cirsium oleraceum	.	.	.	r	.	1	+	+	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	r	.	.	.	.	.	.	.	+	.	.	.
Potentilla erecta	.	.	r	+	.	.	.	.	+	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Sesleria albicans	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	+	.	.	+	1	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix silesiaca	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	r	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Valeriana tripteris	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.
Geum rivale	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Primula elatior	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa trivialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites kablikianus	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Filipendula ulmaria	.	.	.	.	+	+	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites hybridus	.	.	.	.	.	.	1	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.
Epilobium parviflorum	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	+	.	.

Table 3. *Continued.*

Relevé number	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.
Fraxinus excelsior	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.
Abies alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Bryophytes																																																		
Plagiomnium elatum	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Tortella tortuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiochila asplenioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trichocolea tomentella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Taxa occurring in 1–3 relevés

E_2: *Salix silesiaca* + (15).

E_1: *Acetosa pratensis* r (2); *Aconitum variegatum* r (33, 36); *Ajuga reptans* + (42); *Alchemilla* sp. + (12, 46), r (42); *Asplenium viride* + (23), r (29); *Athyrium filix-femina* r (48); *Brachypodium sylvaticum* + (20, 44); *Briza media* + (9), r (11); *Buphthalmum salicifolium* r (28); *Campanula cochleariifolia* + (23, 29); *Carex davalliana* + (36); *C. digitata* + (13); *C. firma* + (25); *C. hirta* + (42); *C. nigra* + (12); *C. paniculata* + (41); *C. *tatrorum* r (14); *C. sylvatica* + (45); *Carpinus betulus* r (43); *Cerastium holosteoides* r (45); *Chrysosplenium alternifolium* + (32); *Cirsium rivulare* + (2), a (42); *Crepis jacquinii* + (23); *Cruciata glabra* + (42); *Dactylorhiza fuchsii* r (6, 7); *D. majalis* r (3); *Daphne mezereum* + (36); *Dianthus nitidus* + (23); *Dryopteris carthusiana* r (45); *Epilobium* sp. + (6), a (41); *Equisetum fluviatile* + (47); *Galium anisophyllum* + (15); *G. mollugo* r (44), + (45); *G. schultesii* + (13, 14); *Glyceria notata* + (38, 45), r (42); *Gymnadenia conopsea* r (14); *Gymnocarpium robertianum* r (34); *Hieracium bifidum* + (27); *H. lachenalii* + (43); *H. murorum* r (43); *Huperzia selago* + (27); *Juncus alpinoarticulatus* 1 (12), + (21); *J. inflexus* + (14); *Linum catharticum* + (9, 28, 46); *Lonicera nigra* + (25); *Lunaria rediviva* + (23); *Melampyrum sylvaticum* r (34); *Melica nutans* r (34); *Myosotis scorpioides* agg. + (8, 29, 45); *M. sylvatica* + (15, 32); *Oxalis acetosella* + (33), r (40); *Parnassia palustris* r (41); *Pimpinella major* + (13); *Poa alpina* + (15); *P. chaixii* + (5); *P. palustris* 1 (32); *Poa* sp. + (15); *Polygala *brachyptera* + (13); *Ranunculus breyninus* r (11); *R. pseudomontanus* + (14, 15); *Rubus saxatilis* + (17); *Rumex* sp. + (41); *Salix caprea* r (4), + (43); *S. cinerea* + (7), r (8); *S. purpurea* r (43); *Sambucus nigra* + (48); *Scirpus sylvaticus* + (7); *Sorbus aucuparia* r (40); *Valeriana *sambucifolia* + (25); *Veronica beccabunga* + (14); *Vicia cracca* + (42).

E_0: *Amblystegium tenax* + (1); *Brachythecium reflexum* + (29); *Calliergonella cuspidata* + (35, 45); *Campylium stellatum* + (7); *Chiloscyphus pallescens* + (40); *Ctenidium molluscum* + (27, 34); *Dicranum bonjeanii* + (34); *Fissidens adianthoides* + (34, 35); *F. dubius* + (27, 37, 39); *Jungermannia atrovirens* + (50); *Lophocolea bidentata* + (17, 18); *Lophozia longiflora* + (4); *Marchantia polymorpha* + (3); *Orthothecium rufescens* + (30, 31); *Peltigera* sp. + (27).

Localities of relevés (relevé data as in Table 2)

1. Blatnica, Blatnická dolina valley, below mouth of Juriašova dolina valley, 660 m, N, 3°, 25 m^2, TC: 95%, E_1: 15%, E_0: 90%, 20 Aug. 1996, MV.
2. Jelenec, Hornojelenská dolina valley, settlement of Prášnica, 817 m, SE, 18°, 15 m^2, TC: 85%, E_1: 10%, E_0: 85%, 48°52′32.0″, 19°07′54.8″, EC = 353 µS/cm, t = 11.2°C, pH = 8.1, 14 June 2006, RH, JKo & JKl.
3. Kraľovany, foothills of Kopa Mt., unnamed left tributary of Váh River, 526 m, WNW, 26°, 24 m^2, TC: 75%, E_1: 50%, E_0: 75%, 49°08′48.1″, 19°08′02.4″, EC = 340 µS/cm, t = 8.2°C, pH = 8.35, 23 June 2006, JKo.
4. Kraľovany, foothills of Kopa Mt., unnamed left tributary of Váh River, 516 m, NW, 14°, 30 m^2, TC: 90%, E_1: 33%, E_0: 90%, 49°08′47.7″, 19°08′02.6″, EC = 343 µS/cm, t = 7.7°C, pH = 8.23, 23 June 2006, JKo.
5. Harmanec, at end of Zalámaná valley, below Krásny kopec Mt., 886 m, WSW, 20°, 21m^2, TC: 90%, E_1: 60%, E_0: 90%, 48°51′12.5″, 19°01′23.5″, EC = 371 µS/cm, t = 6.7°C, pH = 7.95, 18 May 2006, JKo.

