ALPINE HEATHS IN THE WESTERN CARPATHIANS - A NEW APPROACH TO THEIR CLASSIFICATION

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ABSTRACT - Using physiognomic parameters (structure), qualitative and quantitative parameters (presence or absence of significant components (life-forms, chorological elements), abundance of plant species and relation among them (spatial pattern) were classified alpine heaths and contact vegetation habitats. Four clusters were recognized - beside own alpine heath class (*Loiseleurio-Vaccinietea*) also three grassland-like habitats (class *Carici rupestris-Kobresietea bellardii*, class *Caricetea curvulae* and *Nardus stricta*-rich grasslands). Each vegetation type is shortly defined with respect to regional peculiarities in the Western Carpathians.

KEYWORDS - Alpine vegetation, *Loiseleurio-Vaccinietea*, Natura 2000.

INTRODUCTION

In the Western Carpathians alpine heaths were recently classified within the large defined class *Juncetea trifidi*. This class encompassed various stands on soils with acidic to neutral reaction, including alpine grasslands on outcrops and flat to steep slopes, and dwarf scrub heaths forming mosaic vegetation with other above mentioned types. Using floristic criterion there were no sufficient differences, though ecological and physiognomic differences are visible on first look. In the period of mapping programs such as NATURA 2000, there is optimal (and practical) to recognize stands according to their structure and ecological demands, which are connected with following nature protection and management plans.

Material and Methods

The syntaxonomical revision included 1760 phytocoenological relevés of the wind edge naked-rush, dwarf-scrub heaths and grasslands of the mountains of the Western Carpathians. Contextually it relates to the recent study on the Western Carpathians high-mountains communities of the class *Carici rupestris-Kobresietea bellardii* (Petrík *et al.*, 2005).

All relevés used in this study have been collected according to the traditional principles of Zürich-Montpelliér school. Different scales of abundance and dominance have been used by various authors: the five- or seven-degree Braun-Blanquet´s scale, the 10-degree, or the combined 11-degree Hadač and Domin´s scale (cf. Sillinger, 1933; Hadač *et al.*, 1969) and a modified 9-degree scale (Barkman *et al.*, 1964). To obtain the data comparable within the numerical classification, all relevés were transformed into the ordinal scale (van der Maarel, 1979). The taxa determined only at the level of genus were excluded and some taxa were classified within the higher or more broadly defined taxa.

Numerical classification was performed by the program NCLAS from the SYNTAX 2000 package (Podani, 2001). The β-flexible method (β = -0.25) with Euclidian distance and Jaccard's, Ružička's and Wishart's similarity coefficients were used. Obtained hypotheses were evaluated by comparison and analysis of phytocoenological tables processed by program FYTOPACK (Jarolímek & Schlosser, 1997) and simple statistics using life forms and geo-elements accepted according to Dostál (1989).

The contents of each column of the shortened synoptic table (Table 1) comprise the number of relevés used for the synthesis, and the average number of species in the relevant community. Each taxon is characterised by the frequency (in %; + = frequency < 0,5%) and the mean value of abundance (upper index, in ordinal scale) calculated using the FYTOPACK (Jarolímek & Schlosser, 1997). Diagnostically important taxa of individual plant communities are given in bold.

The nomenclature of the taxa generally follows the Checklist of non-vascular and vascular plants of Slovakia (Marhold & Hindák, 1998).

Results and discussion

Recently in the class *Juncetea trifidi* and order *Caricetalia curvulae* four alliances were merged - *Juncion trifidi*, *Loiseleurio-Vaccinion*, *Festucion versicoloris* and *Nardion strictae* (cf. Mucina & Maglocký, 1985). First our proposal displaced from this heterogeneous vegetation the alliance *Festucion versicoloris* into the class *Carici rupestris-Kobresietea* (cf. Petrík *et al.*, 2005, p. 39). Now we upgrade alliance *Loiseleurio-Vaccinion* on the level of class along with new content definition of the alliance *Juncion trifidi*, in the recent proposal the only one alliance in the class *Caricetea curvulae*. The rest vegetation with dominance of *Nardus stricta* belongs evidently to the other acidophilous subalpine *Nardetalia* communities.

