

Diversity of *Calthion* wet meadows in the western part of flysch Carpathians: regional classification based on national formal definitions

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Abstract: We classified vegetation of wet meadows in the western part of flysch Carpathians in Slovakia (Biele Karpaty Mts., Javorníky Mts., Kysuce and Orava region, Inner Carpathian Basins). We tried to classify wet meadow communities in the study area with respect to their diversity at a wider geographical range. For this purpose, we used the formal definitions based on combination of the species groups which were extracted from a large national database. This way the classification could be valid not only at a regional scale, but also for the whole territory of Slovakia. We distinguished six associations of the *Calthion* alliance (*Cirsietum rivularis*, *Chaerophyllo hirsuti-Calthetum*, *Angelico-Cirsietum palustris*, *Scirpetum sylvatici*, *Angelico-Cirsietum oleracei* and *Scirpo-Cirsietum cani*) by combining six species groups and the dominance of some species respectively. Principal gradients in species composition were interpreted using Ellenberg indicator values. The major gradient was associated with soil moisture and pH and the second most important gradient was associated with available nutrients. At last, we suggested two associations originally defined by the dominance of certain species (*Polygono-Cirsietum palustris* and *Trollio-Cirsietum rivularis*) to be only the synonymous of *Angelico-Cirsietum palustris* and *Cirsietum rivularis*, respectively.

Keywords: Ellenberg indicator values, environmental gradients, fen meadows, grassland vegetation, ordination, phytosociology, Slovakia, species groups.

Introduction

Wet *Calthion* meadows are still rather widespread types of hay meadows in Central Europe. If moisture is considered the main environmental gradient controlling species composition of European meadows (ELLENBERG 1996) then the *Calthion* meadows are placed on the wettest end of this gradient. As compared to other meadow types, wet *Calthion* meadows are usually classified into a great number of associations (RYBNÍČEK et al. 1984). This fact is probably caused by the high beta-diversity which increases towards waterlogged meadows (HAVLOVÁ et al. 2004). On the other hand, the high number of described associations is partially caused by common dominance of broad-leaved herbs (*Cirsium* spp., *Scirpus sylvaticus*, *Caltha palustris* etc.), which is often reflected in the classification. Therefore we attempt to define associations not only using dominant species but also using combinations of species groups.

While in some regions wet meadows are over-sampled (e.g. Czech Republic; cf. CHYTRÝ & RAFAJOVÁ 2003), in other regions they have been overlooked. In spite of the fact that wet meadows are rather common in the flysch part of Outer West Carpathians in Slovakia only scarce data are available from this area. Some published relevés of wet meadow vegetation are available from Slovakian East Carpathians, namely from the Bukovské vrchy Mts. (HADAČ et al. 1997, HÁJEK 1999). Concerning our study area, some relevés have been documented only from the Liptov Basin (BALÁTOVÁ-TULÁČKOVÁ & URVICHAROVÁ 1992, RŮŽIČKOVÁ 1978, 1986). Most authors working in our study area have dealt with mire vegetation. Their papers contain data from wet meadows only scarcely (HÁJEK 1998, ŠMARDA 1961, VOZÁROVÁ 1981) or some of the relevés are even without bryophyte documentation (e.g. URBANOVÁ 1994). Moreover, from some particular regions no data have been published (e.g. Javorníky Mts. or the western part of the Kysuce Protected Landscape Area).

As the current agricultural landscape continually changes due to human activities, frequent species-rich wet meadows are step-by-step reduced by drainage, strong disturbance and in many cases also by the absence of any management. Due to these processes, wet meadow vegetation is often invaded by ruderal and nitrophilous species or it successional changes to species-poor tall forb vegetation.

This study is aimed at (i) gathering missing data about *Calthion* meadows from the western part of flysch Carpathians; (ii) classifying wet meadow vegetation in the study area with respect to Slovak national classification; (iii) developing the formal definition for each association and (iv) analysing the major ecological gradients in species composition of the studied wet meadows.

Material and methods

Study area

The study area is located at the western, north-western and northern parts of the Slovak Republic (Fig. 1). Most of the study area lies on the Paleogene flysch bedrock with Magura Nappe as the most widespread geological unit. The entire study area belongs to the Outer West Carpathians. Flysch is bedrock where in each geological stratum (bed) sandstone and claystone alternate. The beds differ from each other both in chemistry and the proportion of sandstone and claystone. It is important to note that such structure is favourable for spring originating. The groundwater chemical composition reflecting the bedrock chemistry (RAPANT et al. 1996) is a very important factor controlling species composition of waterlogged meadows. Besides the Magura Nappe some other bedrock units locally present: Paleogene sediments of Inner-Carpathian Basins (Liptov, Spiš and Poprad Basins), iron-cemented sandstones of the Silesian Unit of Krosno Nappe (Kysuce region) and the Klippen Belt built from limestones of the secondary period (Biele Karpaty Mts.).

The study area comprises a high number of orographical units. South-western and western parts are formed by the Biele Karpaty Mts. with prevailing calcified claystone and the Javorníky Mts. The north-western part (Kysuce region) is composed of the Moravskosliezske Beskydy Mts. with prevailing non-calcified sandstone, the Turzovská vrchovina Mts., the Kysucké Beskydy Mts. and Kysucká vrchovina Mts. with prevailing calcified sandstone and claystone. The next region called Orava is the flysch area with a rather complicated geomorphological structure consisting of mountain ranges (Oravské Beskydy and Oravská Magura Mts.), uplands (i.e. Podbeskydská vrchovina, Skorušinské vrchy), undulated furrows (Podbeskydská brázda, Podtatranská brázda) and one flat inter-mountain basin (Oravská kotlina). The bedrock- and groundwater chemistry varied in this region, where both calcified and non-calcified sandstone and claystone occur. The easternmost localities belong to the Spišská Magura Mts. and to the Inner-Carpathians Basins (Liptov, Spiš and Poprad Basins). Only several localities are located at the foothill of the Inner West Carpathians (Nízke Tatry Mts., Malá Fatra Mts.) lying southwards from the studied flysch area.

The climate of the study area varies with respect to particular regions. The Biele Karpaty Mts. in the south-western part of the study area have warmer (annual mean temperature in the station Myjava, 1951-1980, 8.1°C) and drier climate (annual mean precipitation in the station Nová Bošáca, 1951-1980, 717 mm) (DOSTÁL & PETRÚJOVÁ 1992). On the contrary, the climate of the north-western part (Kysuce region) is more humid and cooler. The mean annual precipitation often reaches more than 1400 mm; the mean annual temperature locally decreases to 5°C (VESECKÝ 1961). The climatic conditions of the Orava region are similar, but the mean annual precipitation is quite higher than that of the Kysuce region and varies between 1100 - 1400 mm. The precipitation is especially high across the main mountain ridges at the northern margin of the

region and at the foothill of the Vysoké Tatry Mts. Climate of Inner-Carpathians Basins (Liptov, Spiš and Poprad Basins) is rather continental due to the rain shadow of the Vysoké Tatry Mts.

Field data sampling

All relevés from the study area were collected in the vegetation seasons 2000 – 2004 in order to complete phytosociological data about *Calthion* wet meadows in Slovakia. For an estimate of abundance and dominance of plant species (vascular plants, bryophytes) the nine-grade scale (VAN DER MAAREL 1979) was used. Most of the relevés have been taken from a plot size of 16 m², which is the recommended size for the sampling of grassland vegetation (CHYTRÝ & OTÝPKOVÁ 2003).

Data analysis

The 4966 phytosociological relevés from the Central Phytosociological Database of Slovakia (www.ibot.sav.sk/cdf) (*Molinio-Arrhenatheretea*, *Scheuchzerio-Caricetea fuscae*, *Festuco-Brometea* and *Nardo-Calunetea* classes) were exported into JUICE software (TICHÝ 2002). In the next step, we tried to define vegetation types of wet meadows which are reported from Slovakia and other Central- European countries (BURKART et al. 2004, ELLMAUER & MUCINA 1993, MORAVEC et al. 1995, RYBNÍČEK et al. 1984). We characterised these vegetation types by the formal definitions using the combination of defined groups of species with the statistical tendency of joint occurrences in vegetation (KOČI et al. 2003). The species groups were created by the Cocktail method (BRUELHEIDE 2000), using the phi-coefficient (SOKAL & ROHLF 1995, CHYTRÝ et al. 2002). The species group is present in the relevé if at least one half of its members are presents. The resulting groups were combined by logical operators AND, OR and AND NOT; the strong dominance of some species was also used as a character in some cases. Further, we kept only our own relevés from the study area (Western flysch Carpathians), deleted the other relevés and then recalculated fidelity of each species to each vegetation type (CHYTRÝ et al. 2002) in resulting small data set from the study area. The species in the table were then sorted according to their fidelity to vegetation type and the species with fidelity above 0.25 (phi-coefficient > 0.25) in any association were regarded as diagnostic. Relevés that remained unclassified were subsequently assigned to the associations by calculating similarity to relevé groups that had already been assigned to the associations using the Positive fidelity-Frequency index (TICHÝ 2005) and by the number of diagnostic species. Finally, the diagnostic species were recalculated. Only species with fidelity higher than 25 and simultaneously with a probability of non-random occurrence yielded by Fischer's exact test above 1.10^{-2} (Chytrý et al. 2002) were included to the synoptic table. Due to using this approach we can regard the resulting classification to be valid for the entire Slovakian territory.