6. Harmanec, Zalámaná valley, *ca* 200 m below reservoir, spring near main stream, 841 m, SSW, 15°, 16 m^2, TC: 90%, E_1: 50%, E_0: 90%, 48°51′00.4″, 19°01′11.0″, 18 May 2006, JKo.
7. Harmanec, Zalámaná valley, main stream near reservoir, 867 m, SW, 18°, 12 m^2, TC: 98%, E_1: 75%, E_0: 90%, 48°51′12.5″, 19°01′23.5″, 18 May 2006, JKo.
8. Harmanec, Zalámaná valley, above forestry hut, below forest, 809 m, WSW, 10°, 8 m^2, TC: 95%, E_1: 60%, E_0: 90%, 48°50′48.3″, 19°00′57.3″, EC = 382 µS/cm, t = 6.4°C, pH = 7.51, 18 May 2006, JKo.
9. Liptovské Revúce, Zelená dolina valley, right branch, side spring, 899 m, ESE, 5°, 18 m^2, TC: 90%, E_1: 40%, E_0: 90%, 48°54′36.7″, 19°06′36.7″, EC = 322 µS/cm, t = 6.4°C, pH = 7.56, 2 Aug. 2006, JKo.
10. Blatnica, Selenec valley, at mouth of Padva gorge, near well, *ca* 780 m, NNW, 5°, 13 m^2, TC: 65%, E_1: 20%, E_0: 65%, 48°54′25.7″, 19°00′10.3″, 348 µS/cm, t = 9.1°C, pH = 7.87, 16 Aug. 2006, JKo & JKl.
11. Blatnica, Selenec valley, spring on left bank of brook above mouth of Skalná River, –, SE, 2°, 8 m^2, TC: 75%, E_1: 18%, E_0: 75%, –, EC = 375 µS/cm, t = 8.6°C, pH = 7.87, 24 Aug. 2006, JKo & JKl.
12. Blatnica, gorge between Kráľova skala and Ťava boulder formation, 1220 m, NE, 15°, 25 m^2, –, E_1: 50%, E_0: 60%, 19 Aug. 1982, DB.
13. Jelenec, Hornojelenská dolina valley, settlement of Rybô, spring at mouth of valley; –, W, 50°, 18 m^2, –, E_1: 35%, E_0: 60%, 5 June 1984, DB.
14. Jelenec, Hornojelenská dolina valley, settlement of Rybô, spring at mouth of valley; –, E, 40°, 50 m^2, –, E_1: 30%, E_0: 60%, 5 June 1984, DB.
15. Main ridge of Veľké Fatra Mts, Ploská Mt., spring on west slope, above tourist trail (traverse line), 1330 m, NW, 40°, 36 m^2, –, E_2: 1%, E_1: 40%, E_0: 80%, 27 Aug. 1985, DB & JKl.
16. Blatnica, Selenec valley, at mouth of Skalná dolina valley, right bank of brook, 755 m, N, 15°, 12 m^2, TC: 90%, E_1: 15%, E_0: 90%, 48°54′51.2″, 19°00′33.9″, EC = 342 µS/cm, t = 10.0°C, pH = 7.81, 16 Aug. 2006, JKo & JKl.
17. Jelenec, Hornojelenská dolina valley, settlement of Valentová, above right bank of brook, 665 m, NNW, 20°, 12 m^2, TC: 100%, E_1: 90%, E_0: 90%, 48°51′59.3″, 19°08′10.1″, 23 May 2006, JKo & JKl.
18. Jelenec, Hornojelenská dolina valley, settlement of Valentová, 663 m, NNZ, 35°, 24 m^2, TC: 80%, E_1: 25%, E_0: 80%, 48°51′59.6″, 19°08′10.1″, EC = 400 µS/cm, t = 8.5°C, pH = 8.06, 23 May 2006, JKo & JKl.
19. Jelenec Hornojelenská dolina valley, settlement of Prášnica, Slivkova dolinka valley, –, SW, 35°, 18 m^2, –, E_1: 40%, E_0: 70%, 5 June 1984, DB.
20. Blatnica, Selenec valley, bottom of Skalná dolina valley (right bank), *ca* 765 m, NW, 10°, 15 m^2, TC: 90%, E_1: 10%, E_0: 90%, 48°54′46.0″, 19°00′40.1″, EC = 344 µS/cm, t = 10.0°C, pH = 7.97, 24 Aug. 2006, JKo & JKl.
21. Blatnica, gorge between Kráľova skala and Ťava boulder formation, 1200 m, NW, 30°, 50 m^2, –, E_1: 70%, E_0: 90%, EC = 304 µS/cm, t = 8.5°C, pH = 7.89 (measured in 2007), 19 Aug. 1982, DB.
22. Jelenec, Hornojelenská dolina valley, settlement of Valentová, rocky spring above brook; –, NW, 60°, 50 m^2, –, E_1: 40%, E_0: 75%, 5 June 1984, DB.
23. Blatnica, Skalná dolina valley, very steep glen in gorge, –, E, 80–90°, 55 m^2, –, E_1: 30%, E_0: 50%, 7 Aug. 1979, DB.
24. Blatnica, Padva gorge, spring above waterfall; –, NNW, 10°, 50 m^2, –, E_1: 30%, E_0: 95%, 10 June 1983, DB.
25. Liptovské Revúce, Zelená dolina valley, opposite water station, foothills of Ostré brdo, 813 m, NE, 50°, 10 m^2, TC: 95%, E_1: 40%, E_0: 95%, 48°54′17.2″, 19°07′36.9″, EC = 322µS/cm, t = 11.9°C, pH = 8.27, 2 Aug. 2006, JKo & JKl.
26. Jelenec, Hornojelenská dolina valley, settlement of Prášnica, Slivkova dolinka valley, next to trail, –, E, 40°, 6 m^2, –, E_1: 40%, E_0: 95%, 5 June 1984, DB.
27. Belá, Belianska dolina valley, bottom of small valley called Lučečné, –, 45°, 60 m^2, –, E_1: 15%, E_0: 90%, 21 May 1985, DB.
28. Belá, Belianska dolina valley, bottom of small valley called Lučečné, –, NW, 45°, 36 m^2, –, E_1: 40%, E_0: 70%, 26 July 2006, DB.
29. Blatnica, Dedošová dolina valley, between Drobkovo and Vrátna, *ca* 800 m, NE, 70°, 30 m^2, –, E_1: 40%, E_0: 75%, 7 Sept. 1982, DB.
30. Blatnica, Vrátna dolina valley, base of rock face (with some flowing water), 950 m, E, 20°, 12 m^2, –, E_1: 30%, E_0: 70%, 16 Aug. 1982, DB.