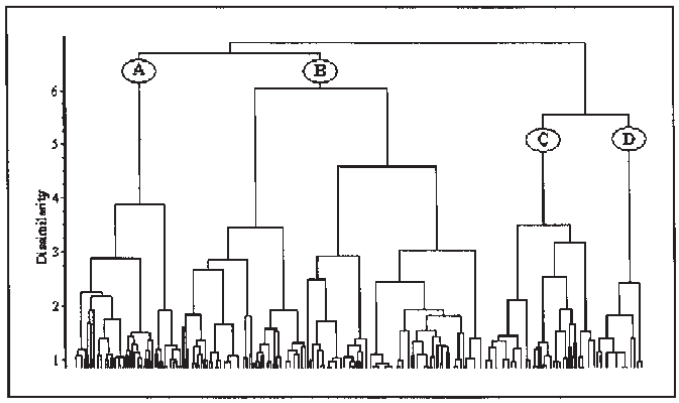


FIGURE 1 - Simplified dendrogram of the numerical classification of the data set of 1.760 phytocoenological relevés from the Western Carpathians.

A - Carici rupestris-Kobresietea bellardii, B - Caricetea curvulae (= Juncetea trifidi p. p.), C - Loiseleurio-Vaccinietea, D - Nardus stricta-group.

The result of numerical classification (FIGURE 1) take into account floristic composition, quantitative values (abundance) of species as well as quantitative occurrence of plants in different layers, mainly relation between herbaceous and woody plants and cover of bryophytes. The four resulting groups (A-D) can be shortly characterised as:

Carici rupestris-Kobresietea bellardii Ohba 1974 (see TABLE 1, column A). Species rich, chionophobous, cryotemperate dwarf scrubs (*Dryas octopetala*, *Salix* spec. div.), cushion-shaped chamaephytes (*Silene acaulis*, *Minuartia* spec. div.) and graminoids (*Festuca versicolor*, *Elyna myosuroides*) on wind-exposed ridges. The soils with neutral pH are obviously calcium-enriched rendzinas. Holoarctic distribution and highest summits in Europe, from Pyrenees to mountains of Balkan Peninsula, which manifest in the high number of endemic species.

Caricetea curvulae Br. Bl. 1948 nom. cons. prop. (Syn. *Juncetea trifidi* Hadač 1946 pp.), (TABLE 1, column B)

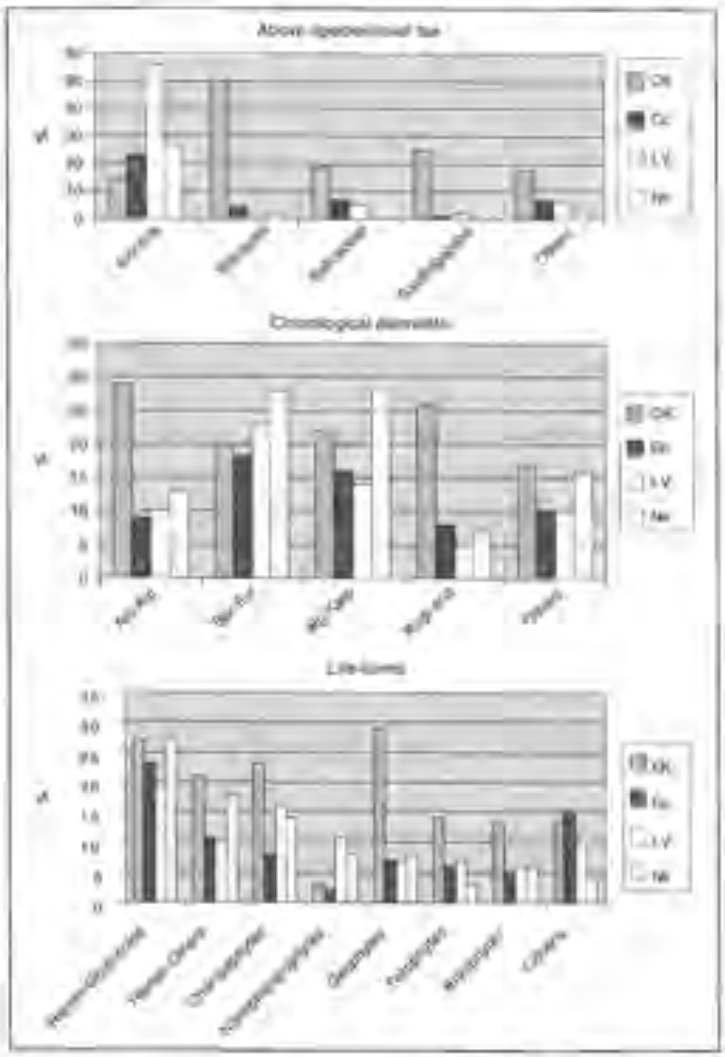
Alpine grassland-like communities (*Juncus trifidus*, *Agrostis rupestris*) on windy slopes with lower snow cover. The strictly acidic soils are alpine ranker. Boreal distribution and Alpine-Caucasian Mountain system.

