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Grasslands in the border area of Carpathian and Pannonian regions: an example from Muránska planina Mts (Central Slovakia)

Rasengesellschaften im Kontaktbereich der Karpatischen und Pannonischen Region: ein Beispiel aus dem Berggebiet Muránska Planina (mittlere Slowakei)

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Abstract

Muránska planina Mts, a small karstic area situated in the southern part of the Western Carpathians in Central Slovakia was chosen as a model region for the study of the variability and diversity patterns of thermophilous and mountain non-forest vegetation on the crossing of the Carpathian and Pannonian bioregions. Altogether, 113 new relevés were sampled using standard methods of the Zürich-Montpellier approach and compared with previously published data. The dataset containing both new and published phytosociological relevés from dry, semi-dry and mesic grasslands (265 relevés) was analysed using the program JUICE 7.0.98. The Beta flexible method, relative Sorensen distance as a similarity measure, and logarithmic transformation of species covers were used for the numerical classification (PC-ORD). The main environmental gradients of species composition were analysed by DCA in the CANOCO 4.5 package using the Borhidi indicator values. The various mosaics of plant communities were detected in succession series from pioneer rocky stands through open rocky grasslands dominated by *Festuca pallens*, *F. tatrae*, *Carex humilis* and *Sesleria albicans* to closed tall grass communities dominated by *Calamagrostis varia* and *C. arundinacea*. Plant communities belonging to six classes (*Sedo-Scleranthetea*, *Festuco-Brometea*, *Elyno-Seslerietea*, *Thlaspietea rotundifolii*, *Mulgedio-Aconitetea* and *Molinio-Arrhenatheretea*) including Pannonian grasslands of the alliance *Bromo pannonici-Festucion pallentis* and high montane/subalpine grasslands of the alliance *Astero alpini-Seslerion calcariae* occur together in the study area. High floristic richness and extraordinary diffusion of thermophilous and montane/subalpine elements is characteristic for the majority of the studied plant communities.

Keywords: *Elyno-Seslerietea*, *Festuco-Brometea*, grassland vegetation, pioneer vegetation, Western Carpathians, Pannonia

Erweiterte deutsche Zusammenfassung am Ende des Artikels

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1. Introduction

The important European Carpathian and Pannonian biogeographical regions overlap on Slovak territory. Muránska planina Mts, a small karstic area situated in the southern part of the Western Carpathians in Central Slovakia was chosen as a model region for the study of variability and diversity patterns of thermophilous and mountain non-forest vegetation. Such areas situated on the crossing of migration routes have often been studied because of their phytogeographical importance. For example, WILLNER et al. (2013) recently studied the grasslands occurring in another mountain region with strong floristic affinities to the Pannonian basin, the Vienna Woods on the eastern slopes of the Eastern Alps in Austria.

Owing to its location near to the border of the Carpathians and the Pannonian Basin, the territory of Muránska planina National park (established in 1997, ca. 40 km^2, altitudinal range 400–1400 m a.s.l.) is a very valuable natural region. Its major part embraces a karst landscape with extraordinary natural habitat and ecosystem diversity hosting many plant species. This diversity is mostly caused by variable geological and geomorphological conditions as well as by the position near to the southern margin of the Western Carpathians, which is warmer and drier than the central part of this mountain range. The larger part of the Muránska planina Mts belongs to the moderately cool climatic sub-region with an average July temperature between 12 and 16 °C. On the other hand, the southern part of the study area where the majority of the dataset was collected, is markedly warmer, belonging to the warm and humid climatic region with an average July temperature above 16 °C. Only few kilometres apart from the southern margin of Muránska planina Mts, a warm and moderately humid region occurs (LAPIN et al. 2002). Mean annual precipitation reaches 700–1000 mm (FAŠKO & ŠŤASTNÝ 2002).

According to a recently published checklist based on a long time continued field research and the critical revision of all available data, altogether 1480 taxa of vascular plants have been documented in this area that comprises more than 30% of the known Slovakian flora (KOCHJAROVÁ et al. 2004). The local checklist of bryophytes includes more than 370 species, representing approximately 40% of the known bryoflora of Slovakia (ŠOLTÉS et al. 2004). Many thermophilous plants, including Pannonian elements (e.g. *Aconitum anthora*, *Allium flavum*, *Asyneuma canescens*, *Campanula sibirica*, *Cerasus mahaleb*, *Cirsium pannonicum*, *Erysimum odoratum*, *Festuca pallens*, *Isatis praecox*, *Leontodon incanus*, *Linum flavum*, *L. tenuifolium*, *Petrorhagia prolifera*, *Peucedanum cervaria*, *Prunella laciniata*, *Scabiosa ochroleuca*, *Sempervivum marmoreum*, *Seseli annuum*, *Tithymalus epithymoides*, *Trifolium ochroleucon*, *Veronica austriaca*) occur there together with numerous montane/subalpine species typical for high elevations of the Central Carpathians (e.g. *Aconitum firmum*, *Androsace lactea*, *Bartsia alpina*, *Campanula cochlearifolia*, *Carex firma*, *Crepis jacquinii*, *Delphinium oxysepalum*, *Dryas octopetala*, *Festuca tatrae*, *Gentiana clusii*, *Hieracium villosum*, *Pedicularis verticillata*, *Pinus mugo*, *Potentilla aurea*, *Ranunculus alpestris*, *R. breyninus*, *Rhodax rupifragus*, *Saxifraga wahlenbergii*, *Thymus pulcherrimus* subsp. *sudeticus*, *Trisetum alpestre*). This well known coexistence phenomenon has been studied by many botanists since the 19th century (e.g. SZONTAGH 1866, SILLINGER 1938, HENDRYCH 1969). In addition, there are a high number of Carpathian endemics present in the vascular plant flora of the territory (more than 30 taxa; cf. HENDRYCH 1965, KLIMENT 1999) including the famous local endemic *Daphne arbuscula*, which is of European importance (COUNCIL OF EUROPEAN COMMUNITIES 1997, EUROPEAN COMMISSION, DG ENVIRONMENT 1999).

The diversity of plant communities occurring in the area is also very high. A recent review confirms the presence of 140 associations belonging to 26 classes on the territory of the National park Muránska planina (HRIVNÁK et al. 2004a). Most of the new phytosociological data was assembled in the period of 2001–2005 for two research projects "Analysis of biological diversity components in the Muránska planina National park" and "Non-forest plant communities of the Muránska planina Mts". Results of these projects were published in several studies. There were comprehensive studies of wetland vegetation, dealing with aquatic and marsh plant communities, water springs, alluvial tall-herb vegetation, mires and calcareous fens (HRIVNÁK et al. 2004b, 2005, 2008, JAROLÍMEK & ZALIBEROVÁ 2004). Detailed local phytosociological research on submontane meadows and pastures (UJHÁZY et al. 2007), mesophilous and thermophilous fringes (KOCHJAROVÁ & VALACHOVIČ 2006), natural *Calamagrostis arundinacea*-dominated tall herb stands (KLIMENT 2004), limestone rock shelters (BERNÁTOVÁ & OBUCH 1992) and shaded rocks (KOCHJAROVÁ et al. 2010) were carried out.

Despite these multi-varied investigations, data sampled in dry rocky and grassland habitats remained insufficiently analysed. In this study, we focus on the variability and diversity patterns of floristically ultra-rich non-forest vegetation developed mostly on the open south- and southeast exposed rocky and grassy slopes of the mountains, in altitudes between 400 and 1100 m a.s.l. Until now, only the phytosociological affiliation of the local endemic dwarf shrub *Daphne arbuscula* was studied in detail focusing on the vegetation complex of *Carex humilis*-dominated rocky grasslands and relic pine-larch forests growing in the highest part of the mountains (VALACHOVIČ & JAROLÍMEK 1994, UHLÍŘOVÁ & BERNÁTOVÁ 2003). VALACHOVIČ & MUCINA (2004) studied a related topic in the same study area, comparing *Festuca*-dominated vegetation on calcareous rocks and also focusing on localities in the higher elevations. Pioneer stands in this area were previously only marginally studied, and no data from Muránska planina Mts was included in the comprehensive overview of Slovak plant communities (cf. VALACHOVIČ & MAGLOCKÝ 1995). The only existing information on communities of the alliance *Alysso-Sedion* was recently documented and published in local studies on just four relevés (HRIVNÁK 1997, BLANÁR 2005, BLANÁR & LETZ 2005).