Table 3. *Continued.*

31. Blatnica, Vrátna dolina valley, wet overhanging rock above spring, 925 m, NNW, 30°, 14 m, –, E_1: 15%, E_0: 70%, 18 Sept. 1985, DB, JKl & I. Jarolímek.
32. Blatnica, Padva Gorge, spring over waterfall, 990 m, N, 40°, 63 m^2, –, E_1: 30%, E_0: 95%, 18 Sept. 1984, DB.
33. Blatnica, Selenec valley, below mouth of Skalná River, right bank, 740 m, WNW, 35°, 18 m^2, TC: 85%, E_1: 10%, E_0: 85%, 48°54′56.7″, 19°00′42.8″, EC = 373 µS/cm, t = 9.3°C, pH = 8.35, 16 Aug. 2006, JKo & JKl.
34. Blatnica, Selenec valley, overhanging rock above mouth of Hlboká River with some seeping water, *ca* 737 m, NNW, 15°, 2.5 m^2, TC: 80%, E_1: 50%, E_0: 80%, 48°55′07.6″, 19°00′51.2″, 24 Aug. 2006, JKo & JKl.
35. Blatnica, Selenec valley, mouth below end of Padva gorge, side valley, 797 m, N, 28°, 10 m^2, TC: 50%, E_1: 40%, E_0: 50%, 48°54′33.7″, 19°00′17.2″, EC = 348 µS/cm, t = 9.5°C, pH = 8.37, 24 Aug. 2006, JKo.
36. Blatnica, Selenec valley, in mouth of side valley between Skalná and Padva, 765 m, NNW, 15°, 8 m^2, TC: 90%, E_1: 60%, E_0: 90%, 48°54′34.1″, 19°00′17.4″, EC = 428 µS/cm, t = 9.5°C, pH = 8.37, 24 Aug. 2006, JKl.
37. Ľubochňa, Ľubochnianska dolina valley, mouth of valley below Ploská Mt., *ca* 900 m, NE, 35°, 20 m^2, TC: 75%, E_1: 10%, E_0: 75%, 48°56′31.7″, 19°08′31.0″, EC = 357 µS/cm, t = 6.6°C, pH = 8.26, 30 Aug. 2006, RH, JKo & JKl.
38. Liptovské Revúce, Zelená dolina valley, left branch, 940 m, ENE, 30°, 12 m^2, TC: 80%, E_1: 60%, E_0: 80%, 48°54′46.5″, 19°06′44.4″, EC = 279 µS/cm, t = 9.2°C, pH = 8.12, 2 Aug. 2006, JKo.
39. Ľubochňa, Ľubochnianska dolina valley, above Vyšný tajch (artificial lake), *ca* 800 m, W, 40°, 8 m^2, TC: 75%, E_1: 15%, E_0: 75%, 48°57′41.6″, 19°08′26.6″, EC = 373 µS/cm, t = 10.2°C, pH = 7.97, 30 Aug. 2006, RH, JKo & JKl.
40. Liptovské Revúce, Zelená dolina valley, left branch, on right bank of brook, 904 m, S, 12°, 16 m^2, TC: 75%, E_1: 35%, E_0: 75%, 48°54′41.3″, 19°06′34.9″, EC = 386 µS/cm, t = 8.6°C, pH = 7.92, 2 Aug. 2006, JKo & JKl.
41. Blatnica, Blatnická dolina valley, mouth of Rakytovská dolina valley, 733 m, SW, 3°, 20 m^2, TC: 95%, E_1: 30%, E_0: 95%, 20 Aug. 1996, MV.
42. Turecká, Ramžiná valley, right brook tributary, 647 m, ENE, 20°, 20 m^2, TC: 80%, E_1: 30%, E_0: 80%, 48°51′12.8″, 19°04′10.4″, EC = 266 µS/cm, t = 7.4°C, pH = 8.07, 14 June 2006, RH, JKo & JKl.
43. Turecká, below village, spring with tufa located above road, 600 m, S, 80°, 16 m^2, TC: 92%, E_1: 30%, E_0: 90%, 48°50′50.9″, 19°05′30.7″, EC = 333 µS/cm, t = 8.3°C, pH = 8.0, 14 June 2006, RH, JKo & JKl.
44. Liptovské Revúce, Zelená dolina valley, intermittent rocky left tributary, 800 m, SSW, 20°, 10 m^2, TC: 70%, E_1: 30%, E_0: 70%, 48°54′19.4″, 19°07′55.9″, EC = 265 µS/cm, t = 13.1°C, pH = 8.05, 10 Aug. 2006, JKo & JKl.
45. Liptovské Revúce, Suchá dolina valley, left tributary, side valley, *ca* 840 m, SW, 25°, 16 m^2, TC: 70%, E_1: 45%, E_0: 70%, 48°53′24.6″, 19°07′41.5″, EC = 323 µS/cm, t = 8.4°C, pH = 8.01, 10 Aug. 2006, JKo & JKl.
46. Liptovské Revúce, Suchá dolina valley, tributary flowing from below Prášnické sedlo saddle, 873 m, NNE, 20°, 16 m^2, TC: 80%, E_1: 25%, E_0: 80%, 48°53′17.1″, 19°07′16.7″, EC = 344 µS/cm, t = 11.2°C, pH = 8.17, 10 Aug. 2006, JKo & JKl.
47. Liptovské Revúce, Teplá dolina valley, below gorge, spring above road, 668 m, SSW, 25°, 15 m^2, TC: 85%, E_1: 20%, E_0: 85%, 48°56′46.1″, 19°13′37.1″, EC = 383 µS/cm, t = 10.2°C, pH = 8.30, 10 Aug. 2006, JKo & JKl.
48. Staré Hory, valley below Japeň (Košiar) Mt., cascades with tufa, 530 m, SE, 20°, 16 m^2, TC: 75%, E_1: 25%, E_0: 75%, 48°50′01.6″, 19°05′51.4″, EC = 535 µS/cm, t = 9.0°C, pH = 8.19, 14 Sept. 2006, JKo.
49. Staré Hory, valley belowJapeň (Košiar), cascades with tufa, 535 m, SW, 15°, 20 m^2, TC: 75%, E_1: 2%, E_0: 75%, 48°50′01.6″, 19°05′51.4″, EC = 534 µS/cm, t = 8.9°C, pH = 8.3, 14 Sept. 2006, RH.
50. Dolný Harmanec, Bystrická dolina valley, above tunnel, left tributary, 630 m, SW, 35°, 20 m^2, TC: 75%, E_1: 5%, E_0: 75%, 48°50′12.5″, 19°04′04.0″, 338 µS/cm, t = 7.9°C, pH = 8.13, 14 Sept. 2006, JKo & RH.

Palustriella commutata-community (*Cratoneurion commutati*)

Table 1, column 7; Table 3, relevé 39–50; Table 4, column 4.

DIAGNOSTIC TAXA: *Acer pseudoplatanus* (const.), *Eupatorium cannabinum* (const.), *Tussilago farfara* (const.); *Bryum pseudotriquetrum* (const.), *Palustriella commutata* (dom., const.).

Bryophytes (particularly *Palustriella commutata*) are the distinct dominants of the community located in shaded flowing springs with tufa. The species-poor herb layer is not very well developed – only the ordinary species of surrounding woodlands and wet meadows are present. The community occurs along small tributaries of larger brooks. The slope of the stands is (3°) 15–25° (80°); altitude varies from 530 to 905 m a.s.l. Water reaction is slightly alkaline.

Philonotido calcareae-Saxifragetum aizoidis Unar in Unar *et al.* 1985

A community recorded by a spring on the southeast slope of Malá Pustalovčia Mt. shows the closest affinities to the association *Philonotido calcareae-Saxifragetum aizoidis*.

LOCALITY: SLOVAKIA. Malá Pustalovčia Mt., spring below water reservoir; 1475 m a.s.l., SE, 45°, 7 m^2, total cover 70%, E_1: 40%, E_0: 70%, 48°53′02.0″N/19°05′01.0″E, EC = 264 µS/cm, t = 18.3°C, pH = 7.91, 18 July 2007, JKo, JKl.

E_1: *Carex flacca* 2b, *Juncus alpinoarticulatus* 2a, *Molinia caerulea* 2a, *Saxifraga aizoides* 2a, *Parnassia palustris* 1, *Carex flava* +, *Deschampsia cespitosa* +, *Equisetum fluviatile* +, *Leucanthemum margaritae* +, *Ranunculus breyninus* +, *Tussilago farfara* +, *Alchemilla* sp. r, *Bellidiastrum michelii* r, *Crepis mollis* r, *Linum catharticum* r.

E_0: *Palustriella commutata* 4, *Bryum schleicheri* 2a, *B. pseudotriquetrum* 1.