Loiseleurio-Vaccinietea Eggler ex Schubert 1960 (TABLE 1, column C), Supratimberline, ericoid dwarf scrubs communities on slopes with various snow cover. Types of soils are rankers and podzols. Circumpolar distribution.

Nardus stricta-rich communities (TABLE 1, column D)

Mountain to alpine grassland-like communities on slopes with moderately long snow cover. The soils are acidic alpine rankers and podzols. Boreal distribution.

The present delimitation of plant communities which follows habitat peculiarities is based according to Theurillat *et al.* (1995) on combination of: 1) the structural homogeneity of all units inside a class, and 2) the floristic similarities. Higher units have to be defined with help of additional criteria such as: horizontal and vertical structure, their dominating life and growth forms, which reflect the distinctive ecological conditions (climate, soil) and succession stage.



A)

B)

C)

FIGURE 2 - A, B, C. Comparison of the average frequency (%) in above species level taxa, chorological elements, and life forms in four selected groups.

Structure in phytosociological sense (Rejmánek, 1977) is defined as system determined by: 1) qualitative presence (or absence) of components belonging to defined class (group), e.g. grasses, arcto-alpine taxa, etc.; 2) quantitative representations of these components, e.g. abundance of plant species; and 3) relation among them, e.g. spatial pattern, etc.

An analyse based on taxa above species-level (e.g. family-level), shows clear predominance of *Salicaceae*, *Saxifragaceae* and *Silenaceae* in the group A (FIGURE 2a). Taxa such as *Saxifraga bryoides*, *S. moschata*, *S. oppositifolia* and others, as well as *Salix reticulata*, *Minuartia sedoides*, *Silene acaulis* manifest absolute preference in the class *Carici rupestris-Kobresietea bellardii* in whole Europe. In term of chorology this group is characterized by typical arcto-alpine elements - they related only this class such as geophytes *Lloydia serotina* and *Bistorta vivipara* or hemicryptophytes *Ligusticum mutellinoides*, *Pedicularis oederi*, *Erigeron uniflorus*, rarely also *Comastoma tenellum* and *Oxytropis halleri*. Boreal elements are typical

for grasslands represented here by mezophilous plant species such as *Anthoxantum alpinum*, *Luzula sudetica*, *Ligusticum mutellina*, *Potentilla aurea*, *Geum montanum*, *Hypericum maculatum*, *Gentiana asclepiadea* etc. (FIGURE 2b).