The main aims of our study are to answer the following questions: (1) which plant communities can be found on the open rocky and grassy slopes in the entire vertical range of the study area? (2) Is the specific transitional position of Muránska planina Mts on the crossing of the Carpathian and Pannonian bioregions manifested also at the level of these particular syntaxa (and if yes, how)?

2. Material and methods

Between 2001 and 2011, new phytosociological relevés of open rocky and grassland vegetation have been sampled in the territory of Muránska planina National park. We selected our sampling plots mostly on sites that were not covered by previous phytosociological studies in order to complete the dataset as much as possible. Thus, more localities in lower altitudes of S–SE–E slopes of the karstic plateau Muránska planina, in close proximity to Tisovec, Muráň, Muránska Huta, and Červená Skala villages, as well as some localities situated in the upper parts of the plateau have been visited (Fig. 1). Usually, the standard plot size of 16–25 m^2 with homogenous vegetation was used. In some cases, e.g. in fragmentally developed pioneer stands smaller plots of 8–16 m^2 were sampled. Herein, we used the Zürich-Montpellier approach with a modified Braun-Blanquet nine-degree scale (BARKMAN et al. 1964). Bryophytes and lichens were mostly recorded simultaneously with vascular plants on the relevé

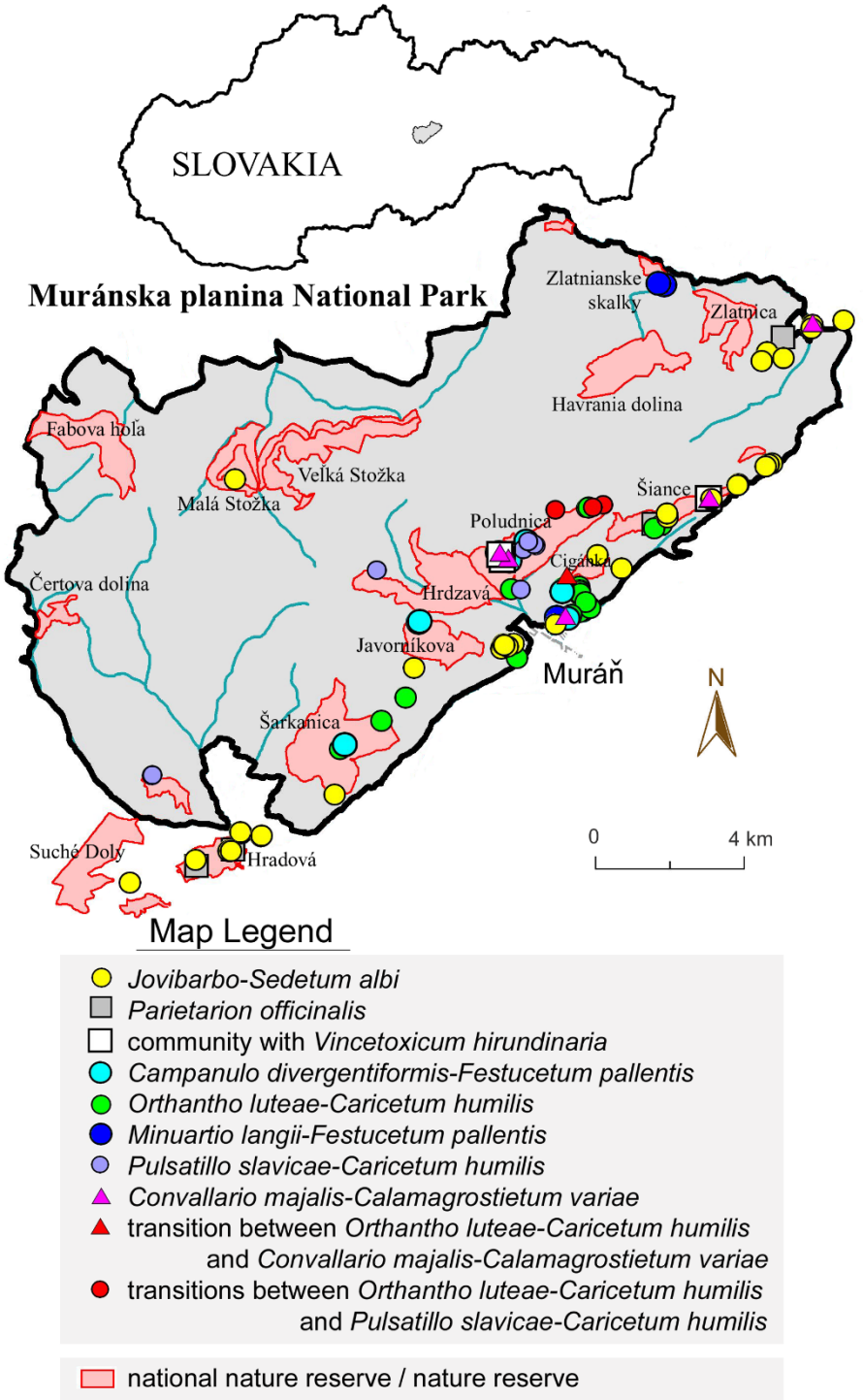


Fig. 1. Map of the study area with the location of the sample plots.

Abb. 1. Karte des Untersuchungsgebiets mit der Lage der Aufnahmepunkte.

plots and their samples were later determined by specialists. In some cases, the moss and lichen layer was not sampled, and only the percentage cover of moss layer was estimated on the sampling plot. Detailed location of all relevés including geographical coordinates is given in the Supplement E1.

The final data set consisted of 265 relevés from dry, semi-dry and mesophilous grasslands: 152 previously published relevés made by other authors in the study area, available in the Slovak vegetation database (ŠIBÍK 2012, EU-SK-001, http://ibot.sav.sk/cdf/) and 113 new sampled ones. As some older relevés were also published without complete information about moss and lichen layer, bryophytes, lichens and all taxa determined only on the level of genus were excluded before numerical processing. Some taxa of vascular plants were merged to higher or more broadly defined ones: *Arenaria serpyllifolia* agg. (*A. leptoclados*, *A. serpyllifolia*), *Leucanthemum vulgare* agg. (*L. margaritae*, *L. vulgare*).

The phytosociological relevés were stored in a TURBOVEG database (HENNEKENS & SCHAMINÉE 2001) and then analysed using the program JUICE 7.0.98 (TICHÝ 2002, TICHÝ & HOLT 2006). To determine the optimal classification algorithm and optimal number of clusters, OptimClass (TICHÝ et al. 2010) was used. Finally, the Beta flexible method, relative Sorensen distance as a similarity measure and logarithmic transformation of species covers was used (PC-ORD; MCCUNE & MEFFORD 1999) for the numerical classification of the dataset. The electronic expert system for identification of grasslands (JANIŠOVÁ et al. 2007, HEGEDÜŠOVÁ VANTAROVÁ & ŠKODOVÁ 2014) assigned only a small amount of the relevés (see Results). Identification of relevés based on similarity indices was rather ambiguous. Thus, the clusters were classified to vegetation units by comparison of diagnostic species in the synoptic table (regarding the original assignment in the case of previously published relevés).

The main gradients of species composition were analysed by detrended correspondence analysis (DCA) in the CANOCO 4.5 package (TER BRAAK & ŠMILAUER 2002). The unimodal method of detrended correspondence analysis was chosen because of extended resultant gradient length (4.064 for the first axis). For the ecological interpretation of ordination axes the mean ecological indicator values (BORHIDI 1995) for the relevés weighted by species cover were plotted onto the DCA ordination diagram as supplementary environmental data. Before analysis we considered both Ellenberg indicator values (ELLENBERG et al. 1992) originally proposed for Central Europe and Borhidi indicator values (proposed for Hungary). Finally the Borhidi indicator values were used, as there were less species with missing information. Ecological indicator values for the studied associations as well as altitude were compared on box-and-whisker plots. The differences in altitude and ecological values between associations were tested using Kruskal-Wallis test and multiple comparisons in Statistica software (STATSOFT 2005).

The nomenclature of taxa follows the Slovak checklist (MARHOLD & HINDÁK 1998). The names of syntaxa and the diagnostic values of the species for higher units used in the phytosociological tables are in accordance with the survey of the vegetation of Slovakia (KLIMENT et al. 2007a, b, JAROLÍMEK & ŠIBÍK 2008, HEGEDÜŠOVÁ-VANTAROVÁ & ŠKODOVÁ 2014).