DISCUSSION

DIVERSITY OF INVESTIGATED COMMUNITIES IN THE CONTEXT OF THE WESTERN CARPATHIANS

We recorded nine plant communities in the area of the Veľká Fatra Mts during our investigation. Only three associations from this region (*Calthetum laetae*, *Cratoneuretum falcati*, *Cochleario pyrenaicae-Cratoneuretum commutati*) were included in the latest national survey (Valachovič 2001), mainly due to insufficient knowledge of them. The high variability of the spring communities in the Veľká Fatra Mts represents nearly the whole range of their diversity within Slovakia. The only missing communities are from alliances *Epilobio nutantis-Montion* Zechmeister in Zechmeister et Mucina 1994 and *Swertio-Anisothecion squarrosi* Hadač 1983 (Syntax. syn.: *Philonotidion seriatae* Hinterlang 1992), but those are present in Slovakia only marginally. The most frequent communities are those occurring in the high, mostly calcareous mountains of the Western Carpathians (Belianske Tatry, Západné Tatry and Nízke Tatry Mts; cf. Hadač *et al.* 1969; Unar *et al.* 1984) belonging to the alliance *Cratoneurion commutati*. Also abundant are communities characteristic of the Carpathian foothills (alliances *Caricion remotae*, *Lycopodo-Cratoneurion commutati*; cf. Hájek 1998, 2000; Valachovič & Janovicová 1999; Hrivnák *et al.* 2005). The location of the Veľká Fatra Mts and their diversity of bedrock types enable both montane and submontane spring communities to persist. Some spring vegetation types whose presence is favored by the bedrock type do not occur because their altitude preferences are not met. Vegetation of the alliances *Caricion remotae* and *Lycopodo-Cratoneurion commutati* is absent from the Belianske Tatry and Západné Tatry Mts, which are higher. Communities of the alliances *Cratoneurion commutati* and *Cratoneuro filicini-Calthion laetae* are absent from the Strážovské vrchy Mts and Muránska planina Mts, which are lower.

CLASSIFICATION WITHIN HIGHER SYNTAXA

Hinterlang (1992: 67) described a new order, *Cardamino-Chrysosplenietalia*, which unifies the forest springs (in most cases silted) of the alliance *Caricion remotae* Kästner 1941. Zechmeister and Mucina (1994: 401) included the alliance *Caricion remotae* [which can be divided into two suballiances: *Caricenion remotae* Zechmeister et Mucina 1994 and *Cratoneuro filicini-Calthenion laetae* (Hadač 1983) Zechmeister et Mucina 1994] in

Table 4. A comparison of mountain calcareous crenal communities from the Western Carpathians (clusters 3–5) with the ones from the Alps (clusters 1–2), and comparison of *Palustriella commutata*-community (cluster 4) with other related spring communities (clusters 5–7). 1 – *Cratoneuretum commutati*, 2 – *Arabido bellidifoliae-Cratoneuretum falcati*, 3 – *Cardamino opicii-Cratoneuretum falcati*, 4 – *Palustriella commutata*-community, 5 – *Cardamino amarae-Cratoneuretum*, 6 – *Cratoneuretum filicino-commutati*, 7 – *Pellio endiviifoliae-Cratoneuretum commutati* (1–6 – *Cratoneurion commutati*, 7 – *Lycopodo europaei-Cratoneurion commutati*).

Column number	1	2a	2b	3a	3b	3c	4	5	6	7
Number of relevés	5	6	*3*	*3*	5	38	12	20	60	14
Average number of species	13	10	14	27	15	20	17	13	?	17
Altitudinal range (m)	450 900	1835 2024	2070 2070	930 1080	1080 1220	516 1330	530 904	690 1245	320 900	250 400
Cratoneuretum commutati										
Silene alpestris	**100**^{4}	.	.	.	.	.	.	.	.	.
Adenostyles alpina	**100**^{3}	.	.	.	.	.	.	.	.	.
Petasites paradoxus	**60**^{2}	.	.	.	.	.	.	.	.	.
Arabido bellidifoliae-Cratoneuretum falcati										
Carex frigida	.	**100**^{3}	***1***$^{2-3}$	.	.	.	.	.	.	.
Saxifraga stellaris	.	**33**^{2}	***3***$^{2-3}$	.	.	.	.	.	.	.
Gentiana bavarica	.	**17**^{2}	***2***^{2}	.	.	.	.	.	.	.
Cardamino opicii-Cratoneuretum falcati										
Cortusa matthioli	.	.	.	***2***^{3}	**100**^{3}	**79**^{5}	25^{4}	.	.	.
Swertia perennis	.	.	.	***2***^{3}	**80**^{3}	**34**^{3}	.	.	.	.
Soldanella carpatica	.	.	.	***2***^{3}	**20**^{1}	**16**^{2}	.	.	.	.
Cardamino amarae-Cratoneuretum commutati										
Epilobium alsinifolium	.	.	*1*^{2}	*2*^{3}	.	5^{4}	.	**75**^{4}	.	.
Pellio endiviifoliae-Cratoneuretum commutati										
Brachythecium rivulare (E_0)	.	.	.	.	.	34^{2}	8^{2}	5^{2}	23	**86**^{4}
Cratoneuron filicinum (E_0)	.	.	.	.	.	21^{4}	8^{2}	15^{2}	22	**64**^{2}
Oxalis acetosella	.	.	.	.	.	3^{2}	8^{1}	5^{2}	.	**50**^{2}
Fissidens taxifolius (E_0)	.	.	.	.	.	.	.	.	.	**29**^{2}
Scrophularia umbrosa	.	.	.	.	.	.	.	.	.	**21**^{3}
Lycopus europaeus	.	.	.	.	.	.	.	.	.	**14**^{2}
Cratoneurion commutati										
Saxifraga aizoides	40^{3}	100^{3}	*2*$^{2-3}$	.	20^{6}	.	.	.	.	.
Silene pusilla	20^{5}	.	.	.	100^{6}	5^{6}	.	.	.	.
*Arabis *subcoriacea*	.	67^{2}	*1*^{2}	*2*^{5}	80^{4}	68^{4}	.	.	2	.
Philonotis calcarea (E_0)	.	.	.	*2*^{3}	.	5^{4}	8^{7}	55^{3}	22	.
Bellidiastrum michelii (d)	100^{2}	33^{2}	*2*^{3}	*2*^{3}	.	45^{2}	.	.	13	.
Pinguicula alpina (d)	100^{3}	.	*1*^{2}	*3*^{3}	20^{3}	13^{2}	.	.	.	.
Tofieldia calyculata (d)	100^{2}	.	.	*3*^{4}	.	32^{2}	.	.	7	.
Montio-Cardaminetalia, Montio-Cardaminetea										
Palustriella commutata[1] (E_0)	100^{9}	100^{6}	*3*$^{3-8}$	*3*^{9}	100^{9}	100^{8}	100^{8}	95^{8}	100	64^{6}
Bryum pseudotriquetrum (E_0)	.	50^{2}	.	*3*^{4}	100^{5}	89^{4}	100^{4}	80^{3}	58	57^{5}
*Cardamine *amara*	.	33^{2}	.	*2*^{3}	.	32^{3}	25^{4}	**95**^{3}	13	14^{5}
Caltha palustris	.	.	*2*$^{2-3}$	*3*^{2}	40^{2}	61^{3}	33^{3}	45^{3}	8	7^{1}
Eucladium verticillatum (E_0)	20^{7}	.	.	.	.	3^{2}	17^{3}	.	23	21^{3}
Aneura pinguis (E_0)	.	.	.	.	40^{2}	5^{2}	8^{2}	**45**^{2}	13	.
Conocephalum conicum (E_0)	.	.	.	.	.	29^{3}	42^{3}	5^{2}	23	21^{3}
Pellia endiviifolia (E_0)	.	.	.	.	.	5^{3}	25^{2}	15^{2}	37	**64**^{4}
Chrysosplenium alternifolium	.	.	.	.	.	3^{2}	.	5^{2}	8	.
Philonotis seriata (E_0)	.	17^{2}	.	.	.	.	8^{3}	.	.	.
*Allium *alpinum*	.	33^{2}	.	.	.	.	.	.	.	.
Epilobium anagallidifolium	.	.	*1*^{2}	.	.	.	.	.	.	.
*Cardamine *opicii*	.	.	.	*1*^{2}	.	.	.	.	.	.