The relations between the above mentioned families and genera and ecological conditions influence spatial arrangement of stands. Snow cover determines the distribution of vegetation types and its extreme values are limiting factor for existence of many plant taxa. Rich lichen and mosses layer in first two groups (A-B) is interacting with small chamaephytes, which utilize cryptogams for protection of seedlings (FIGURE 2c).

Absence of own character species was reason for unification of the alpine dwarf heaths into largely defined class *Juncetea trifidi* on the level of alliance in the past. According to pure floristic criteria there was insufficient basis for further division. Using quantitative parameters (dominance and abundance, biomass) and representation of prevailing life forms (dwarf scrubs) is the division into two classes acceptable and the existence of class *Loiseleurio-Vaccinietea* in Western Carpathians is confirmed. Dominance of ericoid dwarf scrubs clearly characterizes the third group C. Vertical structure of plant communities is composed from low scrubs, while role of grasses such as *Juncus trifidus*, *Agrostis rupestris*, *Avenula versicolor* is suppressed. On the other hand the absence or low abundance of grasses such as *Nardus stricta*, *Anthoxantum alpinum*, *Phleum rhaeticum* and other species give a reason to separate scrubby vegetation from *Nardus stricta*-rich grasslands (group D).

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TABLE 1 - Shortened synoptic table with main differential taxa of the classes Carici rupestris-Kobresietea (A), Caricetea curvulae (B), Loiseleurio-Vaccinietea (C) and Nardus stricta-rich communities (D).

Class	A	B	C	D
Number of relevés	339	926	345	150
Average species number in relevé	42	22	20	20
Silene acaulis	**76**^{5}	8^{3}	1^{2}	2^{2}
Bistorta vivipara	**75**^{3}	23^{2}	12^{2}	5^{2}
Primula minima	**64**^{2}	40^{3}	15^{2}	1^{2}
Campanula tatrae	**60**^{2}	16^{2}	10^{2}	19^{2}
Festuca versicolor	**56**^{5}	4^{5}	9^{2}	1^{2}
Lloydia serotina	**56**^{3}	1^{2}	-	-
Pedicularis oederi	**56**^{2}	6^{2}	1^{2}	-
Saxifraga moschata	**55**^{2}	2^{2}	1^{2}	-
Bartsia alpina	**53**^{2}	6^{2}	8^{2}	-
Saxifraga paniculata	**51**^{3}	1^{3}	2^{2}	-
Salix kitaibeliana	**47**^{5}	5^{2}	3^{3}	-
Ligusticum mutellinoides	**47**^{2}	2^{3}	1^{2}	-
Minuartia sedoides	**46**^{3}	2^{2}	-	-
Pedicularis verticillata	**45**^{2}	6^{2}	3^{2}	1^{1}
Rhodiola rosea	**42**^{2}	2^{2}	1^{2}	1^{1}
*Luzula * mutabilis*	**40**^{2}	2^{2}	-	1^{3}
Cerastium eriophorum	**37**^{2}	1^{3}	1^{2}	-
Carex fuliginosa	**35**^{2}	2^{2}	-	-
Minuartia gerardii	**29**^{3}	+^{2}	-	-
Elyna myosuroides	**4**^{6}	-	-	-
Campanula alpina	61^{2}	**87**^{5}	**50**^{3}	**32**^{3}
Oreochloa disticha	64^{3}	**78**^{5}	**40**^{3}	4^{3}
Juncus trifidus	46^{2}	**74**^{5}	**50**^{3}	17^{2}
Hieracium alpinum	23^{2}	**62**^{2}	52^{2}	61^{2}
Avenula versicolor	29^{2}	**66**^{3}	37^{2}	53^{3}
Agrostis rupestris	21^{2}	**60**^{5}	29^{3}	**57**^{3}
Vaccinium myrtillus	22^{2}	45^{3}	**90**^{5}	**80**^{3}
Vaccinium vitis-idaea	37^{3}	44^{3}	**84**^{5}	27^{2}
Vaccinium gaultherioides	13^{3}	17^{3}	**47**^{6}	10^{3}
Empetrum hermaphroditum	1^{2}	3^{2}	**48**^{6}	3^{2}
Nardus stricta	-	4^{2}	8^{3}	**100**^{8}
Homogyne alpina	15^{2}	49^{3}	57^{3}	**84**^{3}
Ligusticum mutellina	22^{2}	50^{3}	32^{2}	**77**^{3}
Oreogeum montanum	7^{2}	30^{2}	13^{2}	**67**^{3}
Anthoxanthum alpinum	23^{2}	19^{2}	17^{2}	**64**^{3}
Potentilla aurea	13^{2}	34^{2}	21^{2}	**61**^{3}
*Luzula *rubella*	6^{2}	6^{2}	28^{2}	**41**^{2}
Luzula sudetica	7^{2}	1^{3}	1^{2}	**25**^{2}
Deschampsia cespitosa	-	1^{2}	4^{3}	**21**^{2}
Phleum rhaeticum	-	2^{2}	1^{2}	**19**^{2}
Carex nigra	-	2^{2}	1^{2}	**15**^{2}