3. Results

3.1 Cluster analysis

The whole dataset of 265 relevés was divided into ten distinct clusters, which are interpretable mostly on the alliance-level or, in some cases, on the level of associations. The electronic expert system determined only 34 relevés (12.8% of the dataset), mostly belonging to the alliances *Arrhenatherion elatioris* and *Bromion erecti* (clusters 9 and 10). Clusters 1–7 belong to vegetation classes which are not included in the expert system. Within cluster 8 containing 65 relevés of *Festuco-Brometea* class, the expert system identified only 5 relevés (7.7%).

The first three clusters comprised relevés of the class *Elyno-Seslerietea*, with dominance of *Sesleria albicans*, *Carex humilis*, *Festuca tatrae* and *F. pallens*. Cluster 1 included 48 relevés representing mostly *Carex humilis*- and *Sesleria albicans*- dominated grasslands of

the alliance *Astero alpini-Seslerion*. In some cases, also *Festuca tatrae* and *F. pallens* grow in stands with higher coverage. The group of montane/subalpine taxa (e.g. *Kernera saxatilis*, *Minuartia langii*, *Phyteuma orbiculare*, *Pulsatilla subslavica*, *Rhodax rupifragus*, *Saxifraga paniculata*, *Thesium alpinum*, *Thymus pulcherrimus* subsp. *sudeticus*) is present in all relevés, including also local endemic *Daphne arbuscula*. This cluster was classified as association *Pulsatillo slavicae-Caricetum humilis* (VALACHOVIČ & JAROLÍMEK 1994: 30 rel., UHLÍŘOVÁ & BERNÁTOVÁ 2003: 3 rel., VALACHOVIČ & MUCINA 2004: 6 rel., newly sampled: 9 rel.). Three relevés with higher cover percentage of *Carex firma* or *Dryas octopetala* subsumed into this cluster were originally classified as transitions to alliance *Caricion firmae* (VALACHOVIČ & JAROLÍMEK 1994). Cluster 2 included relevés with dominance of *Festuca tatrae* (in some relevés, *Sesleria albicans* is present as well, but not *Carex humilis*) representing the association *Seslerio calcariae-Festucetum tatrae* (VALACHOVIČ & MUCINA 2004: 9 rel., VALACHOVIČ & JAROLÍMEK 1994: 1 rel.). Cluster 3 consisted of relevés dominated by *Festuca pallens* (in some cases also *Sesleria albicans* is present, but not *Carex humilis*, nor *Daphne arbuscula*) representing the association *Minuartio langii-Festucetum pallentis* (VALACHOVIČ & MUCINA 2004: 7 rel., newly sampled: 3 rel.).

Cluster 4 comprised mostly pioneer vegetation of the class *Sedo-Scleranthetea* representing the association *Jovibarbo-Sedetum albi* (HRIVNÁK 1997: 2 rel., BLANÁR 2005: 1 rel., BLANÁR & LETZ 2005: 1 rel., newly sampled: 38 rel.). Three of our relevés representing *Vincetoxicum hirundinaria*-dominated scree vegetation were included to this cluster as well.

The next two clusters comprised tall-herb vegetation of the class *Mulgedio-Aconitetea*. Cluster 5 with 6 relevés (only newly sampled ones) includes closed grassland vegetation dominated by *Calamagrostis varia*, with high constancy of *Anthericum ramosum*, *Vincetoxicum hirundinaria*, *Convallaria majalis* and *Teucrium chamaedrys*. It represents the association *Convallario majalis-Calamagrostietum variae*. Cluster 6 included similar stands dominated by *Calamagrostis arundinacea* classified as *Digitali ambiguae-Calamagrostietum arundinaceae* (KLIMENT 2004: 6 rel.).

Calcareous scree vegetation of the alliance *Parietarion officinalis* with dominance of *Geranium robertianum* or *Parietaria officinalis* formed the cluster 7 including 5 relevés (only newly sampled ones). Because of poor data, only one of them was classified on the association level, namely, as *Parietarietum officinalis*.

Dry grasslands of the alliance *Bromo pannonici-Festucion pallentis* (*Festuco-Brometea*) formed the cluster 8, comprising communities with dominant *Carex humilis* and *Festuca pallens* (in some relevés also *Sesleria albicans* was present with cover higher than 25%). Regular presence of several thermophilous species (e.g. *Anthericum ramosum*, *Colymbada scabiosa*, *Helianthemum grandiflorum* subsp. *obscurum*, *Hippocrepis comosa*, *Inula ensifolia*, *Leontodon incanus*, *Teucrium chamaedrys*, *T. montanum*) is characteristic for this group. Both published (16) and newly sampled (49) relevés were included in this cluster. Two associations could be identified: *Campanulo divergentiformis-Festucetum pallentis* (VALACHOVIČ & MUCINA 2004: 3 rel., BLANÁR & LETZ 2005: 4 rel., newly sampled: 10 rel.) and *Orthantho luteae-Caricetum humilis* (UHLÍŘOVÁ & BERNÁTOVÁ 2003: 7 rel., BLANÁR & LETZ 2005: 1 rel., BLANÁR 2005: 1 rel., newly sampled: 32 rel.). In adition, one relevé with dominance of *Calamagrostis varia* (newly sampled) represented a transition to communities of the alliance *Calamagrostion variae*. More examples of transitional vegetation between the alliances *Bromo pannonici-Festucion* (*Festuco-Brometea*) and *Astero alpini-Seslerion* (*Elyno-Seslerietea*) were placed into this cluster as well (6 newly sampled relevés).

The last two clusters comprising vegetation of mown meadows and extensively grazed pastures were clearly separated from all others. Cluster 9 (30 relevés) included mostly grassland vegetation of the alliance *Bromion erecti* (*Festuco-Brometea*) and cluster 10 included 40 relevés of mesophilous meadows of the alliance *Arrhenatherion elatioris* (*Molinio-Arrhenatheretea*); both published by UJHÁZY et al. (2007).

The floristic composition of all vegetation units of dry, semi-dry and mesic grasslands of the studied territory is given in Supplement S1.

Overview of syntaxa

Sedo-Scleranthetea Br.-Bl. 1995
Alysso alyssoidis-Sedion albi Oberd. et Th. Müller in Th. Müller 1961
Jovibarbo-Sedetum albi Valachovič et Maglocký 1995

Festuco-Brometea Br.-Bl. et Tx. ex Soó 1947
Bromo pannonici-Festucion pallentis Zólyomi 1966
Campanulo divergentiformis-Festucetum pallentis Zólyomi (1936) 1966
Orthantho luteae-Caricetum humilis Kliment et Bernátová 2000
Bromion erecti Koch 1926
Salvio verticillatae-Festucetum rupicolae Ujházy et al. 2007

Elyno-Seslerietea Br.-Bl. 1948
Astero alpini-Seslerion calcariae Hadač ex Hadač et al. 1969
Pulsatillo slavicae-Caricetum humilis (Sillinger 1933) Mucina ex Uhlířová et Bernátová 2004
Seslerio calcariae-Festucetum tatrae Sillinger 1933
Minuartio langii-Festucetum pallentis (Sillinger 1933) Mucina ex Kliment et al. 2005

Thlaspietea rotundifolii Br.-Bl. 1948
Vincetoxicum hirundinaria-community
Parietarion officinalis Gergely et al. 1966
Parietarietum officinalis Csűrös 1958

Mulgedio-Aconitetea Hadač et Klika in Klika 1948
Calamagrostion variae Sillinger 1932
Convallario majalis-Calamagrostietum variae (Sillinger 1933) Kliment et al. 2004
Calamagrostion arundinaceae (Luquet 1926) Jeník 1961
Digitali ambiguae-Calamagrostietum arundinaceae Sillinger 1933

Molinio-Arrhenatheretea Tx. 1937
Arrhenatherion elatioris Tx. 1931

3.2 Indirect gradient analysis

The gradient analysis was done for the 92 newly recorded relevés belonging to the *Sedo-Scleranthetea*, *Festuco-Brometea* and *Elyno-Seslerietea* classes (Fig. 2). The first axis was significantly positively correlated with indicator values for soil reaction (0.64), nutrients (0.36), moisture (0.36) and negatively correlated with indicator values for light (-0.60) and temperature (-0.29). Open communities of the *Sedo-Scleranthetea* class (*Jovibarbo-Sedetum*