Major gradients in species composition of wet meadow vegetation were analysed by the ordination of data set from the study area using detrended

correspondence analysis (DCA) in the CANOCO 4.5 package (TER BRAAK & ŠMILAUER 2002). For ecological interpretation of the ordination axes, average Ellenberg indicator values (ELLENBERG et al. 1992) for relevés were plotted onto DCA ordination diagram as supplementary environmental data. These environmental variables were correlated with ordination axes (the Pearson correlation coefficient) using the SPSS 8.0.0. software.

Nomenclature follows MARHOLD & HINDÁK (1998) for both vascular plants and bryophytes.

Results

We distinguished six species groups (see Tab. 1), which we have used for creating the formal definitions of six wet meadow associations. Species that differentiate particular associations are shown in the shortened synoptic table (Tab. 2). The study wet meadow vegetation was classified within the following associations:

***Cirsietum rivularis* NOWIŃSKI 1927 (Tab. 3, rel. 1-67)**

definition: [(group *Valeriana simplicifolia* AND group *Lychnis flos-cuculi*) OR *Cirsium rivulare* cover > 5%] NOT (*Scirpus sylvaticus* cover > 50% OR group *Eriophorum latifolium*)

Cirsietum rivularis is the most common type of wet meadow vegetation and it occurs over the entire study area. It prefers alkaline, calcareous soils (subass. *eriophoretosum latifolii*) or circumneutral soils (subass. *chaerophylletosum hirsuti* and *typicum*). Most of the habitats are species-rich, only those unmanaged for a long time are rather species-poor.

subass. *trollietosum altissimae* comb. nova (Tab. 3, rel. 29-31; nomenclature type: rel. 31) is differentiated from the other subassociations by the dominance of *Trollius altissimus* and, in our case, also by the presence of *Carex umbrosa* and some *Molinion* species (e.g. *Succisa pratensis*, *Sanguisorba officinalis* and *Scorzonera humilis*). Its distribution in Slovakia is restricted to the Inner-Carpathian Basins (RŮŽIČKOVÁ 1978) and to the Poľana Mts (BALÁTOVÁ-TULÁČKOVÁ & KONTRIŠOVÁ 1999). This vegetation was described from Germany as the *Trollio-Cirsietum rivularis* association (OBERDORFER 1957). Our opinion is that this vegetation should be evaluated only at the subassociation level, because all characteristics of this vegetation fit well to the definition of the *Cirsietum rivularis* association. This conception is in accordance with the new national surveys of the Central-European countries (BURKART et al. 2004, CHYTRÝ 2005), which consider *Trollio-Cirsietum rivularis* to be the synonymous of the *Cirsietum rivularis* association.

***Chaerophyllo hirsuti-Calthetum palustris* BALÁTOVÁ-TULÁČKOVÁ 1985 (Tab. 4, rel. 1-11)**

definition: group *Cardamine amara*. This definition is valid only within non-forest vegetation.

This association scarcely occurs in the Javorníky Mts. and in the Kysuce and Orava regions. The vegetation prefers acidic to neutral soils, running water and moderate shading. The number of species is rather low. *Caltha palustris* and *Chaerophyllum hirsutum* are often dominant species in the vascular plant layer.

***Angelico sylvestris-Cirsietum palustris* DARIMONT ex BALÁTOVÁ-TULÁČKOVÁ 1973 (Tab. 4, rel. 12-27)**

definition: [(group *Carex echinata* AND group *Lychnis flos-cuculi*) OR *Cirsium palustre* cover > 5%] NOT (*Cirsium rivulare* cover > 5% OR group *Eriophorum latifolium*)

This association occurs mostly on non-calcified bedrock. It is often found at margins of the acidic *Sphagnum*-dominated fens, with which it harbours joint species (group *Carex echinata*). This vegetation is relatively rare in Slovakia.

subass. *polygonetosum bistortae* comb. nova (Tab. 4, rel. 22-27; nomenclature type: rel. 24) is differentiated by the subdominance of *Bistorta major* and is restricted to the Orava region in our study area. This vegetation has been evaluated as the separate association by some authors (e.g. BALÁTOVÁ-TULÁČKOVÁ 1974), but excepting subdominance of *Bistorta major* no differences exist as against to *Angelico-Cirsietum palustris*. In other European national surveys, the *Polygono-Cirsietum palustris* is mentioned as a synonymous of the *Angelico-Cirsietum palustris* (ELLMAUER & MUCINA 1993, CHYTRÝ 2005).

***Scirpetum sylvatici* RALSKI 1931 (Tab. 4, rel. 28-34)**

definition: *Scirpus sylvaticus* cover > 25% and absence of all other species groups.

Scirpetum sylvatici is traditionally defined as an association with a strong dominance of *Scirpus sylvaticus*, which mostly reaches more than 50% cover (RYBNÍČEK et al. 1984, ŠPÁNIKOVÁ 1982). This association is not differentiated along the first "pH axis" in DCA, because it can develop on both alkaline and sub-acidic soils. However, it is better delimited along the second ordination axis through the increased supply of nutrients (cf. Fig. 2). This vegetation is extremely species-poor because of a strong competition of the dominant *Scirpus sylvaticus*.

***Angelico sylvestris-Cirsietum oleracei* TÜXEN 1937 (Tab. 4, rel. 35-40)**

definition: *Cirsium oleraceum* cover > 5% NOT *Filipendula ulmaria* cover > 25%

In the study area, this locally rare association is confined to the area of the Biele Karpaty Mts. It occurs at low altitudes (350-450 m a.s.l.) on alkaline and mostly nutrient-rich soils. The association is rather common in the Bohemian Massif and its Carpathian distribution range is restricted to nutrient-richest, mostly alluvial, soils (HÁJEK & HÁJKOVÁ 2004).

***Scirpo sylvatici-Cirsietum cani* BALÁTOVÁ-TULÁČKOVÁ 1973 (Tab. 4, rel. 41-45)**

definition: [(group *Caltha palustris* OR group *Lychnis flos-cuculi*) AND *Cirsium canum* cover > 5%] NOT *Deschampsia cespitosa* cover > 5%.

Scirpo-Cirsietum cani is the rarest association not only in the study area but also in Slovakia as a whole. The association exhibits a continental tendency and it mostly occurs at low altitudes (Biele Karpaty Mts.). In one case, we recorded this vegetation at a higher altitude in the Poprad Basin having a rather continental climate. The association prefers mineral-rich, nearly subhalophilic soils with a fluctuating water level. *Scirpo-Cirsietum cani* is the association with the lowest presence of hydrophilous *Calthion* species within all *Calthion* meadows. It stays close to floodplain vegetation of the *Deschampsion* alliance along the moisture gradient (BOTTA-DUKÁT et al. 2005).

Principal gradients in species composition

The scatter-plot of detrended correspondence analysis (DCA) shows distribution of particular vegetation types along the first and second ordination axes (Fig. 2). Average Ellenberg indicator values for relevés, plotted *a posteriori* onto the ordination diagram, show which environmental factors are probably responsible for the most important variation in species data. The first vegetation gradient is clearly connected with pH, moisture and temperature, the second one with nutrients and light conditions (for Pearson correlations see head to Figure 2). In the right part of the scatter, the relevés of the *Angelico-Cirsietum oleracei* and *Scirpo-Cirsietum cani* associations are placed. These associations occur on alkaline soils at low altitudes in the regions with a high mean temperature. *Angelico-Cirsietum palustris* and *Chaerophyllo hirsuti-Calthetum* are situated at the opposite end of the ordination diagram and they prefer acidic and non-calcified soils. Two latter associations occur in the mountain areas with rather humid climate that causes, among others, high waterlogging all year round. *Scirpetum sylvatici* and *Angelico-Cirsietum oleracei* represent the most productive, nutrient-demanding vegetation types. The occurrence of *Chaerophyllo hirsuti-Calthetum* is negatively correlated with light amount, because the dominant herbs not only tolerate slight shading, but they themselves cause the light unavailability in lower vegetation layers.