Appendix 1 - Comparison of the floristic composition of the classes *Carici rupestris-Kobresietea* (A), *Caricetea curvulae* (B), *Loiseleurio-Vaccinietea* (C) and *Nardus*-rich communities (D) in the Western Carpathians.
(Other taxa with frequency higher than 1 % arranged in alphabetical order from the data set of 1760 relevés and 799 taxa)

Column	A	B	C	D
Number of relevés	339	926	345	150
Average species number	42	22	20	20
Acetosa urifolia	-	$+^{2}$	5^{3}	5^{2}
Agrostis alpina	11^{3}	$+^{3}$	-	1^{2}
Achillea millefolium agg.	4^{2}	1^{2}	3^{2}	7^{3}
Alectoria nigricans (E_0)	4^{2}	1^{2}	1^{2}	-
Alectoria ochroleuca (E_0)	21^{2}	25^{3}	10^{3}	-
Alchemilla sp. div.	15^{2}	2^{2}	2^{2}	10^{3}
Androsace chamaejasme	12^{3}	$+^{2}$	1^{2}	2^{2}
Anemone narcissiflora	27^{2}	7^{2}	6^{2}	-
Antennaria carpatica	24^{2}	2^{2}	-	-
Antennaria dioica	-	2^{3}	3^{2}	5^{3}
Anthelia juratzkana (E_0)	5^{2}	2^{2}	1^{2}	-
Avenello flexuosa	11^{2}	40^{3}	65^{5}	75^{5}
Barbilophozio lycopodioides (E_0)	4^{2}	2^{2}	2^{2}	2^{3}
Bartramia ithyphylla (E_0)	9^{2}	$+^{1}$	-	-
Bazzania tricrenata (E_0)	3^{3}	1^{2}	1^{2}	-
Bellidiastrum michelii	8^{2}	$+^{3}$	$+^{3}$	-
Blepharostoma trichophyllum (E_0)	12^{2}	1^{1}	$+^{2}$	-
Calamagrostis villosa	4^{2}	6^{2}	28^{3}	22^{2}
Callianthemum coriandrifolium	10^{2}	$+^{2}$	-	-
Calluna vulgaris	2^{1}	4^{2}	12^{4}	17^{5}
Campanula serrata	1^{2}	1^{2}	5^{2}	5^{2}
Campylium stellatum (E_0)	21^{3}	$+^{2}$	-	-
Cardaminopsis neglecta	19^{2}	1^{2}	-	-
Carex atrata	30^{2}	11^{2}	2^{2}	3^{3}
Carex firma	9^{3}	-	1^{2}	-
Carex sempervirens	45^{3}	51^{4}	27^{2}	53^{3}
Cephalozia bicuspidata (E_0)	1^{2}	2^{3}	3^{2}	-
*Cerastium *glandulosum*	11^{2}	$+^{2}$	$+^{2}$	6^{2}
Cetraria cucullata (E_0)	22^{2}	17^{2}	6^{2}	-
Cetraria ericetorum (E_0)	2^{2}	4^{2}	2^{4}	-
Cetraria islandica (E_0)	66^{3}	79^{5}	79^{5}	29^{3}
