

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* (Petřík *et al.*, 2005).

All relevés used in this study have been collected according to the traditional principles of Zürich-Montpellier 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 ($\beta = -0.25$) 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 & Schloser, 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 & Schloser, 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. Petřík *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.

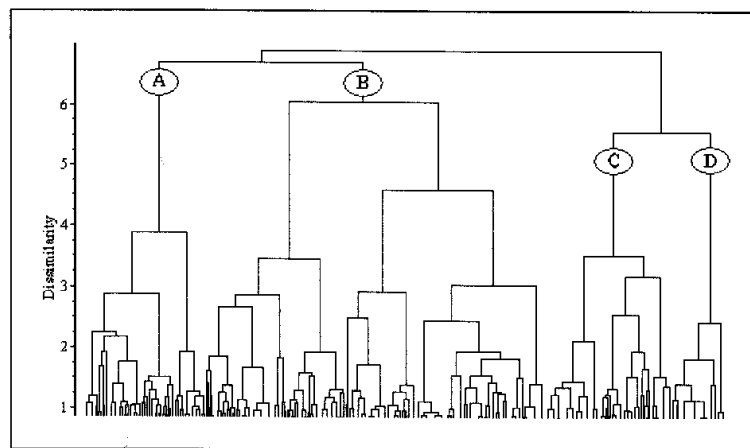


FIGURE 1 - Simplified dendrogram of the numerical classification of the data set of 1.760 phytocoenological relevés from the Western Carpathians.

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. Holarctic 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)

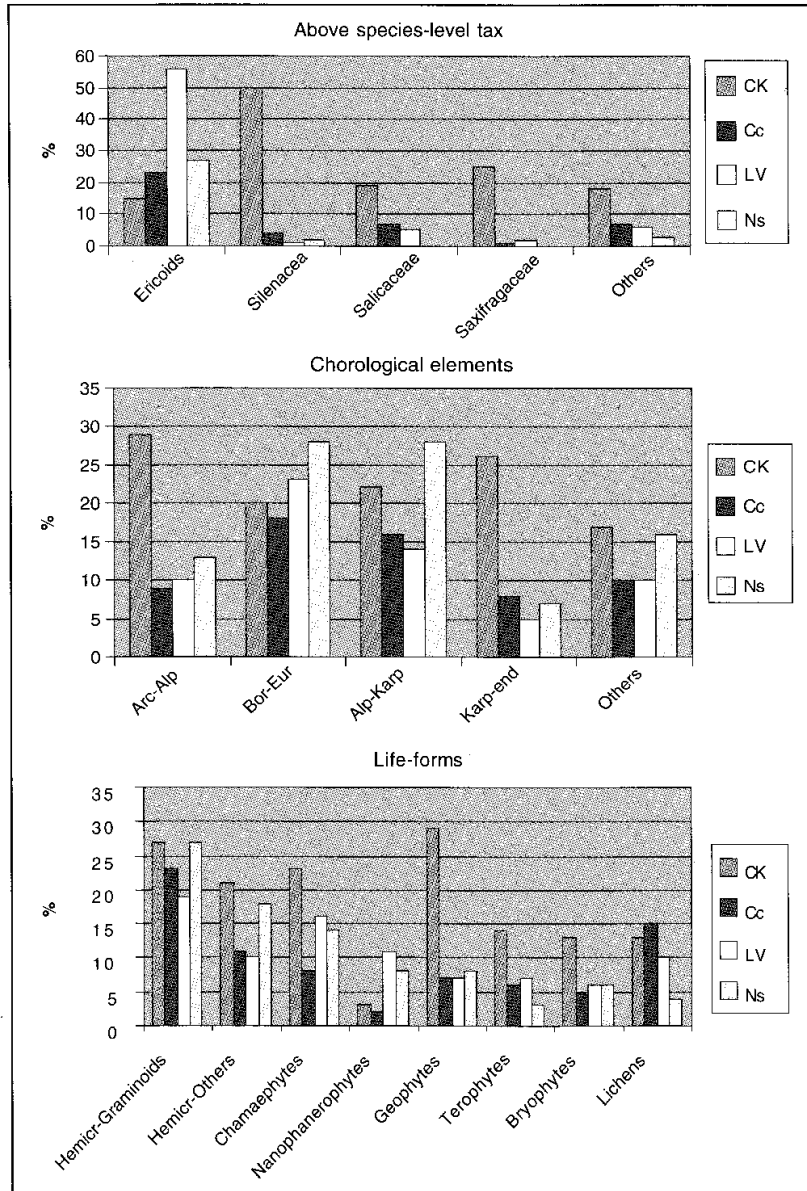
Alpine grassland-like communities (*Juncus trifidus*, *Agrostis rupestris*) on windy slopes with lower snow cover. The strictly acidic soils are alpine ranker. Boreal distribution and Alpine-Caucasian Mountain system.