Discussion

A search for the formal definitions of the associations based on combination of species groups extracted from a large national database seems to be a suitable method how to create an appropriate regional classification. Such classification is valid not only at the regional scale, but also for the entire territory of Slovakia. This could be a way how to cope with a discrepancy between national and regional vegetation classification occurring especially when numerical approaches are used (KUŽELOVÁ & CHYTRÝ 2004).

Using Ellenberg indicator values, we detected two major environmental gradients in the species composition of wet meadow vegetation; the first one is connected with acidity and the second one with nutrients (Fig. 2). This result is consistent with other analyses based on measured environmental data from the entire Czech Republic (HÁJEK & HÁJKOVÁ 2004).

As a syntaxonomical conclusion, we consider two associations originally defined by the dominance (*Polygono-Cirsietum palustris* and *Trollio-Cirsietum rivularis*) to be only the synonymous of *Angelico-Cirsietum palustris* and *Cirsietum rivularis*, respectively. No differences in environmental characteristics were detected by *Angelico-Cirsietum palustris* and *Polygono-Cirsietum palustris* (HÁJEK & HÁJKOVÁ 2004). Further, the species composition of relevés with subdominant *Bistorta major* fits well to the definition of *Angelico-Cirsietum palustris*. This suggested reclassification is consistent with other European national surveys (BURKART et al. 2004, ELLMAUER & MUCINA 1993, CHYTRÝ 2005). *Cirsio palustris-Calthetum* BALÁTOVÁ-TULÁČKOVÁ, KONTRIŠOVÁ ET KONTRIŠ 1994 is the next association having nearly the same species composition as *Angelico-Cirsietum palustris* and we also suggest to regard it to be synonymous. It was described by BALÁTOVÁ-TULÁČKOVÁ (1994) from Poľana Mts. as a vicarious association of *Angelico-Cirsietum palustris*, but it differs only by different cover and constancy of several widespread species (e.g. *Angelica sylvestris*, *Geum rivale*, *Tephrosia crassa*). It is impossible to formally define this association. In addition, the author herself notes that similar vegetation is designated as *Angelico-Cirsietum palustris* in the Alps (BALÁTOVÁ-TULÁČKOVÁ & KONTRIŠOVÁ 1999).

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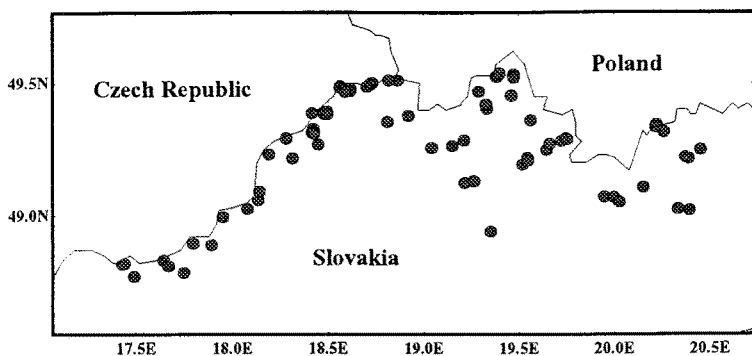


Fig. 1. Distribution of all studied localities in western and northern Slovakia. Coordinates presented at frame are in WGS 84 system.

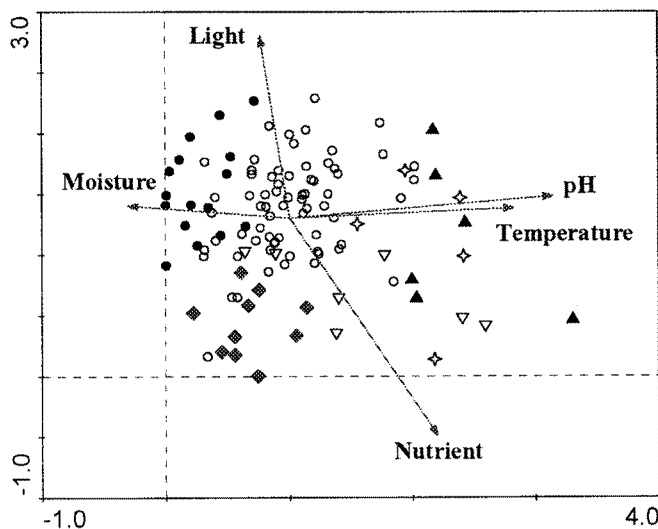


Fig. 2. Detrended correspondence analysis (DCA) ordination diagram of sites (eigenvalues of the first two axes are 0.276 and 0.184). Average Ellenberg indicator values for relevés were plotted onto DCA ordination diagram as supplementary environmental data. Pearson correlation coefficients: the 1st ordination axis correlates with pH (0.815), temperature (0.686) and moisture (-0.510); the 2nd ordination axis correlates with nutrients (-0.742) and light (0.605); all these correlations are significant at $P < 0.001$ level.

Explanations: full circles – *Angelico sylvestris-Cirsietum palustris*; empty circles – *Cirsietum rivularis*; grey diamonds – *Chaerophyllo hirsuti-Calthetum palustris*; stars – *Scirpo sylvatici-Cirsietum cani*; down empty triangles – *Scirpetum sylvatici*; up full triangles – *Angelico sylvestris-Cirsietum oleracei*.

Tab. 1. The species groups created by the Coctail method using a large data set from the Slovak Phytosociological Database (*Molinio-Arrhenatheretea*, *Scheuchzerio-Caricetea fuscae*, *Festuco-Brometea* and *Nardo-Callunetea* classes).

name of sp. group	species
<i>Caltha palustris</i>	<i>Caltha palustris</i> , <i>Myosotis nemorosa</i> , <i>Scirpus sylvaticus</i>
<i>Cardamine amara</i>	<i>Cardamine amara</i> , <i>Chaerophyllum hirsutum</i> , <i>Chrysosplenium alternifolium</i> , <i>Glyceria notata</i> , <i>Stellaria alsine</i> , <i>Stellaria nemorum</i>
<i>Carex echinata</i>	<i>Agrostis canina</i> , <i>Aulacomnium palustre</i> , <i>Carex echinata</i> , <i>Carex nigra</i> , <i>Cirsium palustre</i> , <i>Eriophorum angustifolium</i> , <i>Viola palustris</i>
<i>Eriophorum latifolium</i>	<i>Campylium stellatum</i> , <i>Carex davalliana</i> , <i>Carex flava</i> , <i>Drepanocladus cossonii</i> , <i>Eriophorum latifolium</i> , <i>Parnassia palustris</i> , <i>Pinguicula vulgaris</i> , <i>Primula farinosa</i>
<i>Lychnis flos-cuculi</i>	<i>Acetosa pratensis</i> , <i>Alopecurus pratensis</i> , <i>Cardamine pratensis</i> , <i>Festuca pratensis</i> , <i>Lathyrus pratensis</i> , <i>Lychnis flos-cuculi</i> , <i>Ranunculus acris</i> , <i>Ranunculus auricomus</i> agg.
<i>Valeriana simplicifolia</i>	<i>Cirsium rivularis</i> , <i>Crepis paludosa</i> , <i>Dactylorhiza majalis</i> , <i>Equisetum palustre</i> , <i>Geum rivale</i> , <i>Plagiomnium elatum</i> , <i>Valeriana simplicifolia</i>

Tab. 2. Shortened synoptic table with percentage frequency values. Diagnostic species of the particular associations (defined as those with $\phi > 0.25^*$, $\phi > 0.40^{***}$) are shaded and ranked by decreasing ϕ values, i.e. decreasing fidelities to each columns. Only diagnostic species with a probability of non-random occurrence yielded by Fischer's exact test above $1 \cdot 10^{-2}$ are presented.

Group number	1	2	3	4	5	6
Number of relevés	9	68	16	8	6	5

1. *Chaerophyllo hirsuti-Calthetum palustris*

<i>Chaerophyllum hirsutum</i>	100 ^{***}	34	19	12	.	.
<i>Cardamine amara</i>	100 ^{***}	9	.	12	.	.
<i>Glyceria notata</i>	78 ^{***}	1	.	25	.	.
<i>Stellaria alsine</i>	44 ^{***}	.	.	.	.	.
<i>Stellaria nemorum</i>	22 ^{***}	.	.	.	.	.