Cetraria nivalis (E_0)	24^{2}	21^{2}	8^{3}	-
Cladonia arbuscula (E_0)	20^{2}	29^{2}	21^{3}	8^{3}
Cladonia bellidiflora (E_0)	3^{2}	13^{3}	6^{2}	1^{1}
Cladonia coccifera (E_0)	14^{2}	33^{3}	17^{3}	6^{2}
Cladonia ecmocyna (E_0)	4^{2}	6^{2}	2^{2}	1^{2}
Cladonia furcata (E_0)	3^{2}	2^{2}	6^{2}	1^{2}
Cladonia gracilis (E_0)	31^{2}	40^{2}	27^{2}	6^{2}
Cladonia chlorophaea (E_0)	2^{2}	5^{2}	3^{2}	-
Cladonia leptophylla (E_0)	1^{2}	3^{2}	1^{2}	-
Cladonia macrophyllodes (E_0)	3^{2}	6^{2}	1^{2}	1^{2}
Cladonia mitis (E_0)	1^{2}	5^{2}	3^{2}	3^{2}
Cladonia pyxidata (E_0)	26^{2}	11^{2}	8^{2}	2^{1}
Cladonia rangiferina (E_0)	21^{2}	29^{2}	31^{3}	12^{2}
Cladonia squamosa (E_0)	1^{2}	4^{2}	5^{3}	1^{2}
Cladonia stellaris (E_0)	3^{2}	3^{2}	2^{2}	1^{2}
Cladonia uncialis (E_0)	14^{2}	23^{2}	8^{2}	-
Coeloglossum viride	13^{2}	1^{2}	-	-
Dianthus glacialis	10^{2}	$+^{2}$	-	-
Dicranum fuscescens (E_0)	5^{2}	1^{2}	1^{2}	1^{2}
Dicranum scoparium (E_0)	17^{3}	10^{2}	26^{3}	5^{2}
Dicranum spadiceum (E_0)	7^{3}	1^{2}	1^{2}	-
Diplophyllum taxifolium (E_0)	3^{1}	3^{2}	2^{2}	-
Distichium capillaceum (E_0)	19^{2}	-	1^{2}	-
Ditrichum flexicaule (E_0)	14^{3}	-	1^{2}	-
Doronicum stiriacum	48^{2}	33^{3}	6^{2}	2^{2}
Drepanocladus uncinatus (E_0)	45^{2}	7^{2}	2^{2}	4^{2}
Dryas octopetala	15^{4}	$+^{3}$	4^{2}	-
Erigeron uniflorus	15^{2}	$+^{2}$	-	-
Euphrasia tatrae	14^{2}	6^{2}	6^{1}	3^{3}
Festuca supina	74^{3}	74^{4}	48^{3}	25^{2}
Festuca picturata	13^{3}	9^{3}	7^{2}	35^{3}
Galium anisophyllon	32^{2}	1^{2}	4^{2}	3^{2}
Gentiana asclepiadea	-	1^{2}	9^{2}	13^{2}
Gentiana frigida	32^{2}	10^{2}	-	-
Gentianella lutescens	6^{2}	1^{2}	$+^{2}$	3^{2}
Gentiana punctata	9^{2}	14^{2}	17^{2}	20^{2}
Geum reptans	10^{3}	$+^{2}$	-	-
Hedysarum hedysaroides	11^{4}	$+^{4}$	1^{2}	-
Rhodax alpestris	9^{3}	-	$+^{2}$	-
Heterocladium dimorphum (E_0)	4^{1}	1^{1}	1^{1}	-
Hieracium alpicola	4^{2}	1^{2}	2^{2}	-