Table 4. *Continued.*

Column number	1	2a	2b	3a	3b	3c	4	5	6	7
Palustriella decipiens (E_0)	.	.	.	.	.	11^{3}	.	10^{6}	.	.
Philonotis fontana (E_0)	.	.	.	.	.	8^{4}	.	15^{3}	.	.
Schechzerio-Caricetea fuscae										
Carex flava agg.	20^{2}	.	.	2^{4}	.	32^{2}	25^{2}	5^{2}	.	.
Parnassia palustris	20^{2}	.	.	2^{3}	20^{3}	.	8^{1}	.	.	.
Juncus alpinoarticulatus	.	50^{2}	.	.	.	5^{3}	.	.	.	.
Hippochaete variegata	.	50^{2}	.	.	.	.	.	.	.	.
Carex nigra	.	.	3^{3-7}	.	.	3^{2}	.	.	.	.
Carex davalliana	.	.	2^{2}	.	.	3^{2}	.	.	.	.
Equisetum palustre	.	.	.	2^{5}	.	32^{3}	.	45^{3}	3	.
Cirsium palustre	.	.	.	.	.	11^{2}	25^{2}	5^{3}	.	.
Pinguicula vulgaris	.	.	.	.	.	8^{2}	8^{1}	.	17	.
Juncus articulatus	.	.	.	.	.	8^{2}	25^{2}	.	.	.
Primula farinosa	.	.	.	.	.	5^{2}	8^{4}	.	.	.
Other taxa										
Deschampsia cespitosa	40^{3}	100^{3}	1^{2}	2^{3}	.	34^{3}	8^{5}	65^{4}	15	7^{1}
Tussilago farfara	80^{2}	33^{2}	.	.	.	29^{2}	67^{3}	40^{3}	.	7^{1}
Crepis paludosa	60^{2}	.	.	3^{3}	100^{3}	95^{3}	8^{2}	15^{2}	17	.
Chaerophyllum hirsutum	20^{2}	.	.	3^{4}	100^{3}	58^{3}	50^{4}	40^{3}	.	.
Carex flacca	40^{2}	.	.	.	20^{3}	24^{2}	.	.	33	.
Calamagrostis arundinacea	60^{2}	.	.	2^{2}	.	.	.	5^{2}	.	.
Agrostis stolonifera	.	83^{4}	.	.	.	42^{3}	50^{3}	45^{3}	23	43^{3}
Alchemilla sp. div.	.	17^{2}	1^{2-3}	.	.	3^{2}	17^{2}	.	.	.
Poa alpina	.	.	1^{2}	.	20^{2}	3^{2}	.	5^{3}	.	.
Glyceria plicata	.	.	.	2^{3}	.	3^{2}	17^{2}	15^{2}	.	29^{2}
Viola biflora	.	.	.	3^{2}	20^{3}	61^{3}	25^{3}	50^{3}	.	.
Linum catharticum	.	.	.	2^{2}	.	5^{2}	8^{2}	5^{2}	.	.
Petasites albus	.	.	.	1^{2}	.	26^{3}	33^{4}	.	.	.
Cystopteris fragilis	.	.	.	3^{2}	.	11^{2}	.	.	.	21^{2}
Galium anisophyllum	.	.	.	2^{3}	20^{3}	3^{2}	.	.	.	.
Rhizomnium punctatum (E_0)	.	.	.	.	20^{2}	24^{3}	33^{2}	15^{2}	12	36^{2}
Poa trivialis	.	.	.	.	60^{2}	13^{2}	.	65^{4}	.	29^{3}
Calamagrostis varia	.	.	.	.	20^{2}	42^{2}	33^{2}	.	.	.
Petasites kablikianus	.	.	.	.	40^{3}	11^{3}	8^{3}	.	.	.
Geranium robertianum	.	.	.	.	.	32^{2}	50^{2}	5^{2}	30	57^{2}
Equisetum arvense	.	.	.	.	.	32^{2}	58^{2}	5^{3}	18	7^{2}
Plagiomnium undulatum (E_0)	.	.	.	.	.	26^{3}	42^{2}	5^{2}	20	71^{2}
Cardamine pratensis	.	.	.	.	.	39^{3}	25^{2}	15^{2}	7	.
Mycelis muralis	.	.	.	.	.	29^{2}	33^{3}	10^{2}	.	57^{2}
Epilobium parviflorum	.	.	.	.	.	3^{1}	25^{2}	5^{5}	.	7^{1}
Mentha longifolia	.	.	.	.	.	45^{4}	42^{4}	.	2	7^{3}
Plagiochila asplenioides (E_0)	.	.	.	.	.	8^{4}	.	10^{2}	18	7^{2}
Picea abies	.	.	.	.	.	16^{1}	42^{2}	15^{2}	.	.
Valeriana tripteris	.	.	.	.	.	13^{2}	8^{2}	5^{2}	.	.
Acer pseudoplatanus	.	.	.	.	.	39^{2}	75^{2}	.	.	43^{2}
Cirsium oleraceum	.	.	.	.	.	21^{3}	17^{2}	.	.	14^{2}
Eupatorium cannabinum	.	.	.	.	.	21^{2}	75^{3}	.	30	.
Senecio nemorensis agg.	.	.	.	.	.	18^{2}	.	5^{2}	.	21^{2}
Veronica beccabunga	.	.	.	.	.	3^{2}	.	20^{2}	.	21^{3}
Carex brachystachys	40^{2}	.	.	.	.	11^{2}	.	.	.	.
Dactylorhiza majalis	.	33^{2}	.	.	.	3^{1}	.	.	.	.
Bryum schleicheri (E_0)	.	.	2^{2-8}	.	.	.	.	15^{2}	.	.
Poa palustris	.	.	.	3^{3}	.	3^{3}	.	.	.	.
Sesleria tatrae	.	.	.	2^{4}	20^{2}	.	.	.	.	.

Table 4. *Continued.*

Column number	1	2a	2b	3a	3b	3c	4	5	6	7
Stellaria nemorum	.	.	.	.	.	16^{2}	.	25^{3}	.	.
Marchantia polymorpha (E_0)	.	.	.	.	.	3^{2}	.	.	.	29^{3}
Fraxinus excelsior	.	.	.	.	.	.	17^{1}	.	.	36^{2}
Ranunculus repens	.	.	.	.	.	.	.	5^{2}	.	29^{3}
Ranunculus aconitifolius	.	33^{2}	.	.	.	.	.	.	.	.
Dichodon cerastoides	.	.	2^{2}	.	.	.	.	.	.	.
Cirsium spinosissimum	.	.	2^{2-3}	.	.	.	.	.	.	.
Adenostyles alliariae	.	.	.	2^{3}	.	.	.	.	.	.
Ranunculus alpestris	.	.	.	2^{3}	.	.	.	.	.	.
Thuidium philiberti (E_0)	.	.	.	.	60^{4}	.	.	.	.	.
Aconitum firmum	.	.	.	.	40^{2}	.	.	.	.	.
Chiloscyphus polyanthos (E_0)	.	.	.	.	40	.	.	.	.	.
Sesleria albicans	.	.	.	.	.	18^{2}	.	.	.	.
Cystopteris montana	.	.	.	.	.	16^{2}	.	.	.	.
Prunella vulgaris	.	.	.	.	.	.	25^{3}	.	.	.
Sambucus nigra (E_2)	.	.	.	.	.	.	.	.	.	79^{2}
Fraxinus excelsior (E_2)	.	.	.	.	.	.	.	.	.	43^{2}
Impatiens parviflora	.	.	.	.	.	.	.	.	.	36^{4}
Urtica dioica	.	.	.	.	.	.	.	.	.	36^{2}
Lonicera xylosteum (E_2)	.	.	.	.	.	.	.	.	.	29^{1}
Number of accessory taxa [1] incl var. *falcata*	8	1	9	10	9	70	33	21	5+?	43