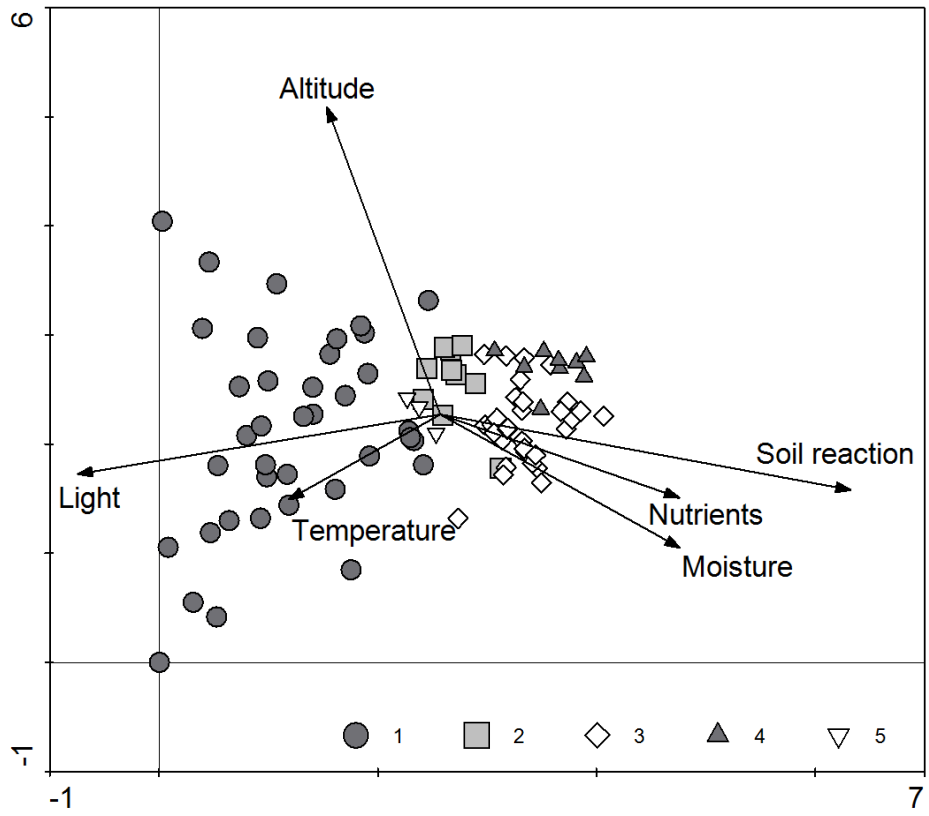


Fig. 2. Detrended correspondence analysis of 92 phytosociological relevés. Altitude and average Borhidi indicator values weighted by species cover were used as supplementary environmental data. 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis.*

Abb. 2. Indirekte Ordination (DCA) von 92 Vegetationsaufnahmen. Seehöhe und mittlere Borhidi-Zeigerwerte (nach Deckungswerten gewichtet) sind als passive Variablen dargestellt. 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis.*

albi) hosting a lot of light-demanding species are depicted in the left part of the ordination space, while grasslands with higher cover of herb layer dominated by *Carex humilis* are situated mostly in the right part. The second axis was significantly positively correlated with altitude (0.63). Relevés of the association *Pulsatillo slavicae-Caricetum humilis* occurring in higher altitudes are mostly grouped in the upper part of chart. There is a rather obvious differentiation between this association and the *Orthantho luteae-Caricetum humilis* along the second axis. Relevés of the rocky grasslands dominated by *Festuca pallens* (*Campanulo divergentiformis-Festucetum pallentis* and *Minuartio langii-Festucetum pallentis*) are grouped in the central part of the ordination space. The distribution of relevés in the ordination space corresponds with the distribution of selected species typical for the distinguished vegetation types (Fig. 3).

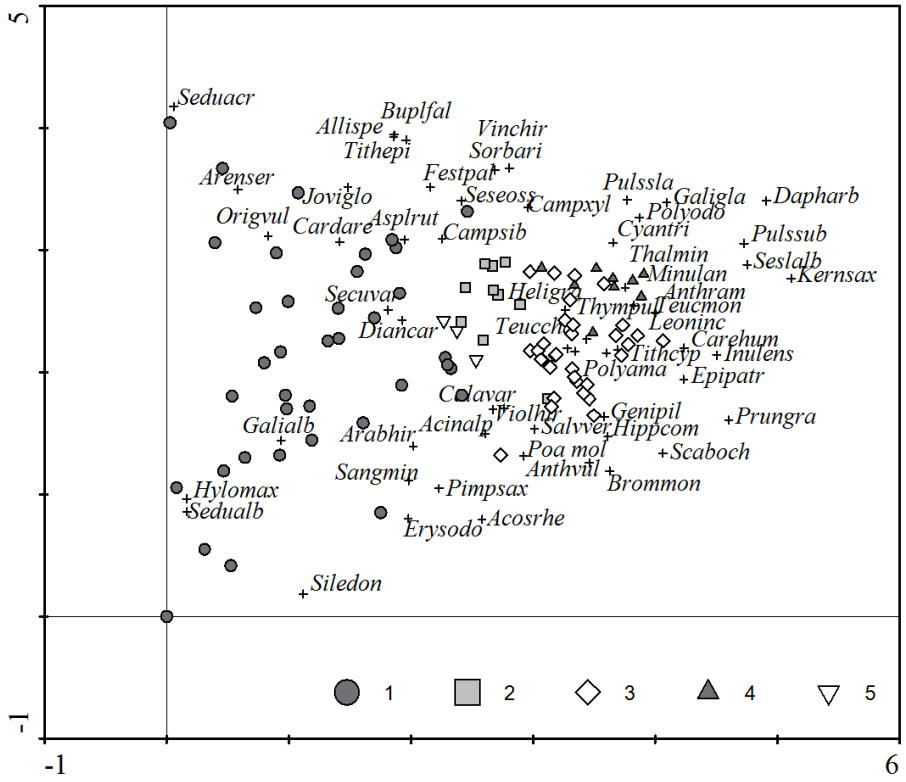
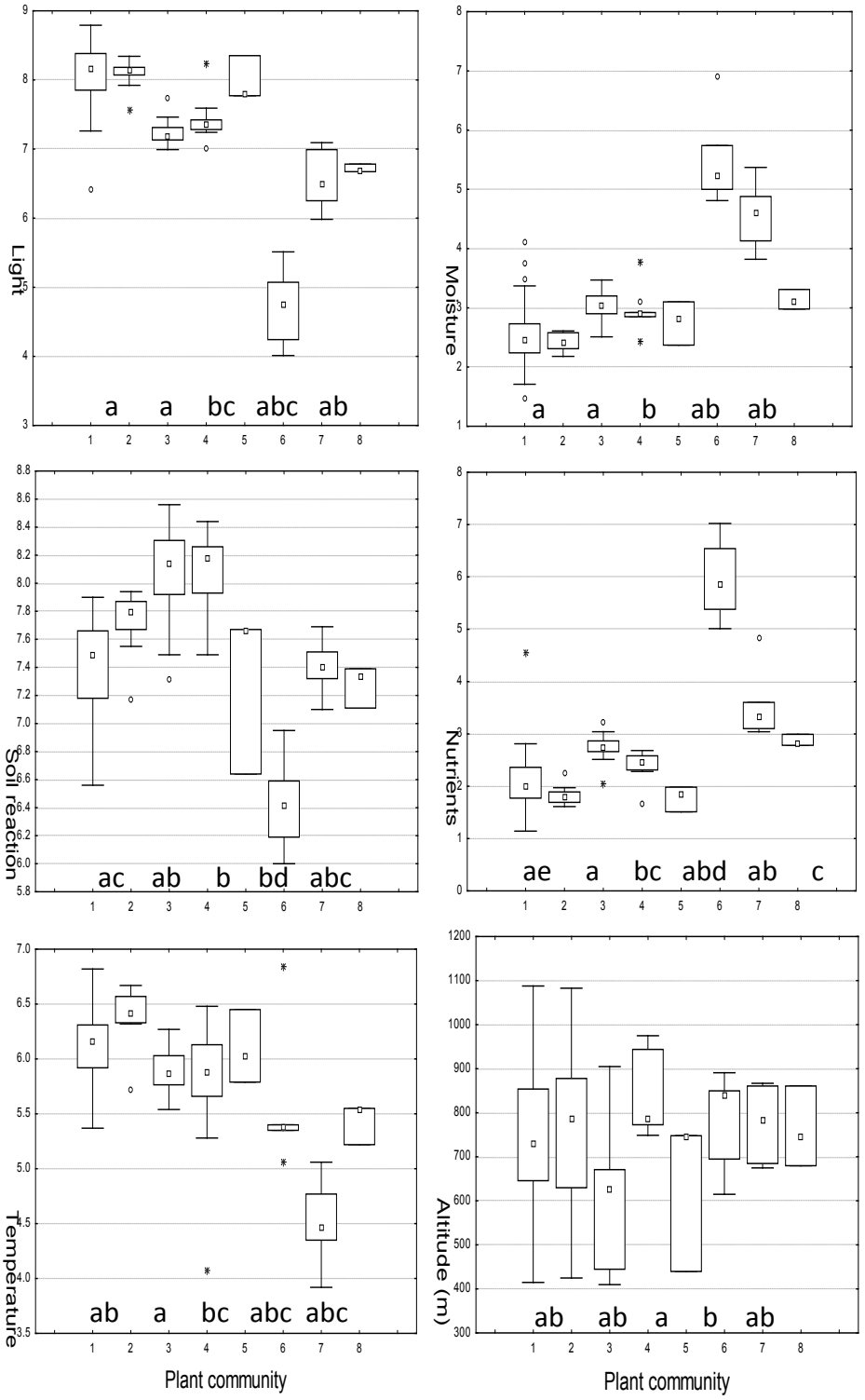