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

Appendix 1 - Comparison of the floristic composition of the classes *Carica rupestris*-*Kobresietea* (A), *Caricetea curvulae* (B), *Loiseleurio-Vaccinieta* (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
<i>Acetosa arifolia</i>	-	+ ²	5 ³	5 ²
<i>Agrostis alpina</i>	11 ¹	+ ³	-	1 ²
<i>Achillea millefolium</i> agg.	4 ²	1 ²	3 ²	7 ²
<i>Alectoris nigricans</i> (E ₀)	4 ²	1 ²	1 ²	-
<i>Alectoris ochroleuca</i> (E ₀)	21 ²	25 ⁵	10 ⁶	-
<i>Alchemilla</i> sp. div.	15 ²	2 ²	2 ²	10 ³
<i>Anemone thamaejasme</i>	12 ²	+ ²	1 ²	2 ²
<i>Anemone narcissiflora</i>	27 ²	7 ²	6 ²	-
<i>Antennaria carpatica</i>	24 ²	2 ²	2 ²	-
<i>Antennaria dioica</i>	-	2 ²	3 ²	5 ³
<i>Anthelia juratzkana</i> (E ₀)	5 ²	2 ²	1 ²	-
<i>Avenella flexuosa</i>	11 ²	2 ²	40 ⁸	75 ³
<i>Barbiphozia lycopodioides</i> (E ₀)	4 ²	2 ²	2 ²	2 ¹
<i>Bartramia ibiphylla</i> (E ₀)	9 ²	+ ¹	-	-
<i>Bazania tricenata</i> (E ₀)	3 ³	1 ²	1 ²	-
<i>Bellidistrum michelii</i>	8 ²	+ ³	+ ³	-
<i>Blepharoxena trichophyllum</i> (E ₀)	12 ²	1 ¹	28 ⁸	22 ²
<i>Calamagrostis villosa</i>	4 ³	6 ²	-	-
<i>Callitricheum coriandifolium</i>	10 ²	+ ²	12 ⁴	17 ²
<i>Calluna vulgaris</i>	2 ¹	4 ²	5 ²	5 ²
<i>Campanula serrata</i>	1 ²	1 ²	-	-
<i>Camphylum stellatum</i> (E ₀)	21 ³	+ ²	-	-
<i>Cardaminopsis neglecta</i>	19 ⁴	1 ¹	2 ²	3 ¹
<i>Carex atrata</i>	30 ²	11 ²	-	-
<i>Carex firma</i>	9 ⁵	-	1 ²	-
<i>Carex sempervirens</i>	45 ³	51 ⁴	27 ²	53 ³
<i>Cephalozia bicuspidata</i> (E ₀)	1 ²	2 ¹	3 ²	-
<i>Cerastium *glandulosum</i>	11 ²	+ ²	+ ²	6 ²
<i>Ceraria cucullata</i> (E ₀)	22 ²	17 ²	6 ²	-
<i>Ceraria ericetorum</i> (E ₀)	2 ²	4 ²	2 ¹	-
<i>Ceraria islandica</i> (E ₀)	66 ³	79 ⁵	79 ⁵	29 ³
<i>Ceraria nivalis</i> (E ₀)	24 ²	-	8 ³	-
<i>Cladonia arbuscula</i> (E ₀)	20 ³	21 ²	20 ³	8 ²