Sources

1 – *Cratoneuretum commutati* (Aichinger 1933, Tab. 17), 2a – *Arabido bellidifoliae-Cratoneuretum falcati* (Koch 1928, Tab. 4, r. 1–6), 2b – *Cratoneuretum falcati* (Gams 1927: 298, r. 1–3), 3a – *Cratoneurum falcatum-Cardamine opizii*-Ass. (Szafer & Sokołowski 1927, Tab. 2, r. 1–3), 3b – *Cratoneureto-Arabidetum bellidifoliae swertietosum perennis* (Hadač *et al*. 1969: 160, 161), 3c – *Cardamino opicii-Cratoneuretum falcati* (Veľká Fatra Mts, Tab. 3, r. 1–38), 4 – *Palustriella commutata*-community (Veľká Fatra Mts, Tab. 3, r. 39–50), 5 – *Cardamino-Cratoneuretum* (Kornaś & Medwecka-Kornaś 1967, Tab. 7), 6 – *Cratoneuretum filicino-commutati* (Philippi & Oberdorfer 1977, Tab. 62, col. 6a), 7 – *Pellio endiviifoliae-Cratoneuretum commutati* (Rivola 1982, Tab. 1)

a broadly conceived order *Montio-Cardaminetalia* Pawłowski 1928 em. Zechmeister 1993. Valachovič (2001: 299) followed the concept of Hinterlang (1992) and used the order *Cardamino-Chrysosplenietalia*, but preferred an altitudinal gradient and included the submontane springs of the alliances *Caricion remotae* (s.str.) and *Lycopodo-Cratoneurion commutati* Hadač 1983 in the order *Cardamino-Chrysosplenietalia.*

Our comparison of a wide spectrum of different spring communities recorded from the Veľká Fatra Mts (Table 1) shows the following: (*i*) great differences in ecological and floristic characteristics between silted (to muddy) springs and springs located on calcareous gravel or tufa, which are affected by fast-flowing water (Fig. 2). DCA analysis using Ellenberg indicator values as supplementary data (Fig. 2) shows that the major variation of the data set corresponds to soil reaction (correlation coefficient 0.72) and nutrients (-0.66). These two factors are shown to be more important than the altitudinal gradient; (*ii*) the communities of montane oligotrophic springs are more related to the phytocoenoses of forest springs (cf. Zechmeister & Mucina 1994); and (*iii*) there are many species (including the dominating mosses) that are common to submontane communities of the alliance *Lycopodo-Cratoneurion commutati* and communities of the 'mountain' alliance *Cratoneurion commutati*.

Based on this, in the study area we assigned (*i*) the order *Cardamino-Chrysosplenietalia* (with two alliances: *Caricion remotae* and *Cratoneuro filicini-Calthion laetae*) and (*ii*) the order *Montio-Cardaminetalia* (with the alliances *Lycopodo-Cratoneurion commutati* and *Cratoneurion commutati*)

Table 5. Mean, maximum and minimum values of selected ecological characteristics (pH, water temperature, water conductivity and altitude). Car-Chry – *Cardamino amarae-Chrysosplenietum alternifolii*; Phi-Calt – *Philonotido seriatae-Calthetum laetae*; Car-Crat – *Cardamino opicii-Cratoneuretum falcati*; Palustriella – *Palustriella commutata*-community; Coch-Crat – *Cochleario pyrenaicae-Cratoneuretum commutati*.

Community	Variables	Min.	Mean	Max.
Car-Chry	pH	6.70	7.42	7.49
	temperature	5.20	9.65	11.70
	conductivity	67.0	290.2	1004.0
	altitude	500.0	743.4	922.0
Phi-Calt	pH	6.15	6.61	6.91
	temperature	6.60	7.40	8.70
	conductivity	58.0	62.7	69.0
	altitude	1296.0	1357.0	1388.0
Car-Crat	pH	7.51	8.05	8.37
	temperature	6.40	8.76	11.90
	conductivity	279.0	351.7	400.0
	altitude	516.0	831.5	1330.0
Palustriella	pH	7.92	8.10	8.30
	temperature	7.40	9.38	13.10
	conductivity	265.0	370.9	535.0
	altitude	530.0	713.3	904.0
Coch-Crat	pH	7.10	7.23	7.40
	temperature	10.60	12.77	14.70
	conductivity	.	.	.
	altitude	564.0	632.8	670.0

(Table 1). This approach is supported by numerical analyses of the species composition and ecological requirements of the studied communities (Tables 1 & 5; Fig. 2).

COMPARISON OF THE STUDIED SPRING PHYTOCOENOSES OF THE VEĽKÁ FATRA MTS WITH THOSE DESCRIBED PREVIOUSLY. VALIDITY OF SYNTAXA

Brachythecio rivularis-Cardaminetum opicii (Krajina 1933) Hadač 1983

A unique recorded stand shows some floristic affinities to the association *Cratoneuro decipiens-Cardaminetum opicii*, described from the Polish part of the High Tatras (Pawłowski *et al.* 1928, Table 14). In comparing our relevé to the original diagnoses, the prevalence of differential taxa of *Brachythecio-Cardaminetum* (*Myosotis scorpioides* agg., *Senecio subalpinus*, *Bryum pseudotriquetrum*, *Philonotis seriata*) was evident. Only two differential taxa of *Cratoneuro-Cardaminetum* (*Stellaria nemorum*, *Palustriella decipiens*) were present. For this reason and because of the high dominance of *Cardamine *opicii* (a typical feature of *Brachythecio-Cardaminetum*) we placed the vegetation within this association.

Consistent with Krajina (1933: 889), Zechmeister and Mucina (1994: 400, 401) considered *Brachythecio rivularis-Cardaminetum* as well as *Cratoneuro decipiens-Cardaminetum* as separate associations, included in two different alliances.

The original diagnosis of the association *Cardaminetum opicii* Szafer *et al*. 1923 (Szafer *et al*. 1923, Table 15) represents a mixture of more communities belonging to different higher syntaxa. In addition, it does not carry any information about the ground layer (scattered information about a few bryophytes refers to those occurring outside of the recorded relevé plots; cf. Szafer *et al*. 1923: 13–14). This may be why the authors of the above-mentioned diagnosis described two separate vicarious *Cardamine *opicii* communities (Szafer & Sokołowski 1927; Pawłowski *et al.* 1928). According to Szafer and Sokołowski (1927: 138) the majority of relevés of '*Cardamine Opizii*-Ass.' might be included in *Cratoneuron falcatum-Cardamine Opizii*-Ass. (in the original approach; see below). However, they correspond more to stages of meadow, forest or tall herb communities than to a typical *Cratoneurion* association.

Cratoneuro falcati-Cardaminetum opizii Szafer et Sokołowski 1927

The mountain spring vegetation of calcareous tufa of the Slovak part of the Western Carpathians has been classified mostly in the associations *Cratoneuretum falcati* Gams 1927 (cf. Valachovič 2001: 322) and *Arabidi bellidifoliae-Cratoneuretum falcati* Koch 1928 nom. invers. (cf. Pawłowski 1956; Hadač *et al.* 1969; Hadač 1983, 1987). Those authors probably overlooked an older Polish paper (Szafer & Sokołowski 1927, Table 2), which describes the association *Cratoneuron falcatum-Cardamine Opizii* from calcareous parts of the Západné Tatry Mts, with the alternative presence of *Cardamine *opicii* and *C. *amara*.