Fig. 3. Distribution of species and relevés in the ordination space of the Detrended correspondence analysis of dry grasslands. 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis*.

Abb. 3. Verteilung der Arten und Aufnahmen im Ordinationsdiagramm einer DCA der Trockenrasen. 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis*.

There are some significant differences between communities in altitude, indicator values for light, moisture, temperature, nutrients and soil reaction (Fig. 4). Grasslands of the association *Pulsatillo slavicae-Caricetum humilis* grow mostly in higher altitudes (about 900 m a.s.l.). Stands of the communities *Jovibarbo-Sedetum albi* and *Campanulo divergentiformis-Festucetum pallentis* occur usually around 800 m a.s.l., but they may also appear in higher altitudes. The *Orthantho luteae-Caricetum humilis* occupies sites in lower altitudes (approximately 600 m a.s.l.). Both *Jovibarbo-Sedetum albi* and *Campanulo divergentiformis-Festucetum pallentis* host a lot of light demanding species, while in the communities of the alliance *Parietarion officinalis* there are more shade-tolerant species and species preferring more nutrients and moisture. In contrast, the communities of the alliances *Alysso alyssoidis-Sedion albi*, *Bromo pannonici-Festucion pallentis* and also *Astero alpini-Seslerion calcariae* are not as demanding on nutrients and moisture, if comparing them with those of *Parietarion officinalis* and *Calamagrostion variae.* With regard to soil reaction, indicator values highlight that while all studied communities prefer soils with pH higher than 7, the *Parietarion officinalis* alliance also tolerates soils with moderately lower pH.


Light
a a bc abc ab
Moisture
a a b ab ab
Soil reaction
ac ab b bd abc
Nutrients
ae a bc abd ab c
Temperature
ab a bc abc abc
Altitude (m)
ab ab a b ab
Plant community
Plant community

3.3 Description of the newly sampled plant communities

3.3.1 *Jovibarbo-Sedetum albi* (Supplement S2, rel. 1–38, Fig. 5a, 5b)

This association represents an open thermophilous pioneer plant community developed on dry calcareous bedrock on shallow soils, dominated mainly by *Jovibarba globifera*, *Sedum album* and *S. acre* succulents. Tussock grass *Festuca pallens*, therophytes (*Arenaria serpyllifolia*, *Cardaminopsis arenosa* agg.) and several species of bryophytes and lichens (*Tortula ruralis*, *Tortella tortuosa*, *Schistidium apocarpum*, *Homalothecium lutescens*, *Bryum argenteum*, *Encalypta streptocarpa*, *Thuidium abietinum*, *Peltigera rufescens*) are often present in the studied stands with higher abundance. Usually, they cover only small patches and in the natural habitats they form mosaics with thermophilous grassland communities of the class *Festuco-Brometea* (most often with the association *Campanulo divergentiformis-Festucetum pallentis*). The plant community *Jovibarbo-Sedetum* was observed on both natural and anthropogenic habitats, such as calcareous rocky slopes, rocky terraces and stabilized screes as well as on abandoned forest road-margins, stone embankments, old walls and castle ruins, or abandoned parts of small limestone quarries. Our relevés were made mostly on S–SE exposed slopes, in altitudes of (415–) 560–930 (–1088) m a.s.l.

3.3.2 Community with *Vincetoxicum hirundinaria* (Supplement S2, rel. 39–41)

In a few cases, dominance of *Vincetoxicum hirundinaria* was detected in stands developed on S–SW exposed limestone gravel screes (680–860 m a.s.l.). We did not classify this community at the association level, partly due to insufficient data from the only three relevés involved and also because of its transitional character. Habitat conditions and the dominant species indicate a close relation to the association *Vincetoxicetum officinalis* Kaiser 1926 (*Stipion calamagrostis* Jenny-Lips ex Br.-Bl. et al. 1952, *Thlaspietea rotundifolii*). On the other hand, there were several diagnostic species of the association *Convallario majalis-Calamagrostietum variae* (*Calamagrostion variae*, *Mulgedio-Aconitetea*) such as *Calamagrostis varia*, *Convallaria majalis*, and *Anthericum ramosum* present.

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Fig. 4. Comparison of Borhidi indicator values and altitude for the studied plant communities. Median values, quartiles (25–75%), ranges, outliers and extremes are shown. Communities are numbered as follows: 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis*, 6. *Parietarion officinalis*, 7. *Convallario majalis-Calamagrostietum variae*, 8. *Vincetoxicum hirundinaria*-community. Significant differences between groups (Kruskal-Wallis test) are marked with letters.

Abb. 4. Vergleich der mittleren Borhidi-Zeigerwerte und Seehöhen in den untersuchten Gesellschaften. Gezeigt sind Median, Quartilen (25 und 75 %), Wertebereich und Ausreißer. Signifikante Unterschiede (Kruskal-Wallis-Test) sind durch Buchstaben symbolisiert. 1. *Jovibarbo-Sedetum albi*, 2. *Campanulo divergentiformis-Festucetum pallentis*, 3. *Orthantho luteae-Caricetum humilis*, 4. *Pulsatillo slavicae-Caricetum humilis*, 5. *Minuartio langii-Festucetum pallentis*, 6. *Parietarion officinalis*, 7. *Convallario majalis-Calamagrostietum variae*, 8. *Vincetoxicum hirundinaria*-Gesellschaft.

3.3.3 *Parietarion officinalis* (Supplement S2, rel. 48–52)

Plant communities of the alliance *Parietarion officinalis* growing on the instable calcareous screes were detected only marginally. Sometimes, they are in close contact with pioneer association *Jovibarbo-Sedetum*. In the floristic composition, the dominant species *Geranium robertianum* (or *Parietaria officinalis* in one case), several succulents (*Sedum album*, *S. acre*, *Hylotelephium maximum*) and bryophytes (*Porella platyphylla*, *Homalothecium philippeanum*, *H. lutescens*, *Anomodon viticulosus*, *Hypnum cupressiforme*) are present with higher abundance. They were observed on both natural and human-made habitats consisting of calcareous screes at the base of rocky slopes and boulders, both natural and artificial gravel accumulations and limestone quarry margins. Our relevés were made mostly on S–SE exposed slopes, in altitudes of (440–) 565–865 (–890) m a.s.l.