2. *Cirsietum rivularis*

<i>Cirsium rivulare</i>	67	100 ^{***}	12	62	83	40
<i>Briza media</i>	22	66 ^{***}	31	12	17	40
<i>Listera ovata</i>	.	29 [*]	.	12	.	.
<i>Carex davalliana</i>	.	28 [*]	.	.	17	.
<i>Eriophorum latifolium</i>	.	31 [*]	6	.	17	.
<i>Alchemilla vulgaris</i> agg.	56	68 [*]	44	38	17	.
<i>Plagiomnium elatum</i>	89	81 [*]	50	25	67	20
<i>Cruciata glabra</i>	33	65 [*]	38	38	33	20
<i>Carex panicea</i>	33	84 [*]	81	50	50	60
<i>Primula elatior</i>	22	32 [*]	.	25	.	.
<i>Vicia cracca</i>	.	38 [*]	12	12	17	40

<i>Epipactis palustris</i>	.	21	.	.	.	20
<i>Festuca rubra</i> agg.	11	81	88	50	50	60
<i>Climacium dendroides</i>	22	65	69	25	17	20

3. *Angelico sylvestris*-*Cirsietum palustris*

<i>Cirsium palustre</i>	33	22	100	38	.	.
<i>Agrostis canina</i>	22	16	88	12	.	.
<i>Aulacomnium palustre</i>	.	7	62	.	.	.
<i>Sphagnum palustre</i>	.	.	25	.	.	.
<i>Viola palustris</i>	22	3	38	.	.	.
<i>Calliergon stramineum</i>	.	.	19	.	.	.
<i>Nardus stricta</i>	.	4	31	.	.	.
<i>Plagiomnium ellipticum</i>	.	1	19	.	.	.
<i>Carex rostrata</i>	.	6	31	12	.	.
<i>Bistorta major</i>	.	10	38	12	.	.
<i>Galium palustre</i>	67	43	81	38	17	20
<i>Epilobium palustre</i>	56	22	56	12	.	.
<i>Potentilla erecta</i>	33	78	100	38	50	.
<i>Anthoxanthum odoratum</i>	22	57	88	38	33	40

4. *Scirpetum sylvatici*

<i>Scirpus sylvaticus</i>	78	51	19	100	83	40
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5. *Angelico sylvestris*-*Cirsietum oleracei*

<i>Cirsium oleraceum</i>	.	6	.	12	100	20
<i>Ajuga reptans</i>	22	18	6	50	100	40
<i>Lysimachia nummularia</i>	22	12	.	25	83	40
<i>Cratoneuron filicinum</i>	11	22	.	.	83	40
<i>Mentha longifolia</i>	22	16	.	50	83	40
<i>Dactylis glomerata</i>	22	12	.	38	67	40
<i>Lysimachia vulgaris</i>	22	22	19	50	83	20
<i>Carex flacca</i>	.	22	.	.	67	40

6. *Scirpo sylvatici*-*Cirsietum cani*

<i>Cirsium canum</i>	.	.	.	.	.	100
<i>Potentilla reptans</i>	.	1	.	.	17	60
<i>Symphytum officinale</i>	.	1	.	12	.	40

Species diagnostic for more than one association

<i>Eurhynchium hians</i>	11	1	.	25	83	60
<i>Carex tomentosa</i>	.	4	.	12	50	40

[illegible]

Phleum pratense +. +. +.
 Avenula pubescens 1. +.
 Trisetum flavescens +. +.
 Leucanthemum vulgare agg. +. r. +.

Scheuchzeria-Caricetea fuscae

Carex panicea aab1+aaab11+1.a+aaamabmbial11 11+ 11111a....11.a. 1..+1bm1+aaala.1.am+a1
 Carex nigra 1.baab11b..1b.1a11m.al1m.+aa 1+. mm11baa1+m1a. 1b..am4+aaaalaa.11b+ma
 Valeriana simplicifolia ab..b.3b.aaa4.1a3bb.a.+a...a 1++ 11..b.baa1... a...b..alb..b3ba...b
 Eriophorum angustifolium 11b1ama+1.m...11mma+1a1b1.. .. +. m+. m1la.1.a.aaa3+am.m...
 Juncus articulatus ..+.1+.+.+.+++++.+.1.. ++. +. +. r. +.
 Carex echinata ..1+.+.+.11....+. +. +. m.1....1.+.
 Triglochin palustre 1..+...r..+.+.+.+. +. +.
 Valeriana dioica b.b.b.. bb+... .. 1
 Carex canescens 1....1 m.1.....
 Equisetum variegatum m....+. m.....

Species with synanthropic tendency

Equisetum arvense 11+..1.1+.+.+.+.+.+.r+1 .+. +1....a+. 1..a.1....+.a+....+
 Carex hirta ..+.+.r.....+. r.r.1....r.... ..+.r+1....+.+.1.+
 Ranunculus repens ..+.+.+.+.a.. ..+. +. +. 1....+.ra...+
 Eupatorium cannabinum 1....1....1....1....++ 1....+. a....+.
 Heracleum sphondylium ..+.+.+.+. 1....+.
 Potentilla anserina 1a..... ..+. +. r....
 Vicia sepium+. +. +. r....
 Taraxacum sect. Ruderalia+. r.....+. +.

Other bryophytes

Plagiomnium elatum aal+b33b13+b31a+3313b3+3++4b 1a +5.1+b..4a.b.1 1b.+11+1aaba..b3.1..b
 Calliargonella cuspidata +a4.+bbaa+aal11.1+ 1aaa+b3+3 ++ +.11a.+..+11. 3a1ab4.b.aab..alb....a
 Climacium dendroides 131b3a.1+b.1a.bbbba...bb..a. al. 1.+1a.1+.1++ +....+.b+3b3a.a.b.baa
 Brachythecium rivulare ..+.1+....la..1....a..+.a +1+....+31.13 ..3..1.+1..+1+a+....a
 Rhytidiadelphus squarrosus ..+.11+.+.1....a....1 ... ++r+1.1.1+.. +.....ab..b3b...3aa4+

Relevé number

1111111111112222222222 233 33333333444444 4444555555555566666666
1234567890123456789012345678 901 23456789012345 6789012345678901234567

<i>Cirriophyllum piliferum</i>	1.+...+++.1.....	1..+1..1..11.	1.....+	a..a+
<i>Cratoneuron filicinum</i>	.1....++.....b.+...+al..	.a. +	+..+.....	a.....
<i>Thuidium philibertii</i>	a.....r.....	+...+.....	+.....	a..a++
<i>Hypnum pratense</i>	.1.b.....1.....+1.....	++.....	+.....	+.....
<i>Aneura pinguis</i>	++.....1.....	r.....	+.....	1.....
<i>Aulacomnium palustre</i>	...b.....	++.....	.a.	+.....
<i>Palustriella decipiens</i>	1..1.....	1.	.....	.....b.....
<i>Plagiomnium undulatum</i>	+.....	a.+.....	b.....	.....
<i>Fissidens adianthoides</i>	.1.....	.....+.....	.....+	.....
<i>Brachythecium mildeanum</i>	...1.....a.....	b.....	.....	.....

Other vascular plant species

<i>Potentilla erecta</i>	aal.11a1alba..aaaaaa+a..aa	+a+	++a+.++11+++1.	1...1.ar11..ab.aa.all.
<i>Cruciata glabra</i>	1mr1la.11+a..+1a1.1+a1..m+	.11	11+m.a.+.....	+...+11++m..+++++..+
<i>Agrostis stolonifera</i>	+...+m.rm...1...11..1+.+	...	+...1.m.....	mmmm+...+m.....+
<i>Primula elatior</i>	++a+.+1.....+1	1+a	1..1.....	1.....+...+...+1+...
<i>Veronica chamaedrys</i>	l...++.....+.....	...	1+1+11..1..1.	1.....1.+...+1..a
<i>Mentha arvensis</i>	ar+1...r.....++...+..a	...	a+...a.....	+...+...+1+...+
<i>Equisetum fluviatile</i>	.a.a.....b...+1a...	...	1....b1+...+a	...a+...+1..1...1
<i>Listera ovata</i>	.1.+...1.+...+1+...+...+.	...	++...++...+.	+.....
<i>Carex pallescens</i>	...1...+...+...+.....	...	++...++...+m.	+...m...1.a.
<i>Agrostis capillaris</i>	+1.....+.....	...	1...11m+1+.	r+...+...a1.
<i>Epilobium palustre</i>	...1...+...+r+...r.....	r..	...+...+...+.	+r...+...+
<i>Ajuga reptans</i>	+++.+	...	...+...+...+.	+...+...+
<i>Agrostis canina</i>	+.....+...+.	...	...+...a+...1.	m...a.+
<i>Lotus uliginosus</i>	...1.....	...	...a.a1+...1.	a...+1.
<i>Juncus inflexus</i>	1.m.....	...	1.....	+...+...+
<i>Leontodon hispidus s.l.</i>	...+...r1.+...+.....	...	+.	+...+...+
<i>Lysimachia nummularia</i>	...1..1.....+.....	...	...+...+...+.	1..r.....1...
<i>Senecio subalpinus</i>	...+.....	...	1a...a...	...1...1...1...
<i>Stellaria graminea</i>	...+.....	...	+1.1+...+	r.....+
<i>Hypericum tetrapterum</i>	+.....+...+.	...	...+...+...+.	...+...+...+.