<i>Cladonia bellidiflora</i> (E ₀)	3 ²	29 ²	17 ³	6 ²
<i>Cladonia coccifera</i> (E ₀)	14 ²	33 ³	6 ²	1 ²
<i>Cladonia eremocyna</i> (E ₀)	4 ²	6 ²	2 ²	1 ²
<i>Cladonia furcata</i> (E ₀)	3 ²	2 ²	6 ²	1 ²
<i>Cladonia gracilis</i> (E ₀)	31 ²	40 ³	27 ²	6 ²
<i>Cladonia chlorophaea</i> (E ₀)	2 ³	5 ²	-	-
<i>Cladonia leptophylla</i> (E ₀)	1 ³	3 ²	1 ²	-
<i>Cladonia macrophyloides</i> (E ₀)	1 ²	6 ³	1 ²	1 ²
<i>Cladonia mitis</i> (E ₀)	1 ²	5 ²	3 ²	3 ²
<i>Cladonia pyxidata</i> (E ₀)	26 ²	11 ²	8 ²	2 ¹
<i>Cladonia rangiferina</i> (E ₀)	21 ²	29 ²	31 ³	12 ²
<i>Cladonia squamosa</i> (E ₀)	1 ²	4 ²	5 ³	1 ²
<i>Cladonia stellaris</i> (E ₀)	3 ²	3 ²	2 ³	1 ²
<i>Cladonia uncialis</i> (E ₀)	14 ²	23 ²	8 ²	-
<i>Coeloglossum viride</i>	13 ²	1 ²	-	-
<i>Dianthus lactalis</i>	10 ²	+ ²	-	-
<i>Dicranum fuscescens</i> (E ₀)	5 ²	1 ²	1 ²	1 ²
<i>Dicranum scoparium</i> (E ₀)	17 ³	10 ²	26 ³	5 ²
<i>Dicranum spadicum</i> (E ₀)	7 ¹	1 ¹	-	-
<i>Diplophyllum taxifolium</i> (E ₀)	3 ¹	3 ²	2 ²	-
<i>Distichium capillaceum</i> (E ₀)	19 ²	-	-	-
<i>Distichum flexicaule</i> (E ₀)	14 ³	-	1 ³	-
<i>Doronicum striatum</i>	48 ²	33 ³	6 ²	2 ²
<i>Drepanocladus uncinatus</i> (E ₀)	45 ²	7 ²	2 ²	4 ²
<i>Dryas octopetala</i>	15 ⁴	+ ³	-	-
<i>Erigeron uniflorus</i>	15 ²	+ ⁴	-	-
<i>Euphrasia tatrae</i>	14 ²	6 ²	6 ¹	3 ³
<i>Festuca supina</i>	74 ³	74 ⁴	48 ³	25 ²
<i>Festuca picturata</i>	13 ³	9 ¹	7 ²	35 ³
<i>Gallium anisophyllum</i>	32 ²	1 ²	4 ²	3 ²
<i>Gentiana asclepiadea</i>	-	1 ²	9 ²	13 ²
<i>Gentiana frigida</i>	32 ²	10 ²	-	-
<i>Gentiana lutescens</i>	6 ²	1 ²	+ ²	3 ³
<i>Gentiana punctata</i>	9 ²	14 ²	17 ²	20 ²
<i>Geum reptans</i>	10 ³	+ ²	-	-
<i>Hedysarum hedysaroides</i>	11 ⁴	+ ⁴	-	-
<i>Rhodax alpestris</i>	9 ³	-	-	-
<i>Heterocladium dimorphum</i> (E ₀)	4 ¹	1 ¹	1 ¹	-
<i>Hieracium alpicola</i>	4 ¹	1 ¹	2 ²	-