Column	A	B	C	D
Huperzia selago	43^{2}	22^{2}	29^{2}	1^{1}
Hylocomium splendens (E_0)	45^{4}	10^{2}	21^{5}	1^{1}
Hypericum maculatum	0^{0}	1^{2}	10^{2}	14^{2}
Hypnum cupressiforme (E_0)	10^{4}	$+^{3}$	-	-
Tromsdorfia uniflora	1^{2}	13^{2}	6^{2}	25^{2}
*Juniperus *alpina*	3^{2}	4^{2}	13^{2}	13^{2}
Lecidea granulosa (E_0)	-	3^{2}	1^{2}	1^{2}
Leontodon pseudotaraxaci	15^{2}	2^{2}	-	-
Lepidoma demissum (E_0)	1^{2}	5^{2}	2^{2}	-
Leucorchis albida	1^{2}	1^{2}	1^{2}	7^{2}
Leucanthemopsis alpina	16^{2}	26^{2}	3^{1}	1^{1}
Lophozia collaris (E_0)	3^{2}	3^{2}	1^{2}	-
Lophozia ventricosa (E_0)	1^{1}	2^{2}	1^{2}	-
Luzula alpinopilosa	45^{2}	48^{2}	3^{2}	19^{2}
Luzula sylvatica	-	-	7^{2}	5^{2}
Melampyrum sylvaticum	-	-	7^{2}	3^{2}
Mnium thamsonii (E_0)	16^{3}	-	-	-
Myosotis alpestris	21^{2}	1^{2}	-	-
Nardia scalaris (E_0)	3^{2}	2^{3}	1^{3}	1^{2}
Omalotheca supina	1^{2}	5^{2}	$+^{1}$	6^{2}
Oxyria digyna	12^{2}	1^{3}	-	-
Paraleucobryum enerve (E_0)	6^{2}	4^{2}	1^{3}	1^{2}
Parnassia palustris	13^{2}	1^{2}	2^{2}	2^{2}
Peltigera aphthosa (E_0)	9^{2}	1^{2}	2^{2}	1^{1}
Phyteuma orbiculare	27^{2}	1^{3}	3^{2}	3^{2}
Picea abies	2^{1}	1^{2}	8^{3}	-
Pinus mugo	3^{1}	2^{3}	18^{2}	10^{2}
Plagiochila porelloides (E_0)	9^{2}	$+^{3}$	-	-
Pleurozium schreberi (E_0)	19^{3}	17^{2}	37^{5}	27^{3}
Poa alpina	24^{2}	2^{2}	2^{2}	8^{3}
Poa laxa	18^{2}	5^{2}	-	1^{2}
Pogonatum urnigerum (E_0)	23^{2}	6^{2}	1^{1}	1^{2}
Pohlia cruda (E_0)	24^{2}	1^{2}	1^{2}	1^{3}
Pohlia nutans (E_0)	4^{2}	5^{2}	2^{2}	1^{5}
Polytrichum alpinum (E_0)	45^{5}	34^{5}	14^{3}	1^{2}
Polytrichum commune (E_0)	1^{2}	4^{3}	6^{4}	19^{3}
Polytrichum formosum (E_0)	4^{3}	2^{3}	4^{3}	11^{3}
Polytrichum juniperinum (E_0)	3^{2}	9^{3}	10^{3}	3^{2}
Polytrichum piliferum (E_0)	22^{2}	29^{3}	10^{3}	5^{3}
Polytrichum sexangulare (E_0)	1^{2}	3^{3}	$+^{3}$	-
Polytrichum strictum (E_0)	5^{2}	8^{3}	26^{4}	9^{3}