Euphrasia rostkoviana agg. 32: r; *Eurhynchium hians* 31: +; *Festuca rupicola* 66: +; *Filipendula vulgaris* 23: +, 58: r; *Galium rivale* 3: r, 40: 1; *Geranium palustre* 12: +, 32: 1; *Glechoma hederacea* 35: +; *Glyceria nemoralis* 8: +; *Gymnadenia conopsea* ssp. *conopsea* 15: +, 58: r; *Gymnadenia densiflora* 20: +, 22: +; *Hamatocaulis vernicosus* 54: +; *Hylocomium splendens* 16: +, 54: +; *Hypnum lindbergii* 4: +; *Chaerophyllum aromaticum* 67: +; *Chiloscyphus polyanthos* agg. 9: +; *Jacea phrygia* agg. 11: 1, 29: 1; *Lophocolea bidentata* 16: +, 28: +; *Lophocolea heterophylla* 62: +; *Medicago lupulina* 8: +; *Melampyrum nemorosum* 12: +, 31: +; *Myosotis laxiflora* 48: +; *Melampyrum pratense* 46: +; *Mentha aquatica* 20: a, 25: a; *Molinia arundinacea* 26: 2, 49: 2; *Molinia caerulea* 19: 1, 31: +; *Ononis arvensis* 28: +; *Paludella squarrosa* 27: +; *Palustriella commutatus* 3: +, 26: +; *Pedicularis palustris* 22: +, 54: +; *Pedicularis sceptrum-carolinum* 12: +; *Petasites albus* 17: +; *Pimpinella lactucella* 29: +; *Pimpinella major* 31: r, 37: +; *Plagiomnium affine* 29: b; *Plagiomnium ellipticum* 39: 3; *Plantago major* 22: r; *Plantago media* 57: +; *Platanthera bifolia* 67: +; *Polemonium caeruleum* 12: +, 31: +; *Polygala amarella* 2: +; *Polygala vulgaris* 9: +, 15: +; *Potentilla reptans* 67: r; *Pseudoscleropodium purum* 3: 1; *Ranunculus polyanthemus* 4: +; *Rhinanthus serotinus* 5: +, 47: +; *Rhytidadelphus triquetrus* 46: a; *Rumex alpestris* 31: +; *Salix pentandra* (juv.) 18: +; *Salix purpurea* (juv.) 25: +; *Scabiosa lucida* 11: r; *Scutellaria galericulata* 67: +; *Selinum carvifolia* 30: +; *Senecio erraticus* 35: +; *Sphagnum contortum* 19: 1; *Sphagnum warnstorffii* 19: a; *Symphytum officinale* 40: +; *Symphytum tuberosum* 49: r; *Taraxacum* sect. *Palustria* 23: r; *Thuidium recognitum* 46: +, 30: +; *Thuidium delicatulum* 51: +; *Trifolium repens* 22: 1; *Trifolium montanum* 20: r, 29: r; *Veronica beccabunga* 26: +; *Veronica officinalis* 66: +; *Viola canina* 30: r; *Viola palustris* 39: +, 59: +.

Table heads and localities (* before longitude = inaccurate values taken from Geobase or En Carta software)

subass. *eriphoretosum latifolii*

1: slope 2°, exp. NW, 815 m a. s. l., Skorušinské vrchy Mts., Velké Borové village, southeastern margin of the village, rich fen complex, longitude 19°31'16'', latitude 49°11'38''. 2: slope 5°, exp. WW1, 719 m a. s. l., Podbeskydská vrchovina uplands, Klin village, Taskovka, longitude 19°27'39'', latitude 49°27'14''. 3: slope 2°, exp. SW, 310 m a. s. l., Biele Karpaty Mts., mountain pass of the Vlára river, calcareous tufa-forming fen, longitude 18°04'54'', latitude 49°01'29''. 4: slope 2°, exp. NE, 650 m a. s. l., Turzovská vrchovina uplands, Kelčov-Lieskov village, behind the house no. 1195, longitude 18°28'47'', latitude 49°23'03''. 5: slope 1°, exp. -, 795 m a. s. l., Oravské Beskydy Mts., 4 km NW from Oravské Veselé village, longitude 19°23'11'', latitude 49°31'30''. 6: slope 0°, exp. -, 490 m a. s. l., Javorníky Mts., Štiavnická dolina valley, Tisové settlement, 4 km NW from Štiavnik settlement, longitude 18°27'00'', latitude 49°16'04''. 7: slope 5°, exp. W, 788 m a. s. l., Chočské vrchy Mts., Studničná village, southern margin of the village, along the small brook, longitude 19°15'55'', latitude 49°07'53''. 8: slope 1°, exp. NE, 786 m a. s. l., Skorušinské vrchy Mts., Huty village, upper end of village, near the road, small spring fen, longitude 19°32'48'', latitude

49°12'28". 9: slope 3°, exp. NE, 778 m a. s. l., Moravskoslezské Beskydy Mts., Makov pass, small spring fen meadows, longitude 18°25'02", latitude 49°23'12". 10: slope 2°, exp. ↘, 857 m a. s. l., Nízke Tatry Mts., Liptovská Lúžna village, upper margin of village, along the small brook, longitude 19°21'10", latitude 48°56'25". 11: slope 2°, exp. N, 822 m a. s. l., Chočské vrchy Mts., Studničná village, slopes south from the village, longitude 19°15'48", latitude 49°07'52". 12: slope 3°, exp. ↘, 815 m a. s. l., Liptov basin, Važec village, Krivošova lúka Nature Reserve, fen complex, longitude 19°59'58", latitude 49°04'06". 13: slope 1°, exp. WWS, 630 m a. s. l., Turzovská vrchovina uplands, Nižný Kelčov village, before the house no. 1109, longitude 18°29'40", latitude 49°23'33". 14: slope 0°, exp. ↘, 611 m a. s. l., Poprad basin, Hôrka, longitude 20°23'43", latitude 49°01'10". 15: slope 2°, exp. WWJ, 801 m a. s. l., Oravské Beskydy Mts., 4 km from the Oravské Veselé village, longitude 19°23'02", latitude 49°31'31". 16: slope 4°, exp. NNE, 805 m a. s. l., Skorušinské vrchy Mts., Malé Borové village, cca 0.5 km from southeastern margin of village, the right bank of small brook, longitude 19°32'44", latitude 49°13'06". 17: slope 4°, exp. NE, 710 m a. s. l., Podbeskydská vrchovina uplands, Klin village, slope with ski lift, longitude 19°27'43", latitude 49°27'08". 18: slope 0°, exp. ↘, 674 m a. s. l., Podbeskydská brázda furrow, Beňadovo Nature Reserve, longitude 19°19'41", latitude 49°25'15". 19: slope 0°, exp. ↘, 467 m a. s. l., Chočské vrchy Mts., Komjatná valley, 2 km NE from Švošov, longitude 19°12'59", latitude 49°07'31". 20: slope 1°, exp. NW, 815 m a. s. l., Skorušinské vrchy Mts., Velké Borové village, rich fen complex on the SSE margin of the village, longitude 19°31'16", latitude 49°11'38". 21: slope 1°, exp. NW, 815 m a. s. l., Skorušinské vrchy Mts., Velké Borové village, rich fen complex on the SSE margin of the village, longitude 19°31'16", latitude 49°11'38". 22: slope 2°, exp. ↘, 520 m a. s. l., Malá Fatra Mts., Terchová village, behind the playground, longitude 19°02'37", latitude 49°15'21". 23: slope 0°, exp. ↘, 580 m a. s. l., Javorníky Mts., Štiavnik valley, Medvedie settlement, by the road, longitude 18°25'03", latitude 49°18'46". 24: slope 3°, exp. SW, 460 m a. s. l., Jablunkovské medzihorie uplands, Čierne village, Markov potok brook, 2 km NW from village, longitude 18°48'17", latitude 49°30'07". 25: slope 0°, exp. ↘, 539 m a. s. l., Biele Karapaty Mts., Chvojnicia village, Žalostinná Nature Reserve, *longitude 17°25'50", latitude 48°48'52". 26: slope 5°, exp. E, 456 m a. s. l., Biele Karapaty Mts., Krivoklátské lúky Nature Reserve, longitude 18°08'14", latitude 49°03'31". 27: slope 1°, exp. ↘, 857 m a. s. l., Podtatranská brázda furrow, Oravice village, Mihuľčie, longitude 19°43'28", latitude 49°16'53". 28: slope 10°, exp. NNW, 760 m a. s. l., Orava basin, Tvrdošín town, Krivý Kút, longitude 19°33'45", latitude 49°21'36".