Column	A	B	C	D	Column	A	B	C	D
<i>Hyperzia selago</i>	43 ²	22 ²	29 ²	1 ¹	<i>Potentilla crantzii</i>	12 ²	+ ³	1 ²	-
<i>Hylocomium splendens</i> (E ₀)	45 ⁴	10 ²	21 ⁵	1	<i>Ptilidium ciliare</i> (E ₀)	12 ²	3 ²	7 ²	-
<i>Hypericum maculatum</i>	0 ⁰	1 ²	10 ²	14 ²	<i>Pulsatilla alba</i>	42 ³	42 ³	25 ⁵	19 ²
<i>Hymnum cupressiforme</i> (E ₀)	10 ³	4 ⁵	-	-	<i>Pyrola carpatica</i>	9 ⁵	+ ²	+ ²	-
<i>Trommsdorffia uniflora</i>	1 ²	13 ²	6 ²	25 ²	<i>Racomitrium canescens</i> (E ₀)	9 ²	2 ²	2 ²	1 ²
<i>Juniperus</i> *alpina	3 ²	4 ²	13 ²	13 ²	<i>Racomitrium heterostichum</i> (E ₀)	2 ²	2 ²	1 ²	1 ²
<i>Leucidea granulosa</i> (E ₀)	-	3 ²	1 ²	1 ²	<i>Racomitrium lanuginosum</i> (E ₀)	21 ³	9 ⁵	4 ²	1 ²
<i>Leontodon pseudotataraci</i>	15 ²	2 ²	-	-	<i>Racomitrium sudeticum</i> (E ₀)	1 ²	3 ²	1 ²	-
<i>Lepidodermis demissum</i> (E ₀)	1 ²	5 ²	2 ²	7 ²	<i>Ranunculus alpestris</i>	22 ¹	+ ³	1 ²	-
<i>Lewortchis albidus</i>	1 ²	1 ²	1 ²	1 ²	<i>Ranunculus bryoninus</i>	22 ¹	1 ²	1 ²	-
<i>Leucanthenopsis alpina</i>	16 ²	26 ²	3 ¹	1 ¹	<i>Ranunculus pseudomontanus</i>	21 ²	26 ²	6 ²	19 ²
<i>Lophozia collaris</i> (E ₀)	3 ²	3 ²	1 ²	-	<i>Rhytidium rugosum</i> (E ₀)	26 ²	1 ²	5 ²	10 ²
<i>Lophozia ventricosa</i> (E ₀)	1 ¹	2 ²	1 ²	-	<i>Rhytidadelphus squarrosus</i> (E ₀)	3 ²	+ ²	1 ²	1 ²
<i>Luzula alpiniopilosa</i>	45 ²	48 ²	3 ²	19 ²	<i>Rhytidadelphus triquetrus</i> (E ₀)	27 ³	2 ²	8 ³	1 ²
<i>Luzula sylvatica</i>	-	-	7 ¹	5 ²	<i>Salix alpina</i>	4 ³	+ ²	8 ⁴	-
<i>Melampyrum sylvaticum</i>	-	-	7 ²	3 ²	<i>Salix herbacea</i>	17 ²	17 ⁵	9 ³	-
<i>Mnium thomsonii</i> (E ₀)	16 ³	-	-	-	<i>Salix reticulata</i>	19 ⁵	-	1 ³	-
<i>Myosotis alpestris</i>	21 ²	1 ²	-	-	<i>Salix retusa</i>	9 ³	3 ⁶	2 ⁴	-
<i>Nardia scalaris</i> (E ₀)	3 ²	2 ²	1 ³	1 ²	<i>Salix silesiaca</i>	4 ²	+ ²	4 ²	1 ¹
<i>Omalotheca supina</i>	1 ²	5 ²	+	6 ²	<i>Saussurea pygmaea</i>	16 ²	3 ²	-	-
<i>Oxyria digyna</i>	12 ²	1 ³	-	-	<i>Saxifraga aizoides</i>	14 ²	+ ²	2 ²	-
<i>Paraleucobryum enerve</i> (E ₀)	6 ²	4 ²	1 ³	1 ²	<i>Saxifraga androsacea</i>	15 ²	+ ³	-	-
<i>Parnassia palustris</i>	13 ²	1 ²	2 ²	2 ²	<i>Saxifraga bryoides</i>	19 ²	1 ²	-	-