3.3.4 *Campanulo divergentiformis-Festucetum pallentis* (Supplement S3, rel. 1–10, Fig. 5c)

This association represents open dry rocky grasslands (alliance *Bromo pannonici-Festucion pallentis*) occurring on limestone bedrock in the Pannonian region. This community is well adapted to extremely dry and warm habitats such as steep sun-exposed slopes with shallow soils and high content of carbonate rocks (karsts rocky fields). Stands in the study area are dominated by *Festuca pallens* while some special drought-adapted species groups are present with high abundance. These include stress-tolerant succulents as *Jovibarba globifera* and several chamaephytes (e.g. *Teucrium chamaedrys*, *T. montanum*, *Genista pilosa*). The frequency of bryophytes was relatively high (e.g. *Tortella tortuosa*, *T. inclinata*,

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Fig. 5. Stands of the following communities: **a)** *Jovibarbo-Sedetum albi* in the limestone quarry Čremošná near Tisovec; **b)** *Jovibarbo-Sedetum albi* in the Nature reserve Cigánka near Muráň; **c)** *Campanulo divergentiformis-Festucetum pallentis* at the Mt. Cigánka (locality Homôlky) near Muráň; **d)** *Orthantho luteae-Caricetum humilis* in the Nature reserve Cigánka near Muráň; **e)** *Pulsatillo slavicae-Caricetum humilis* in the open gaps between relic pine-larch forests in the Nature reserve Veľká Stožka near Závadka nad Hronom; **f)** *Pulsatillo slavicae-Caricetum humilis* with presence of *Daphne arbuscula* in the Nature reserve Poludnica near Muráň; **g)** *Convallario majalis-Calamagrostietum variae* in the Mt Homoľa (1083.3 m) near Červená Skala; **h)** *Pulsatillo slavicae-Caricetum humilis* in the Nature reserve Veľká Stožka near Závadka nad Hronom (All photos by D. Blanár except **5e** by J. Kochjarová).

Abb. 5. Bestände der folgenden Gesellschaften: **a)** *Jovibarbo-Sedetum albi aestivalis* im Kalksteinbruch Čremošná bei Tisovec; **b)** *Jovibarbo-Sedetum albi aestivalis* im Naturschutzgebiet Cigánka bei Muráň; **c)** *Campanulo divergentiformis-Festucetum pallentis* am Berg Cigánka bei Muráň; **d)** *Orthantho luteae-Caricetum humilis* im Naturschutzgebiet Cigánka bei Muráň; **e)** *Pulsatillo slavicae-Caricetum humilis* in den offenen Lücken zwischen reliktischen Kiefern-Lärchen-Forsten im Naturschutzgebiet Veľká Stožka bei Závadka nad Hronom; **f)** *Pulsatillo slavicae-Caricetum humilis humilis* mit Präsenz von *Daphne arbuscula* im Naturschutzgebiet Poludnica bei Muráň; **g)** *Convallario majalis-Calamagrostietum variae* am Homoľa-Berg (1083.3 m) bei Červená Skala; **h)** *Pulsatillo slavicae-Caricetum humilis* im Naturschutzgebiet Veľká Stožka bei Závadka nad Hronom (Alle Fotos von D. Blanár except **5e** von J. Kochjarová).


a)
b)
c)
d)
e)
f)
g)
d)

Schistidium apocarpum, *Bryum argenteum*). The plant community *Campanulo-Festucetum* was observed mainly on natural habitats such as steep calcareous rocky slopes or rocky terraces, while localities of the anthropic origin were found only sporadically (e.g. forest road-margins, abandoned parts of inactive small limestone quarries). Our relevés were made mostly on S–SE exposed slopes, in altitudes of (425–) 500–900 (–1080) m a.s.l.

3.3.5 *Orthantho luteae-Caricetum humilis* (Supplement S3, rel. 11–42, Fig. 5d)

Submontane to montane *Carex humilis*-dominated grasslands are the most mesic vegetation type of the alliance *Bromo pannonici-Festucion pallentis*. They form a transition to sub-xerophilous grasslands of the order *Brometalia erecti* and, on the other hand, to high-montane and subalpine communities of the class *Elyno-Seslerietea*. This community occurs on limestone or fluvial limestone gravels and slopes with more deep soil substrate than in the case of pioneer association *Jovibarbo-Sedetum* or *Festuca pallens*-dominated rocky grasslands. Beside marked dominance of *Carex humilis*, more sub-xerophilous grass species (e.g. *Bromus monocladus*, *Calamagrostis varia*) and chamaephytes (*Teucrium chamaedrys*, *T. montanum*, *Genista pilosa*, *Helianthemum grandiflorum* subsp. *obscurum*) are frequently present, together with a large group of mesophilous forbs and calcicolous submontane/montane species (e.g. *Anthericum ramosum*, *Inula ensifolia*, *Leontodon incanus*, *Hippocrepis comosa*, *Vincetoxicum hirundinaria*, *Sesleria albicans*, *Colymbada scabiosa*, *Thalictrum minus*, *Salvia verticillata*, *Anthyllis vulneraria*, *Tithymalus cyparissias*, *Seseli osseum*, *Dianthus carthusianorum*). Typical thermophilous species (e.g. *Festuca pallens*, *Bothriochloa ischaemum*, *Asperula cynanchica*, *Acosta rhenana*, *Prunella grandiflora*, *Scabiosa ochroleuca*, *Erysimum odoratum*, *Linum flavum*, *L. tenuifolium*) occur less frequently and with lower coverage. The abundance of bryophytes and lichens is also relatively high (e.g. *Tortella tortuosa*, *T. inclinata*, *Ditrichium flexicaule*, *Thuidium abietinum*, *Cladonia pyxidata*, *Cladonia symphycarpa*). The plant community *Orthantho-Caricetum* was observed on both natural and human-influenced habitats in the study area, as a common vegetation type of the open calcareous rocky slopes and extensively grazed or partially abandoned dry and sunny pastures in the lower altitudes. Sometimes it forms open grassland gaps in the oak, oak-hornbeam or lime-maple scree forests. Our relevés were made mostly on S–SE–E exposed slopes, in altitudes of (410–) 450–750 (–905) m a.s.l. Mosaics of the *Orthantho-Caricetum* and *Campanulo divergentiformis-Festucetum pallentis* are developed on rocky slopes. Especially in the higher altitudes, stands that were transitional towards the *Pulsatillo slavicae-Caricetum humilis* were recorded (Supplement S3, rel. 44–49).

3.3.6 *Pulsatillo slavicae-Caricetum humilis* (Table 1, rel. 1–9, Fig. 5e, 5f, 5h)

These are natural, species-rich grasslands dominated by *Carex humilis*, developed on limestone bedrock, representing the part of the montane/subalpine alliance *Astero alpini-Seslerion calcariae* which is restricted to the montane belt. The most frequent taxa are the dominant grasses *Carex humilis* and *Sesleria albicans* together with a large group of calcicolous high-montane species including some Carpathian endemics (e.g. *Polygala amara* subsp. *brachyptera*, *Pulsatilla slavica*, *P. subslavica*, *Daphne arbuscula*, *Phyteuma orbiculare*, *Kernera saxatilis*) and some chamaephytes (*Teucrium montanum*, *Helianthemum grandiflorum* subsp. *obscurum*, *Rhodax rupifragus*, *Thymus pulcherrimus* subsp. *sudeticus*). On the other hand, numerous submontane and thermophilous plants occurring as well in the association *Orthantho-Caricetum* (e.g. *Festuca pallens*, *Anthericum ramosum*, *Leontodon incanus*,

Table 1. Communities of the *Elyno-Seslerietea class*. 1–9: *Pulsatillo slavicae-Caricetum humilis*, 10–12: *Minuartio langii-Festucetum pallentis*.

Tabelle 1. Gesellschaften der Klasse *Elyno-Seslerietea*. 1–9: *Pulsatillo slavicae-Caricetum humilis*, 10–12: *Minuartio langii-Festucetum pallentis*.

Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12
Pulsatillo slavicae-Caricetum humilis												
Carex humilis	**3**	**4**	**3**	**3**	**3**	**1**	**b**	**+**	**b**	.	.	1
Daphne arbuscula	**b**	**+**	**+**	**a**	**1**	**b**	**+**	**1**	**1**	.	.	.
Pulsatilla slavica	**.**	**.**	**+**	**+**	**+**	**r**	**1**	**1**	**+**	.	.	.
Rhodax rupifragus	**+**	**+**	**.**	**1**	**+**	**+**	**+**	**a**	**.**	.	.	.
Campanula xylocarpa	**+**	**.**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	+	.	.
Minuartio langii-Festucetum pallentis												
Festuca pallens	1	1	+	+	.	.	a	.	3	**3**	**3**	**b**
Campanula carpatica	.	.	.	.	.	.	.	.	.	**.**	**+**	**+**
Pinus sylvestris	.	.	.	.	.	.	.	.	.	**.**	**r**	**r**
Libanotis pyrenaica	.	.	.	.	.	.	.	.	.	**.**	**+**	**1**
Acinos alpinus	.	.	.	.	.	.	.	.	.	**.**	**1**	**.**
Astero alpini-Seslerion calcariae												
Sesleria albicans	a	+	+	+	+	1	b	3	1	.	.	.
Kernera saxatilis	+	+	+	+	+	+	+	r	.	.	.	.
Minuartia langii	.	+	+	.	.	.	.	.	.	.	.	.
Allium senescens ssp. *montanum*	.	.	.	.	.	.	+	.	.	.	.	.
Primula auricula	.	.	.	.	.	.	.	+	.	.	.	.
Elyno-Seslerietea, Seslerietalia coerulae												
Thymus pulcherrimus	.	.	+	.	+	.	1	+	1	+	.	.
Pulsatilla subslavica	a	+	1	+	+	+	.	.	.	.	.	.
Phyteuma orbiculare	1	+	+	+	+	.	.	1	.	.	.	.
Polygala amara ssp. *brachyptera*	+	.	+	r	+	+	.	+	.	.	.	r
Thesium alpinum	+	+	+	.	.	.	.	.	.	.	.	.
Carduus glaucinus	r	.	.	.	.	.	.	.	.	.	1	a
Saxifraga paniculata	.	.	.	.	.	.	.	+	.	.	.	.
Festuco-Brometea												
Tithymalus cyparissias	+	+	+	+	+	+	1	.	.	+	.	.
Leontodon incanus	1	1	+	+	+	+	+	+	.	+	.	.
Anthericum ramosum	1	1	a	1	1	+	.	+	.	.	.	.
Bupleurum falcatum	+	+	.	+	+	.	.	.	.	+	+	+
Inula ensifolia	1	+	1	b	b	1	.	.	.	.	.	.
Teucrium montanum	+	a	1	+	+	.	.	.	.	+	.	.
Helianthemum grandiflorum ssp. *obscurum*	+	+	+	+	+	.	+	.	.	.	.	.
Teucrium chamaedrys	+	+	+	+	.	.	.	.	.	a	.	.
Asperula cynanchica	+	.	.	.	+	+	.	.	.	.	.	.
Cyanus triumfettii	.	.	.	+	+	.	+	.	.	+	.	.
Galium glaucum	+	.	+	.	.	+	.	.	.	.	.	.
Epipactis atrorubens	.	.	+	r	.	.	.	.	.	.	.	.
Dianthus carthusianorum agg.	.	.	.	.	.	.	+	.	.	.	+	.
Securigera varia	.	.	.	.	.	.	+	.	.	.	.	+
Sanguisorba minor	.	.	.	.	.	.	.	.	.	.	+	+
Sedo-Scleranthetea												
Jovibarba globifera	+	+	+	+	.	+	.	.	+	1	+	a
Asplenium ruta-muraria	+	.	+	r	.	.	r	r	.	+	.	+

Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12
Other species												
Vincetoxicum hirundinaria	1	1	1	1	1	+	1	+	.	.	.	.
Seseli osseum	+	+	.	+	+	.	1	.	+	.	.	.
Genista pilosa	.	1	.	.	.	.	.	a	+	1	b	+
Chamaecytisus sp.	+	1	+	+	+	.	.	+	.	.	.	.
Polygonatum odoratum	+	+	a	.	.	+	+	+	.	.	.	.
Thymus sp.	+	1	.	+	.	+	.	.	.	.	+	.
Erysimum odoratum	+	.	.	.	.	.	+	+	.	.	.	.
Hieracium sp.	+	.	.	.	.	.	.	r	.	r	.	.
Rosa pimpinellifolia	.	.	.	+	+	+	.	.	.	.	.	.
Acer pseudoplatanus	.	.	.	.	r	.	.	r	.	r	.	.
Platanthera bifolia	.	+	r	.	.	.	.	.	.	.	.	.
Sorbus aria	.	.	.	r	.	.	.	.	.	.	r	.
Cardaminopsis arenosa	.	.	.	.	.	.	.	.	.	+	+	.
Carex sp.	.	.	.	.	.	.	.	.	.	.	+	+
Carlina acaulis	.	.	.	.	.	.	.	.	.	.	+	r
Bryophytes												
Tortella tortuosa	+	a	a	1	1	+	3	3	1	+	b	b
Ditrichum flexicaule	.	+	.	.	+	.	.	a	1	+	.	.
Homalothecium philippeanum	.	+	+	.	.	.	.	+	.	.	.	.
Rhytidium rugosum	.	+	.	.	.	.	.	.	.	.	a	+
Homalothecium lutescens	+	.	.	.	.	.	.	.	1	.	.	.
Fissidens dubius	.	+	.	.	.	.	.	+	.	.	.	.
Tortella inclinata	.	.	.	.	.	+	.	.	.	3	.	.
Schistidium apocarpum	.	.	.	.	.	+	.	.	.	+	.	.

Other species:

E1: *Allium ochroleucum* 10: 1; *A.* sp. 1: +; *Arabis hirsuta* agg. 11: +; *Asperula tinctoria* 4: +; *Brachypodium pinnatum* 12: +; *Campanula glomerata* agg. 12: r; *Campanula rapunculoides* 12: +; *Campanula sibirica* 3: +; *Cephalanthera rubra* 1: +; *Chamaecytisus hirsutus* 7: +; *Colymbada scabiosa* 11: r; *Convallaria majalis* 11: r; *Cotoneaster integerrimus* 8: +; *Fagus sylvatica* 8: r; *Fragaria viridis* 12: +; *Galium album* s.str. 10: +; *Genista tinctoria* 1: +; *Gymnadenia conopsea* 8: +; *Hieracium bupleuroides* 1: +; *Leucanthemum vulgare* agg. 1: +; *Lotus corniculatus* 11: r; *Pimpinella saxifraga* 10: +; *Platanthera* sp. 1: +; *Populus tremula* 7: +; *Salvia verticillata* 1: +; *Sorbus austriaca* 7: +; *Tithymalus epithymoides* 4: r; *Verbascum chaixii* ssp. *austriacum* 12: r; *Viola hirta* 4: +.

E0: *Agonimia tristicula* 8: +; *Bryum caespiticium* 10: +; *Bryum moravicum* 6: +; *Catapyrenium squamulosum* 8: +; *Cladonia pyxidata* 8: +; *Cladonia* sp. 12: r; *Cladonia symphycarpa* 7: a; *Collema crispum* 8: +; *Encalypta streptocarpa* 10: 1; *Hypnum cupressiforme* 1: +; *Rhytidiadelphus triquetrus* 8: +; *Solorina saccata* 8: +; *Tortula muralis* 10: +; *Weissia condensa* 6: +.

Inula ensifolia, *Tithymalus cyparissias*, *Jovibarba globifera*, *Seseli osseum*, *Polygonatum odoratum*, *Vincetoxicum hirundinaria*) are present with relatively high abundance. Among bryophytes and lichens, *Tortella tortuosa*, *Ditrichium flexicaule* and *Cladonia pyxidata* are the most frequent ones. In the studied area, the plant community *Pulsatillo-Caricetum humilis* was observed only on natural habitats, mostly in higher altitudes on steep calcareous rocky slopes, boulders, cliffs and edges, where they often form open patches in the vegetation complex with relic forest stands of *Pinus sylvestris* and *Larix decidua* and community *Minuartio langii-Festucetum pallentis*. Our relevés were made mostly on S–SE exposed slopes, in altitudes of (750–) 785–950 (–975) m a.s.l.

3.3.7 *Minuartio langii-Festucetum pallentis* (Table 1, rel. 10–12)

These mostly natural open rocky grasslands dominated by *Festuca pallens* occur only sporadically throughout the study area in a vegetation complex with relic pine-larch forests. They form mosaics with *Carex humilis*-dominated stands of association *Pulsatillo slavicae-Caricetum*. Only three relevés of this community were sampled on S exposed rocky slopes in altitudes of about 750 m a.s.l.

3.3.8 *Convallario majalis-Calamagrostietum variae* (Supplement S2, rel. 42–47, Fig. 5g)

The *Calamagrostis varia*-dominated community of the alliance *Calamagrostion variae* is developed on shallow humid soils on steep leeward slopes. Beside marked dominance of turf grass *Calamagrostis varia*, several broad-leaved flowering herbs (e.g. *Laserpitium latifolium*, *Securigera varia*, *Cirsium erisithales*, *Vincetoxicum hirundinaria*, *Digitalis grandiflora*, *Convallaria majalis*, *Pimpinella major*, *Origanum vulgare*) and some species occurring also in the *Orthantho luteae-Caricetum* (*Anthericum ramosum*, *Thalictrum minus*, *Teucrium chamaedrys*) are the most frequent taxa. Occasionally, transitions to *Orthantho-Caricetum* were observed (as example, the rel. 43 in the Supplement S3 is given). This association was recorded mostly on natural non-forest habitats, such as steep S–SW slopes in altitudes of (435–) 570–850 (–870) m a.s.l.