The reason for overlooking that work might be that Pawłowski (1956: 18) listed only *Arabideto-Cratoneuretum* within the alliance *Cratoneurion commutati* in the Tatry Mts. Relevés 1–3 of the original diagnosis are related to communities later classified in the associations *Cratoneuretum falcati* or *Arabido-Cratoneuretum.* Relevés 4 and 5 represent a species-poor community without any diagnostic taxa. Relevé 6 (without *Palustriella falcata*) is a facies with *Philonotis calcarea*. Relevés 7 and 8 represent some wetland phytocoenoses with *Carex rostrata* and *Glyceria notata*.

Only a year later, Koch (1928: 157) described *Arabidi bellidifoliae-Cratoneuretum falcati* as a geographic vicariant to the Western Carpathian association *Cratoneuron falcatum-Cardamine Opizii*. Hadač (1983: 351) drew attention to the differences between the Alpine and Carpathian phytocoenoses once again. He separated stands from the Belianske Tatry Mts into a new subassociation *Cratoneuro-Arabidetum bellidifoliae swertietosum perennis*.

Unar *et al.* (1984: 62, Table 22, 1985: 40) reused the old name *Cratoneuro falcati-Cardaminetum opizii* Szaf. et Sokoł. 1927 in characterizing spring communities from the Červené vrchy in the Západné Tatry Mts. The authors chose a lectotype (relevé 3) that typifies the association as a community of tufa-forming springs. Applying Art. 10b, 41a and 42 of ICPN, the correct form of the association name is ***Cardamino opicii-Cratoneuretum falcati*** Szafer et Sokołowski 1927 *nom. invers. propos*. Nomenclature type (lectotypus): Szafer & Sokołowski 1927, Table 2, relevé 3 (Unar *et al.* 1985: 40):

LOCALITY. POLAND. Dolina Małej Łąki valley, 1000 m, eastern slope, right bank of stream near forest, moss cover *ca* 100 m^2, 26 Aug. 1924 & 26 May 1926.

E_1: *Arabis *subcoriacea* 2.2, *Carex flava* 2.2, *Crepis paludosa* 2.2, *Pinguicula alpina* 2.2, *Caltha palustris* 1.2, *Cardamine *amara* 1.1, *Chaerophyllum hirsutum* 1.1, *Cortusa matthioli* 1.1, *Deschampsia cespitosa* 1.2, *Epilobium alsinifolium* 1.2, *Equisetum palustre* 1.1, *Glyceria notata* 1.1, *Parnassia palustris* 1.1, *Poa palustris* 1.1, *Soldanella carpatica* 1.2, *Swertia *alpestris* 1.2, *Tofieldia calyculata* 1.1, *Viola biflora* 1.2, *Adenostyles alliariae* r.1, *Bellidiastrum michelii* r.1, *Cystopteris fragilis* r.1, *Galium anisophyllum* r.1, *Primula elatior* r.1, *Sesleria tatrae* r.2, *Saxifraga aizoides*.

E_0: *Palustriella falcata* 4.5, *Bryum pseudotriquetrum* 2.2. *Palustriella commutata* 1.2.

Palustriella commutata-community (*Cratoneurion commutati*)

In shaded crenal habitats in mountain valleys of the Veľká Fatra Mts, we also recorded stands with a floristic composition close to the association *Cardamino opicii-Cratoneuretum* but without any differential taxa (Table 4). Using ordinal clustering, we compared these stands with original relevés of other related low-altitude communities from Central Europe [*Cratoneuretum commutati* Aichinger 1933, *Cardamino-Cratoneuretum* Kornaś et Medwecka-Kornaś 1967 (for nomenclatural issues see below) and *Pellio endiviifoliae-Cratoneuretum commutati* Rivola 1982]. Then we compared them with the brief original synoptic table of the association *Cratoneuretum filicino-commutati* (Kuhn 1937) Oberd. 1977 (for nomenclatural issues see below). The incompleteness of the original source prevents a precise comparison of the two communities. Numerical analysis did not show consistency with any of the compared communities. We judged the studied stands to be a regional community of the alliance *Cratoneurion commutati* without any rank.

Cardamino-Cratoneuretum Kornaś et Medwecka-Kornaś 1967

Hinterlang (1992: 65) used this name for strongly basophilous spring communities of lower altitudes (comparing to *Arabido-Cratoneuretum*) and considered it to be a central association of the alliance *Cratoneurion commutati.* However, Kornaś and Medwecka-Kornaś (1967: 175) listed this association in an overview of studied communities using the name *Cardamino-Cratoneuretum* Szafer, Kulcz. et Pawł. 1926. Twenty relevés from the Gorce Mts [(690) 835–1245 m] were assigned to it. *Cratoneuron commutatum* (incl. var. *falcatum*) dominates in the stands and *Cardamine *amara* is present. In the original source (Kornaś & Medwecka-Kornaś 1967: 175, 199) it

is obvious that the authors intended the association *Cratoneuron falcatum-Cardamine Opizii* instead. It was described from the Polish part of the West Tatras (see above). The results of numerical analysis (Table 4) show that the vegetation from the Gorce Mts and the Západné Tatry Mts differs and belongs to two related but still separate associations. According to Recomm. 46J of ICPN, for the pseudonym *Cardamino opicii-Cratoneuretum falcati* sensu Kornaś & Medwecka-Kornaś 1967 non Szafer & Sokołowski 1927 we propose the substitute name ***Cardamino amarae-Cratoneuretum commutati*** *ass. nov. hoc loco.* Nomenclatural type (lectotypus): Kornaś & Medwecka Kornaś 1967, Table 7, relevé 2 (Hinterlang 1992: 65):

LOCALITY. POLAND. Gorce Mts, Dolina Lepietnicy valley, 840 m, WNW, 15°, 4 m^2, total plant cover 95%, E_1: 30%, E_0: 90%, 4.8.1950.

E_1: *Deschampsia cespitosa* 2.2, *Poa trivialis* 2.2, *Epilobium alsinifolium* 1.2, *Cardamine* **amara* +, *Tussilago farfara* +, *Viola biflora* +, *Glyceria notata* +.

E_0: *Palustriella commutata* 5.5, *Philonotis calcarea* 1, *Bryum pseudotriquetrum* +.

Cratoneuretum filicino-commutati Kuhn ex Oberd. in Philippi et Oberd. 1977

This community, which is dominated by mosses *Palustriella commutata* and/or *Cratoneuron filicinum*, has been cited with several author citations such as *Cratoneuretum filicino-commutati* (Kuhn 1937) Oberd. 1977 (cf. Philippi & Oberdorfer 1977: 209; Rivola 1982: 336; Fajmonová 1991: 428, 432; Coldea 1991: 417, 1997: 147; Pott 1995: 171) or *Cratoneuretum filicino-commutati* (Kuhn 1937) Philippi et Oberd. 1977 (Zechmeister 1993: 233; Hájek 2000: 7; Schubert *et al.* 2001: 250; Valachovič 2001: 327). Kuhn (1937: 34–35) described 'die Gesellschaft von *Hypnum commutatum* und *Cratoneuron filicinum*' (Art. 3c), documented by two relevés. Under Recomm. 51A, this invalidly published name has been validated by Oberdorfer (in Philippi & Oberdorfer 1977: 209). Therefore the correct form of the name is *Cratoneuretum filicino-commutati* Kuhn ex Oberd. in Philippi et Oberd. 1977. Nomenclatural type: Kuhn 1937: 34, relevé 2, lectotypus *hoc loco*: Near a brook between Hermannsdorf and Killer, forest ravine, northern slope, tufa overhangs, *ca* 4 m^2:

E_1: *Geranium robertianum* 2.1, *Chrysosplenium alternifolium* 1.1, *Galium mollugo* +.1, *Hedera helix* +.1, *Impatiens noli-tangere* +.1.