<i>Peltigera aphthosa</i> (E ₀)	9 ²	1 ²	2 ²	1 ¹	<i>Saxifraga hieracifolia</i>	17 ²	+ ²	-	-
<i>Phyteuma orbiculare</i>	27 ²	1 ³	3 ²	3 ²	<i>Saxifraga oppositifolia</i>	23 ³	+ ²	-	-
<i>Picea abies</i>	21	1 ²	8 ³	-	<i>Saxifraga retusa</i>	12 ²	+ ²	-	-
<i>Pinus mugo</i>	31	2 ²	18 ²	10 ²	<i>Saxifraga wahlenbergii</i>	14 ²	+ ⁴	+ ³	-
<i>Plagiocchia porelloides</i> (E ₀)	9 ²	4 ³	-	-	<i>Sedum alpestris</i>	11 ²	6 ²	1 ¹	2 ²
<i>Pleurozium schreberi</i> (E ₀)	19 ³	17 ²	37 ³	27 ³	<i>Selaginella selaginoides</i>	22 ¹	2 ²	1 ²	4 ²
<i>Poa alpina</i>	24 ²	2 ²	2 ²	8 ³	<i>Sempervivum montanum</i>	3 ²	6 ²	3 ¹	4 ²
<i>Poa laxa</i>	18 ²	5 ²	-	1 ²	<i>Senecio abrotanifolius</i>	5 ²	20 ³	4 ²	6 ²
<i>Pogonatum urigerum</i> (E ₀)	23 ²	6 ²	1 ¹	1 ²	<i>Senecio *carniolicus</i>	9 ²	9 ²	4 ²	1 ¹
<i>Pohlia cruda</i> (E ₀)	24 ²	1 ²	1 ²	1 ³	<i>Sesleria albicans</i>	11 ²	+ ²	6 ³	1 ²
<i>Pohlia nutans</i> (E ₀)	4 ²	5 ²	2 ²	1 ⁵	<i>Soldanella carpatica</i>	62 ²	35 ²	30 ²	58 ²
<i>Polytrichum alpinum</i> (E ₀)	45 ³	34 ³	14 ³	1 ²	<i>Solidago *minuta</i>	16 ²	12 ²	17 ²	35 ²
<i>Polytrichum commune</i> (E ₀)	1 ²	4 ³	6 ⁴	19 ³	<i>Solorina crocea</i> (E ₀)	11 ²	3 ²	4 ²	-
<i>Polytrichum formosum</i> (E ₀)	4 ³	2 ³	4 ³	11 ³	<i>Sorbus aucuparia</i>	1 ²	-	13 ²	-
<i>Polytrichum juniperinum</i> (E ₀)	3 ²	9 ³	10 ³	3 ²	<i>Sphagnum</i> sp. div. (E ₀)	6 ³	6 ³	21 ⁵	21 ⁷
<i>Polytrichum piliferum</i> (E ₀)	22 ²	29 ³	10 ³	5 ³	<i>Sphenolobus minutus</i> (E ₀)	2 ¹	2 ¹	2 ²	2 ²
<i>Polytrichum sexangulare</i> (E ₀)	1 ²	3 ³	+	-	<i>Swertia *alpestris</i>	25 ³	1 ²	2 ²	3 ³
<i>Polytrichum strictum</i> (E ₀)	5 ²	8 ³	26 ⁴	9 ³	<i>Taraxacum</i> sp. div.	4 ²	2 ²	-	-
					<i>Thamnochloa subuliformis</i> (E ₀)	6 ²	5 ²	1 ²	-
					<i>Thamnochloa verniculans</i> (E ₀)	32 ²	20 ²	5 ²	1 ²
					<i>Thymus alpestris</i>	24 ²	4 ²	3 ²	5 ²
					<i>Tortella tortuosa</i> (E ₀)	45 ²	1 ²	2 ²	-
					<i>Tritomania quinqueidentata</i>	8 ²	1 ²	1 ²	-
					<i>Valeriana tripteris</i>	6 ²	1 ²	1 ²	-
					<i>Veratrum *lobelianum</i>	2 ²	2 ²	7 ²	15 ²
					<i>Viola biflora</i>	25 ²	2 ³	1 ²	2 ²
					<i>Viola *suedica</i>	-	2 ²	-	5 ²