Column	A	B	C	D
Potentilla crantzii	12^{2}	$+^{3}$	1^{2}	-
Ptilidium ciliare (E_0)	12^{3}	3^{2}	7^{2}	-
Pulsatilla alba	42^{5}	42^{5}	25^{2}	19^{2}
Pyrola carpatica	9^{4}	$+^{2}$	$+^{2}$	-
Racomitrium canescens (E_0)	9^{2}	2^{2}	2^{2}	1^{2}
Racomitrium heterostichum (E_0)	2^{2}	2^{2}	1^{2}	1^{3}
Racomitrium lanuginosum (E_0)	21^{5}	9^{3}	4^{2}	1^{2}
Racomitrium sudeticum (E_0)	1^{2}	3^{2}	$+^{1}$	-
Ranunculus alpestris	22^{3}	$+^{3}$	1^{2}	-
Ranunculus breyninus	22^{3}	1^{2}	1^{2}	-
Ranunculus pseudomontanus	21^{2}	26^{2}	6^{2}	19^{2}
Rhytidium rugosum (E_0)	26^{2}	1^{2}	5^{3}	-
Rhytidiadelphus squarrosus (E_0)	3^{2}	$+^{2}$	1^{2}	10^{2}
Rhytidiadelphus triquetrus (E_0)	27^{3}	2^{2}	8^{3}	1^{2}
Salix alpina	4^{4}	$+^{2}$	8^{4}	-
Salix herbacea	17^{2}	17^{5}	9^{3}	-
Salix reticulata	19^{5}	-	1^{3}	-
Salix retusa	9^{3}	3^{6}	2^{4}	-
Salix silesiaca	4^{2}	$+^{2}$	4^{2}	1^{1}
Saussurea pygmaea	16^{2}	3^{2}	-	-
Saxifraga aizoides	14^{2}	$+^{2}$	2^{2}	-
Saxifraga androsacea	15^{2}	$+^{3}$	-	-
Saxifraga bryoides	19^{2}	1^{2}	-	-
Saxifraga hieraciifolia	17^{2}	$+^{2}$	-	-
Saxifraga oppositifolia	23^{3}	$+^{2}$	-	-
Saxifraga retusa	12^{2}	$+^{2}$	-	-
Saxifraga wahlenbergii	14^{2}	$+^{4}$	$+^{3}$	-
Sedum alpestre	11^{2}	6^{2}	$+^{1}$	2^{2}
Selaginella selaginoides	22^{2}	2^{2}	1^{2}	4^{2}
Sempervivum montanum	3^{2}	6^{2}	3^{1}	4^{2}
Senecio abrotanifolius	5^{2}	20^{3}	4^{2}	6^{2}
*Senecio *carniolicus*	9^{2}	9^{2}	4^{2}	1^{1}
Sesleria albicans	11^{2}	$+^{2}$	6^{3}	1^{2}
Soldanella carpatica	62^{2}	35^{2}	30^{2}	58^{2}
*Solidago *minuta*	16^{2}	12^{2}	17^{2}	35^{2}
Solorina crocea (E_0)	11^{2}	3^{2}	$+^{2}$	-
Sorbus aucuparia	1^{2}	-	13^{2}	-
Sphagnum sp. div. (E_0)	6^{3}	6^{3}	21^{3}	21^{7}
Sphenolobus minutus (E_0)	2^{1}	2^{1}	2^{2}	-
*Swertia *alpestris*	25^{3}	1^{2}	2^{2}	2^{2}
Taraxacum sp. div.	4^{2}	2^{2}	-	3^{2}
Thamnolia subuliformis (E_0)	6^{2}	5^{2}	1^{2}	-
Thamnolia vermicularis (E_0)	32^{2}	20^{2}	5^{2}	1^{2}
Thymus alpestris	24^{2}	4^{2}	3^{2}	5^{2}
Tortella tortuosa (E_0)	45^{2}	1^{2}	2^{2}	-
Tritomaria quinquedentata	8^{3}	1^{2}	1^{2}	-
Valeriana tripteris	6^{4}	1^{2}	1^{2}	-
*Veratrum *lobelianum*	2^{2}	2^{2}	7^{2}	15^{2}
Viola biflora	25^{2}	2^{3}	1^{2}	2^{2}
*Viola *sudetica*	-	2^{2}	-	5^{2}