E_0: *Palustriella commutata* 3.5, *Marchantia polymorpha* 3.3, *Plagiomnium undulatum* 2.3, *Amblystegium serpens* 1.3, *Cratoneuron filicinum* 1.1, *Plagiochila asplenioides* 1.3.

In spite of the correction, *Cratoneuretum filicino-commutati* Kuhn ex Oberd. in Philippi et Oberd. 1977 is an illegitimate name for the following reasons: (*i*) it is a later homonym of the name *Cratoneuron commutatum-C. filicinum*-Ass., which was used by Giacomini (1939: 72) for a high-mountain, species-poor spring bryocoenosis from the Italian Alps (Art. 31); (*ii*) it represents a superfluous name (*nomen superfluum*) for the validly published name ***Pinguiculo vulgaris-Cratoneuretum commutati*** Oberd. 1957 (cf. Oberdorfer 1957: 149), which has been cited by Philippi and Oberdorfer (1977) as a synonym (Art. 29c).

Along with the typical stands, Philippi and Oberdorfer (1977: 211) also distinguished a 'Molinia-reiche, zu Flachmoorgesellschaften vermittelnde Ausbildung' (Table 62, column 6b) within the association *Cratoneuretum filicino-commutati*. This extended the association concept to include springs with higher abundance of fen species (e.g., *Carex lepidocarpa*, *C. panicea*, *C. hostiana*, *C. davalliana*, *Parnassia palustris*, *Primula farinosa*, *Schoenus ferrugineus*). This probably is what led to the use of the name *Cratoneuretum filicino-commutati* also for submontane springs dominated by short sedges in the Western Carpathians (Fajmonová 1991: 428–430; Valachovič 2001: 327).

NOTES ON CORRECT NAMES OF OTHER MENTIONED COMMUNITIES

Caricetum remotae Kästner 1941

The association is usually mentioned with the author citation *Caricetum remotae* (Kästner 1941) Schwickerath 1944 (e.g., Hinterlang 1992:

90; Zechmeister & Mucina 1994: 401; Pott 1995: 173; Valachovič & Janovicová 1999: 51, 54; Kliment *et al.* 2000: 175; Schubert *et al.* 2001: 248; Valachovič 2001: 331). Kästner (1941) described the associations *Caricetum remotae montanum* (pp. 156–158, Table IV; pp. 168–169, Table V) and *Caricetum remotae collinum* (pp. 172–176, Table VI). In the list of associations assigned to the class *Montio-Cardaminetea* (p. 202), the author included *Caricetum remotae hercynicum* (with two subassociations, *montanum* and *collinum*) in the alliance *Caricion remotae.* Studying this classification system, we conclude that Kästner described a single association *Caricetum remotae* while differentiating two altitudinal forms (cf. Kästner 1941: 163; 'Berglandsform' and 'Hügellandsform'). This is also demonstrated in the table caption on page 164: 'Charakterarten und stete Begleiter des *Caricetum remotae*, ...'. Therefore we consider ***Caricetum remotae*** Kästner 1941 to be the correct name (validly published and legitimate), in accordance with Dengler *et al.* (2004: 351). Passarge (1979: 789) was one of the first to point out Kästner's priority in publishing the author citation *Caricetum remotae* Kästner (1939) 1942.

Schwickerath (1944: 217, Table 63) described the association *Caricetum remotae* and synonymized it with *Caricion remotae* Kästner 1941. According to Art. 27 of ICPN, Note 1, changes in rank can occur only between principal and supplementary ranks; changes between principal ranks are not permitted. Therefore the additional author citation *Caricetum remotae* (Kästner 1941) Schwickerath 1944 is not sustained.

Philonotido seriatae-Calthetum laetae (Krajina 1933) Coldea 1991

In various synopses of vegetation units, the association is presented mostly under the name *Calthetum laetae* Krajina 1933 (cf. Hadač 1983: 349; Mucina & Maglocký 1985: 198; Zechmeister & Mucina 1994: 401; Valachovič 2001: 319). It was described from supramontane to subalpine belts (1300–1890 m) of the Vysoké Tatry Mts (Krajina 1933, Table 25), based on 8 relevés. A short time before this, Sillinger (1933: 137–140) described the association *Calthetum palustris* from the montane belt of the Nízke Tatry Mts (forest zone, 1 050–1 180 m), dominated by *Caltha palustris* (s.l.). The dominant species in both associations (*Calthetum laetae* and *Calthetum palustris*) is most likely the same (cf. Valachovič 2001: 320). For this reason, Coldea (1991: 416) created a new name for the community described by Krajina (Art. 39a).

Cochleario pyrenaicae-Cratoneuretum commutati Th. Müller 1961

The name of this rare community usually has been cited in the form *Cochleario pyrenaicae-Cratoneuretum commutati* (Oberd. 1957) Th. Müller 1961 (cf. Philippi & Oberdorfer 1977: 212; Coldea 1991: 417, 1997: 147; Pott 1995: 172; Valachovič & Kochjarová 2000: 484–486; Valachovič 2001: 328). Oberdorfer (1957: 150) published a '*Cochlearia pyrenaica*-Gesellschaft' without any relevé or synoptic table documentation. It is an idle name of a syntaxon without any rank (Art. 2b, 3c), which is impossible to validate. Based on a synoptic table, Müller (1961: 20, Table 3) described a relict spring association *Cratoneuro-Cochlearietum pyrenaicae* (Oberd. 57 n. n.) Müller 1961 from foothills of the Alps (540–700 m a.s.l.). Two subassociations were designated: *typicum* and *tussilaginetosum*. In two later papers, the order of the two species in the name of the association was inverted. Work by Philippi and Oberdorfer (1977: 212) deals with *Cochleario pyrenaicae-Cratoneuretum commutati* (Oberd. 1957) Th. Müller 1961. Zechmeister and Mucina (1994: 400) gave *Cochleario pyrenaicae-Cratoneuretum commutati* Müller 1961. However, in neither of these papers did the authors suggest the name inversion (Art. 42). Moreover, Zechmeister and Mucina (1994) reclassified the association to the suballiance *Lycopodo-Cratoneurenion commutati* (Hadač 1983) Zechmeister et Mucina 1994; Valachovič (2001: 299), *Lycopodo-Cratoneurion* alliance. In the original diagnosis, both dominants (*Cratoneuron commutatum*, *Cochlearia pyrenaica*) occur with the same values

of constancy and cover (V^{3-4}). For this reason, Art. 10b of ICPN is not applicable. Based on the general use of the name and on the dominance of bryophytes, we suggest a corresponding inversion of the association name: ***Cochleario pyrenaicae-Cratoneuretum commutati*** Th. Müller 1961 *nom. invers. propos*.

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