subass. *trollietosum altissimae*

29: slope 2°, exp. NE, 910 m a. s. l., Liptov basin, Štrba village – Pastierske (Brezové), longitude 20°01'42", latitude 49°03'03". 30: slope 0°, exp. ↘, 677 m a. s. l., Spiš basin, Belianske lúky Nature Reserve, longitude 20°23'25", latitude 49°12'52". 31: slope 1°, exp. ↘, 782 m a. s. l., Liptov basin, Važec village, margin of the small fen in the Belanský brook valley, longitude 19°56'55", latitude 49°04'14".

subass. *chaerophylletosum hirsuti*

32: slope 3°, exp. NW, 620 m a. s. l., Javorníky Mts., Horná Mariková village, Ráztoka settlement, longitude 18°17'02'', latitude 49°17'26''. **33:** slope 1°, exp. -, 796 m a. s. l., Oravské Beskydy Mts., 4 km from Oravské Veselé village, longitude 19°23'11'', latitude 49°31'30''. **34:** slope 0°, exp. -, 827 m a. s. l., Podtatranská brázda furrow, Oravice village, Peciská 2, longitude 19°44'48'', latitude 49°17'30''. **35:** slope 0°, exp. -, 448 m a. s. l., Javorníky Mts., Lazy pod Makytou village, Olšová settlement, longitude 18°11'39'', latitude 49°13'50''. **36:** slope 0°, exp. -, 650 m a. s. l., region Kysuce, Kormická brázda furrow, between Hlavice and Klin settlements, brook floodplain, longitude 18°35'30'', latitude 49°27'57''. **37:** slope 0°, exp. -, 684 m a. s. l., Podbeskydská brázda furrow, Beňadovo village, Beňadovský Mlyn and Hlavice settlements, brook floodplain, longitude 19°19'58'', latitude 49°24'15''. **38:** slope 0°, exp. -, 650 m a. s. l., Kormická brázda furrow, between Klin and Hlavice settlements, brook floodplain, by the road, longitude 18°35'30'', latitude 49°27'57''. **39:** slope 1°, exp. NW, 887 m a. s. l., Západné Tatry Mts., below the Sivý vrch hill, 2 km SE from Zuberec village, longitude 19°38'46'', latitude 49°14'55''. **40:** slope 2°, exp. -, 580 m a. s. l., Turzovská vrchovina uplands, Keľčov village, 1 km NW from railway station Nižný Keľčov, longitude 18°29'54'', latitude 49°22'59''. **41:** slope 1°, exp. N, 590 m a. s. l., Turzovská vrchovina uplands, Raková-Kúkoľanka village, 2 km NNW from Prieláčský hill (649.6 m a. s. l.), longitude 18°42'17'', latitude 49°29'07''. **42:** slope 0°, exp. -, 859 m a. s. l., Podtatranská brázda furrow, Oravice village, Peciská 3, longitude 19°45'10'', latitude 49°17'17''. **43:** slope 2°, exp. -, 485 m a. s. l., Jablunkovské medzihorie uplands, Čierne village, Čierny potok brook, longitude 18°49'08'', latitude 49°30'38''. **44:** slope 7°, exp. W, 615 m a. s. l., Turzovská vrchovina uplands, Kľokočov village, Vrchpredmier - Žilkovci settlement, longitude 18°33'46'', latitude 49°28'56''. **45:** slope 1°, exp. NE, 540 m a. s. l., Turzovská vrchovina uplands, Megonky village, Soglovci settlement, longitude 18°42'78'', latitude 49°29'40''.

subass. *typicum*

46: slope 3°, exp. NE, 740 m a. s. l., Oravská Magura Mts., Zázrivá village, Kozinská Nature Reserve, longitude 19°12'47'', latitude 49°17'08''. **47:** slope 2°, exp. N, 535 m a. s. l., Malá Fatra Mts., Terchová village, behind the playground, longitude 19°02'38'', latitude 49°15'22''. **48:** slope 0°, exp. -, 410 m a. s. l., Biela Karpaty Mts., Malejov village, brook floodplain below the Pecková hill, longitude 17°29'32'', latitude 48°46'08''. **49:** slope 1°, exp. NE, 342 m a. s. l., Biela Karpaty Mts., Chocholanská valley, slopes of the Tlstá hill, longitude 17°53'41'', latitude 48°53'18''. **50:** slope 5°, exp. NNW, 783 m a. s. l., Oravská Magura Mts., Zázrivá village, Kozinská Nature Reserve, longitude 19°12'45'', latitude 49°17'05''. **51:** slope 2°, exp. SSW, 645 m a. s. l., Liptov basin, Vojniány village, longitude 20°27'12'', latitude 49°14'53''. **52:** slope 2°, exp. -, 310 m a. s. l., Biela Karpaty Mts., mountain pass of the Vlára river, Zábava settlement, *longitude 18°04'54'', latitude 49°01'29''. **53:** slope 1°, exp. NE, 820 m a. s. l., Podtatranská brázda furrow, Oravice village, near the pub, longitude 19°44'48'', latitude 49°17'30''. **54:** slope 0°, exp. -, 811 m a. s. l., Podtatranská brázda furrow, Habovka village, Blatná valley, 3 km E from village, longitude 19°39'43'', latitude 49°16'18''. **55:** slope 7°, exp. NNE, 801 m a. s. l., Skorušinské vrchy Mts., Malé Borové village, 0.5 km SE from village, along the small brook,

longitude 19°32'44'', latitude 49°13'06''. **56:** slope 1°, exp. -, 746 m a. s. l., Oravské Beskydy Mts., Oravská Polhora village, Slaná Voda settlement, near the chalet, longitude 19°28'24'', latitude 49°31'23''. **57:** slope 8°, exp. N, 600 m a. s. l., Turzovská vrchovina uplands, Korcháňovci-Kopčísko settlement, opposite the house no. 572, longitude 18°41'84'', latitude 49°29'08''. **58:** slope 1°, exp. -, 490 m a. s. l., Javorníky Mts., Štiavnická dolina valley, Tisové settlement, longitude 18°27'00'', latitude 49°16'04''. **59:** slope 0°, exp. -, 610 m a. s. l., Turzovská vrchovina uplands, Klokočov village, Vrchpredmier settlement, longitude 18°33'52'', latitude 49°29'15''. **60:** slope 0°, exp. -, 520 m a. s. l., Javorníky Mts., Štiavnická dolina valley, 6 km NW from Štiavnik village, longitude 18°24'98'', latitude 49°18'33''. **61:** slope 4°, exp. W, 751 m a. s. l., Oravské Beskydy Mts., Oravská Polhora village, Slaná Voda settlement, 500 m from the chalet, right side of the road, longitude 19°28'22'', latitude 49°31'17''. **62:** slope 3°, exp. W, 746 m a. s. l., Oravské Beskydy Mts., Oravská Polhora village, Slaná Voda settlement, 500 m from the chalet, right side of the road, longitude 19°28'23'', latitude 49°31'20''. **63:** slope 0°, exp. -, 564 m a. s. l., Malá Fatra Mts., Zázrivá village, near the junction, in direction to the Párnica village, longitude 19°09'06'', latitude 49°15'48''. **64:** slope 0°, exp. -, 756 m a. s. l., Oravské Beskydy Mts., Oravská Polhora village, Slaná Voda settlement, longitude 19°28'31'', latitude 49°32'01''. **65:** slope 0°, exp. -, 482 m a. s. l., Jablunkovské medzihoríe, Skalité village, Čierne Polesie settlement, near the railway, longitude 18°51'55'', latitude 49°30'37''. **66:** slope 0°, exp. -, 610 m a. s. l., Turzovská vrchovina uplands, Klokočov-Vrchpredmier settlement, longitude 18°33'52'', latitude 49°29'15''. **67:** slope 1°, exp. -, 542 m a. s. l., Kysucké Beskydy Mts., Klubina village, longitude 18°55'14'', latitude 49°22'35''.

Tab. 4. Phytosociological relevés of the *Chaerophyllo hirsuti-Calthetum palustris*, *Angelico sylvestris-Cirsietum palustris*, *Scirpetum sylvatici*, *Angelico sylvestris-Cirsietum oleracei*, *Scirpo sylvatici-Cirsietum cani* associations. Explanations: cover m = 2m, a = 2a, b = 2b.

Relevé number	11	111111111222222222	2233333	333334	44444
	12345678901	2345678901234567	8901234	567890	12345
Area (m ²)	11	11111111	111112112112121	11	11 112111 12 1
Cover of herb layer (E1)	00806266600	666605256665656	6595666	660666	60696
	1 1 11 111	1 11 1 1 1 1 1	1 1	1 1	1 1
Cover of moss layer	08090087000	9899098009080909	9080789	888090	99888
	00000050000	0000050000050000	8050555	550000	50550
	564689697	252 14588342	327 6 5 1	77217	2 373
Number of species	00000000010	0051000500005000	0100500	500505	50000
	24323434421	3332333453323334	6351211	435542	42542
	72281239877	5505267117861562	1473925	614153	85763
ass. <i>Chaerophyllo hirsuti-Calthetum palustris</i>					
<i>Cardamine amara</i>	aalblbb+++a	.....	.....	.....	.....
<i>Chaerophyllum hirsutum</i>	33444bbrbb.	a.b3.....	.....	.....	.....
<i>Glyceria notata</i>	1+1+al+1.	.....	.....	.....	.....
<i>Stellaria alsine</i>	rl...r.l.	.....	.....	.....	.....
<i>Stellaria nemorum</i>	.a.....+	.....	.....	.....	.....
ass. <i>Angelico sylvestris-Cirsietum palustris</i>					
<i>Cirsium palustre</i>	+.....+..+.	aaala+aallalrl+	..1.+.	.....	.....
<i>Potentilla erecta</i>	..+...11...	aaalaala+blabab+	+1...+	1.+.	.....
<i>Anthoxanthum odoratum</i>	a.l.	all.1.111mlmlal	a+a.....	..1.+.	.....
<i>Agrostis canina</i>	+++	a+anabml+a.aalm.	.....	.....	.....
<i>Auacommium palustre</i>	.....	+11...ab.+rl...+	.....	.....	.....
<i>Carex echinata</i>	+.	alll+.a.l.+..+	..1.....	.....	.....
<i>Epilobium palustre</i>	+..+...+..+	..+m...11.+..+	.....	.....	.....
<i>Viola palustris</i>	1.	+a+11.....	.....	.....	.....
<i>Nardus stricta</i>	.....	1+.....	.....	.....	.....
<i>Sphagnum palustre</i>	.....	a+r.....+	.....	.....	.....

<i>Calliergon stramineum</i>	.....	.r+.r.....	.....	.....	.....
<i>Plagiomnium ellipticum</i>	.....	.....	l.....b1.....	.....	.....
subass. polygonetosum bistortae					
<i>Bistorta major</i>	.....	.....	bbba33 .b	.....	.....
<i>Angelica sylvestris</i>	+.....r.....	r.....a.++abab.	++.....	.....	1+.....
<i>Carex rostrata</i>	.....	.....	l.....r11..	.....	.....
ass. Scirpetum sylvatici					
<i>Scirpus sylvaticus</i>	.....	aa.abb+33b ...33.....+	.....	4445433 ab141.	b.a.
subass. menthetosum longifoliae					
<i>Mentha longifolia</i>	.....	...1a.....	.....	+...ab3 +11a.1	+1....
<i>Juncus inflexus</i>	.....	.....	.....	+.....l+	1a..a. a.1.
ass. Angelico sylvestris-Cirsietum oleracei					
<i>Cirsium oleraceum</i>	.....	.....	.....	1.....	aabb5 1....
<i>Ajuga reptans</i>	+r1...	.....	.....+	1.+..+1	+++1++ ..++.
<i>Cratoneuron filicinum</i>	.....	.....	.....	.....	a3a+a. a.1..
<i>Lysimachia nummularia</i>	.....	...1a.....	.....	1..1..	1.+al+ 1.+..
<i>Lysimachia vulgaris</i>	r.....+...b	1.1.a.....	.....	+..a.b. al++a.	..+.
<i>Dactylis glomerata</i>	.....++.....	.....	.....	+.....l	+a+.1 .al..
<i>Carex flacca</i>	.....	.....	.....	.....	a+.b. .al.
ass. Scirpo sylvatici-Cirsietum cani					
<i>Cirsium canum</i>	.....	.....	.....	.....	3b1a1
<i>Potentilla reptans</i>	.....	.....	.....	.....	..+.. +.1+.
<i>Symphytum officinale</i>	.....	.....	.....	r.....	.....
<i>Alopecurus pratensis</i>	.....	.....	.....	.....	.....
Calthion					
<i>Myosotis nemorosa</i>	aa.+..+1.al1	..+1+1a.lallaaa+	a+.r. ....	..+..	.....
<i>Caltha palustris</i>	3b3a3.b.b34	...11.a+bb1.1..	+a+....	..++1.	1....

r; *Glyceria nemoralis* 10: +; *Hieracium lachenalii* 14: +; *Tomenthypnum nitens* 39: 1; *Hypnum lindbergii* 17: a; *Inula salicina* 35: +; *Juncus filiformis* 27: 1; *Juncus tenuis* 45: 1; *Knautia maxima* 8: +; *Lamium maculatum* 40: +; *Leontodon hispidus* 19: +; 20: +; *Linum catharticum* 19: +, 43: +; *Listera ovata* 8: +, 34: r; *Lophocolea bidentata* 2: +, 4: +; *Lophocolea heterophylla* 21: +; *Medicago lupulina* 43: r; *Melampyrum nemorosum* 3: +; *Mentha aquatica* 41: +; *Menyanthes trifoliata* 25: a; *Molinia arundinacea* 36: +, 37: +; *Myosotis laxiflora* 38: +; *Ononis spinosa* 43: +; *Ophioglossum vulgatum* 37: 1, 43: 1; *Oxalis acetosella* 3: r; *Parnassia palustris* 19: +; *Pedicularis palustris* 17: 1, 19: +; *Philonotis fontana* 9: +; *Phleum pratense* 17: +, 20: +; *Physcomitrium pyriforme* 45: +; *Pimpinella major* 20: +; *Pimpinella saxifraga* 8: +; *Plagiomnium undulatum* 2: 1, 43: +; *Plantago media* 8: +, 30: +; *Pleurozium schreberi* 20: +; *Poa compressa* 37: r; *Poa palustris* 45: 1; *Polytrichum commune* 13: +; *Potentilla anserina* 43: +, 45: +; *Primula veris* 37: +, 43: +; *Pulmonaria mollis* 28: r; *Pulmonaria officinalis* 40: +; *Quercus petraea* agg. (juv.) 35: r; *Ranunculus auricomus* agg. 27: +; *Ranunculus lanuginosus* 8: +; *Rhinanthus minor* 43: +; *Rhinanthus serotinus* 27: +; *Rhytidadelphus triquetrus* 27: a, 43: +; *Riccardia multifida* 12: +; *Rosa canina* agg. (juv.) 35: +; *Rubus caesius* (juv.) 40: +; *Rumex obtusifolius* 30: +, 42: 1; *Rumex sanguineus* 45: 1; *Sagina procumbens* 30: 1; *Salix aurita* (juv.) 28: +; *Salix caprea* (juv.) 7: +; *Salix rosmarinifolia* (juv.) 39: +; *Sanguisorba officinalis* 41: +; *Scutellaria galericulata* 31: +; *Silvaum silaus* 41: a; *Sphagnum contortum* 12: +; *Sphagnum flexuosum* 23: +; *Sphagnum subsecundum* 13: b; *Sphagnum teres* 16: a, 23: a; *Stellaria media* 40: +; *Symphylum tuberosum* 37: +; *Thuidium philibertii* 43: +; *Tilia species* (juv.) 28: r; *Trifolium hybridum* 20: +; *Trifolium medium* 8: +, 20: 1; *Trifolium montanum* 43: +; *Trifolium repens* 41: +; *Trifolium spadiceum* 27: a; *Trisetum flavescens* 3: +; *Trollius altissimus* 8: +; *Veratrum album* 21: +, 26: a; *Veronica beccabunga* 9: r, 10: 1; *Veronica officinalis* 16: r; *Veronica scutellata* 1: +, 17: +; *Viola hirta* 37: +; *Viola reichenbachiana* 37: +.

Table heads and localities (* before longitude = inaccurate values taken from Geobase or En Carta software):

ass. *Chaerophyllum hirsuti-Calathetum palustris*

1: slope 3°, exp. NW, 887 m a. s. l., Západné Tatry Mts., below the Sivý hill, 2 km SE from Zuberec village, longitude 19°38'46'', latitude 49°14'55''. **2:** slope 2°, exp. NNE, 540 m a. s. l., Turzovská vrchovina uplands, Soglovci settlement, longitude 18°42'72'', latitude 49°29'33''. **3:** 8 m², slope 0°, exp. -, 490 m a. s. l., Javorníky Mts., Štiavnická dolina valley, Tisové settlement, 4 km NW from the Štiavnik village, longitude 18°27'00'', latitude 49°16'04''. **4:** slope 5°, exp. -, 857 m a. s. l., Nizké Tatry Mts., Liptovská Lúžna village, upper margin of the village, by the small brook, longitude 19°21'10'', latitude 48°56'25''. **5:** slope 1°, exp. SE, 660 m a. s. l., Javorníky Mts., pastures above the Štiavnik - Ráztocka settlement, longitude 18°25'27'', latitude 49°19'06''. **6:** slope 0°, exp. -, 580 m a. s. l., Javorníky Mts., Štiavnická dolina valley, Medvedie settlement, 8 km NW from Štiavnik village, near the road,

longitude 18°24'99'', latitude 49°18'54''. 7: slope 0°, exp. -, 520 m a. s. l., Javorníky Mts., Štiavnická dolina valley, 6 km NW from Štiavnik village, floodplain of small brook, longitude 18°24'98'', latitude 49°18'33''. 8: slope 7°, exp. SW, 650 m a. s. l., Javorníky Mts., pastures above Štiavnik – Ráztoka settlement, longitude 18°24'90'', latitude 49°18'94''. 9: slope 2°, exp. NE, 540 m a. s. l., Turzovská vrchovina uplands, Vyšné Megonky village, NW margin of the village, floodplain of small brook, longitude 18°43'55'', latitude 49°29'61''. 10: slope 2°, exp. N, 590 m a. s. l., Turzovská vrchovina uplands, Raková – Kúkoľanka village, 2 km NNW from Prielašský hill (649,6 m n. m.), longitude 18°42'17'', latitude 49°29'07''. 11: slope 3°, exp. -, 590 m a. s. l., Turzovská vrchovina uplands, Raková – Megonky village, longitude 18°42'56'', latitude 49°29'32''.

ass. *Angelico sylvestris-Cirsietum palustris*

12: slope 0°, exp. -, 720 m a. s. l., Kornická brázda furrow, Hrubý Buk-Zajacovci settlement, behind the last house, longitude 18°37'01'', latitude 49°28'40''. 13: slope 1°, exp. -, 482 m a. s. l., Jablunkovské medzihorie, Skalité village, Čierne Polesie settlement, along the railway, longitude 18°51'55'', latitude 49°30'37''. 14: slope 5°, exp. W, 730 m a. s. l., Kornická brázda furrow, Hrubý Buk-Fujákovci settlement, spring in the left side of the small brook, on the slopes, longitude 18°37'01'', latitude 49°28'09''. 15: slope 3°, exp. N, 600 m a. s. l., Turzovská vrchovina uplands, Raková – Kúkoľanka village, 2 km NNW Prielašský hill (649,6 m n. m.), longitude 18°42'17'', latitude 49°29'07''. 16: slope 5°, exp. S, 740 m a. s. l., Kornická brázda furrow, Hrubý Buk-Zajacovci settlement, longitude 18°36'51'', latitude 49°28'43''. 17: slope 0°, exp. -, 870 m a. s. l., Spišská Magura uplands, Osturňa village, Malé Osturňanské jazero, *longitude 20°13'19'', latitude 49°20'35''. 18: slope 2°, exp. NW, 887 m a. s. l., Západné Tatry Mts., below Sivý hill, 2 km SE from Zuberac village, longitude 19°38'46'', latitude 49°14'55''. 19: slope 1°, exp. -, 880 m a. s. l., Spišská Magura uplands, Osturňa village, along the blue mark, *longitude 20°15'39'', latitude 49°18'53''. 20: slope 1°, exp. -, 730 m a. s. l., Spišská Magura uplands, Osturňa village, by the green mark, *longitude 20°13'00'', latitude 49°20'00''. 21: slope 3°, exp. NW, 794 m a. s. l., Oravské Beskydy Mts., 4 km NE from Oravské Veselé village, in direction Biela Farna, longitude 19°22'56'', latitude 49°31'29''. 22: slope 1°, exp. NW, 827 m a. s. l., Podtatranská brázda furrow, Oravice village, Peciská 2, longitude 19°44'48'', latitude 49°17'30''. 23: slope 0°, exp. -, 727 m a. s. l., Oravské Beskydy Mts., Oravská Polhora - Slaná voda settlement, behind the chalet, longitude 19°28'32'', latitude 49°31'35''. 24: slope 0°, exp. -, 775 m a. s. l., Podbeskydská brázda furrow, Mútne village, Mútianska Píla Nature Reserve, bog margin, longitude 19°17'21'', latitude 49°28'10''. 25: slope 0°, exp. -, 741 m a. s. l., Oravské Beskydy Mts., near the chalet Biela Farna, longitude 19°23'58'', latitude 49°32'15''. 26: slope 0°, exp. -, 775 m a. s. l., Podbeskydská brázda furrow, Mútne village, Mútianska Píla Nature Reserve, bog margin, longitude 19°17'21'', latitude 49°28'10''. 27: slope 2°, exp. S, 935 m a. s. l., Vysoké Tatry Mts., margin of the Nature Reserve Mraznica, Kraviarska lúka, longitude 20°09'11'', latitude 49°06'22''.

ass. Scirpetum sylvatici

28: slope 0°, exp. -, 330 m a. s. l., Biele Karpaty Mts., Horná Súča village, Trnávká settlement, *longitude 17°57'15'', latitude 48°59'39''. **29:** slope 0°, exp. -, 811 m a. s. l., Podtatranská brázda furrow, Habovka village, Blatná dolina valley, 3 km E from village, longitude 19°39'43'', latitude 49°16'18''. **30:** slope 0°, exp. -, 540 m a. s. l., Turzovská vrchovina uplands, Výšné Megonky village, upper end of the village, on the right side of the road, floodplain, longitude 18°43'55'', latitude 49°29'61''. **31:** slope 0°, exp. -, 373 m a. s. l., Kysucká vrchovina uplands, Kysucký Lieskovec village, locality Horné Vežiská, near the road, longitude 18°48'42'', latitude 49°21'13''. **32:** slope 2°, exp. SSE, 660 m a. s. l., Javorníky Mts., pastures above the Štiavnik – Ráztočka settlement, longitude 18°25'27'', latitude 49°19'06''. **33:** slope 0°, exp. -, 413 m a. s. l., Javorníky Mts., Dolná Mariková-Hadoše village, Kátina, Marálovci settlement, near the house no. 620, longitude 18°18'59'', latitude 49°12'58''. **34:** slope 0°, exp. -, 610 m a. s. l., Javorníky Mts., Horná Mariková – Ráztočka settlement, longitude 18°17'01'', latitude 49°17'32''.

ass. Angelico sylvestris-Cirsietum oleracei

35: slope 2°, exp. SE, 433 m a. s. l., Biele Karpaty Mts., Nová Bošáca-Grúň settlement, wet meadow in the Grúň Nature Reserve, longitude 17°47'55'', latitude 48°53'40''. **36:** slope 5°, exp. E, 456 m a. s. l., Biele Karpaty Mts., Krivoklátske lúky Nature Reserve, longitude 18°08'14'', latitude 49°03'31''. **37:** slope 0°, exp. -, 469 m a. s. l., Biele Karpaty Mts., Červený Kameň-Trokanovo settlement, Brezovská dolina Nature Reserve, longitude 18°08'37'', latitude 49°05'28''. **38:** slope 0°, exp. -, 330 m a. s. l., Biele Karpaty Mts., Horná Súča – Trnávká settlement, *longitude 17°57'15'', latitude 48°59'39''. **39:** slope 3°, exp. -, 437 m a. s. l., Biele Karpaty Mts., Borotová village, *longitude 17°38'41'', latitude 48°49'48''. **40:** slope 0°, exp. -, 420 m a. s. l., Biele Karpaty Mts., Stará Turá village, Dolná Súš settlement, *longitude 17°40'13'', latitude 48°48'31''.

ass. Scirpo sylvatici-Cirsietum cani

41: slope 1°, exp. -, 320 m a. s. l., Biele Karpaty mts., Stará Turá village, Vrzávka valley, *longitude 17°45'00'', latitude 48°47'00''. **42:** slope 0°, exp. -, 320 m a. s. l., Biele Karpaty Mts., Stará Turá village, Vrzávka valley, under the farm building, *longitude 17°45'00'', latitude 48°47'00''. **43:** slope 0°, exp. -, 0 m a. s. l., Biele Karpaty Mts., U Šiflov Nature Reserve, *longitude 17°24'01'', latitude 48°47'52''. **44:** slope 0°, exp. -, 510 m a. s. l., Biele Karpaty Mts., Bučková jama Nature Reserve, *longitude 17°26'29'', latitude 48°49'04''. **45:** slope 0°, exp. -, 610 m a. s. l., Poprad basin, "recultivated" meadow near the Gánovce travertine, longitude 20°20'05'', latitude 49°01'26''.