4. Discussion

The various plant communities are often distributed along series from pioneer rocky stands through open rocky grasslands dominated by *Festuca pallens*, *F. tatrae*, *Carex humilis* and *Sesleria albicans* to closed tall grass communities dominated by *Calamagrostis varia* and *C. arundinacea*. The plant communities of the classes *Sedo-Scleranthetea*, *Festuco-Brometea*, *Elyno-Seslerietea*, *Thlaspietea rotundifolii* and *Mulgedio-Aconitetea* – including thermophilous grasslands of the alliance *Bromo pannonici-Festucion pallentis* and montane/subalpine grasslands of the alliance *Astero alpini-Seslerion calcariae* – occur in the major part of the study area, often mixed together forming a vegetation mosaic (Fig. 6). Very strong relationships between syntaxa of the classes *Elyno-Seslerietea* and *Festuco-Brometea* were confirmed as indicated by MICHÁLKOVÁ & ŠIBÍK (2006) for whole Slovakia.

All our newly sampled relevés of the pioneer vegetation were classified as association *Jovibarbo-Sedetum albi* where usually either *Jovibarba globifera* or *Sedum album* occupies the dominant position (Fig. 5a, 5b). Only rarely some other vascular plants prevail (e.g. *Sedum acre* in the rel. 4, 20, *Allium senescens* subsp. *montanum* in the rel. 19). Mosaics of the pioneer stands with the tussock grass community *Campanulo divergentiformis-Festucetum pallentis* were observed on several localities throughout the study area. Some of our relevés classified as *Jovibarbo-Sedetum* where the cover of *Festuca pallens* reaches

Fig. 6. View from the Mt. Cigánka (935.4 m) to the east-southeast slope of the Muránska planina Mts (Poludnica National nature reserve). Open rocky and grassy gaps between the beech- and lime-maple forests are the typical biotopes of the studied communities (Photo: J. Kochjarová, June 2013)

Abb. 6. Blick vom Berg Cigánka (935.4 m) zum Ost-Südosthang des Muránska Planina-Gebirges (Naturschutzgebiet Poludnica). Offene felsige und grasige Lücken zwischen Buchen- und Linden-Ahornwäldern sind die typischen Biotope der untersuchten Gesellschaften (Photo: J. Kochjarová, Juni 2013).

20–30% (Supplement S2, rel. 20–23) represent transitions between pioneer communities of succulents of the alliance *Alysso-Sedion* and *Festuca pallens*-dominated xerothermophilous rocky grasslands of the alliance *Bromo pannonici-Festucion*. In the moss layer, *Tortula ruralis* and *Bryum argenteum* are present in some stands, what is in accordance with the original description of the community (VALACHOVIČ & MAGLOCKÝ 1995). On the other hand, several other bryophytes (e.g. *Tortella tortuosa*, *Schistidium apocarpum*) were observed much more often. In most stands, the cover of the moss layer is relatively high (between 20 and 50%). The distinction of two subassociations, *tortuletosum ruralis* and *allietosum montani* (cf. VALACHOVIČ & MAGLOCKÝ 1995), could not to be reproduced with our dataset.

On some localities, the pioneer vegetation occurs in close contact with scree communities of the alliance *Parietarion officinalis*. The latter are developed on the instable gravel accumulations with minimum content of shallow soil. Only scattered data on the occurrence of the *Vincetoxicetum officinalis* (*Stipion calamagrostis*) have been published so far (VALACHOVIČ 1995, HRIVNÁK 1997, BLANÁR 2005). Our three relevés of the *Vincetoxicum hirundinaria*-dominated community have close relation to this association (see chapter 3.3.2).

The majority of the studied habitats contain varied grasslands dominated by *Festuca pallens*, *Carex humilis* and *Sesleria albicans* (or *Calamagrostis varia* in some instances). Species presence depends on diverse abiotic conditions such as altitude, slope, soil depth, content of open bedrock cover, etc. The dry rocky grasslands dominated by *Festuca pallens* are developed mostly on steep dry and sun-exposed S–SE slopes with shallow soil and the highest portion of the limestone rock base. They have the closest relation to the pioneer communities of the alliance *Alysso-Sedion* including similar abiotic conditions, several common vascular plant species (e.g. *Jovibarba globifera*, *Aplenium ruta-muraria*, *Seseli osseum*), as well as common bryophytes with high constancy (e.g. *Tortella tortuosa*, *Schistidium apocarpum*, *Homalothecium philippeanum*, *Bryum argenteum*). The stands of the Pannonian plant community *Campanulo divergentiformis-Festucetum pallentis* (*Festuco-Brometea*) on the southern slopes of the study area represent the northern margin of the association range. There are several thermophilous plants regularly present in this community (e.g. *Campanula sibirica*, *Hippocrepis comosa*, *Leontodon incanus*, *Teucrium chamaedrys*, *T. montanum*). Until now, this association was only known from the karstic area Slovenský kras/Aggteleki karszt on the Slovak-Hungarian border (cf. DÚBRAVKOVÁ et al. 2010, JANIŠOVÁ & DÚBRAVKOVÁ 2010, JANIŠOVÁ 2014). However, this territory is not too far (only about 25 kilometres) from the study area. It seems that, as in the case of the Pannonian floristic elements, some thermophilous plant communities reach the northern margin of their distribution range on the southern slopes of Muránska planina Mts. Seven relevés previously classified as *Minuartio langii-Festucetum pallentis* (*Elyno-Seslerietea*) (VALACHOVIČ & MUCINA 2004, BLANÁR & LETZ 2005) have been included in the *Campanulo divergentiformis-Festucetum pallentis* in our analyses (see chapter 3.1). On the other hand, in the higher altitudes of the study area closely related natural stands with dominance of *Festuca pallens* and *Sesleria albicans* and presence of more montane/subalpine elements are occurring that were classified as *Minuartio langii-Festucetum pallentis* (Table 1, rel. 10–12, and also 7 relevés published by VALACHOVIČ & MUCINA 2004 and KLIMENT et al. 2005, 2007a).

Communities dominated by *Carex humilis* developed mostly on the semi-natural or man-influenced habitats in the lower elevations (Supplement S3, rel. 11–42 and 9 relevés published by UHLÍŘOVÁ & BERNÁTOVÁ 2003, BLANÁR 2005 and BLANÁR & LETZ 2005, Fig. 5d) have been grouped to one cluster and classified as *Orthantho lutei-Caricetum humilis* (*Festuco-Brometea*). This community has not been reported from the study area before, because most authors focused on the natural stands with *Carex humilis* and the local endemic shrub *Daphne arbuscula*, occurring in the highest part of the karstic plateau (VALACHOVIČ & JAROLÍMEK 1994, UHLÍŘOVÁ & BERNÁTOVÁ 2003). The *Orthantho-Caricetum* is a plant community of transitional character between the thermophilous grasslands of the alliance *Bromo pannonici-Festucion*, and the montane/subalpine grasslands of the alliance *Astero alpini-Seslerion* (JANIŠOVÁ 2014). Primarily, it was described from the Carpathian basin Turčianska kotlina in Central Slovakia (KLIMENT & BERNÁTOVÁ 2000). Later it was confirmed from more localities, as a mesic part of the alliance *Bromo pannonici-Festucion*, restricted to the mountain area of Central Slovakia (DÚBRAVKOVÁ et al. 2010, JANIŠOVÁ & DÚBRAVKOVÁ 2010, JANIŠOVÁ 2014). Several differential taxa of this association (e.g. *Acinos alpinus*, *Bromus monocladus*, *Colymbada scabiosa*, *Hippocrepis comosa*, *Knautia kitaibelii*, *Leucanthemum vulgare* agg., *Pimpinella saxifraga*, *Sesleria albicans*) are regularly present in the stands in the study area, as well as the major part of constant taxa (e.g. *Anthericum ramosum*, *Carex humilis*, *Anthyllis vulneraria*, *Asperula cynanchica*, *Genista pilosa*, *Helianthemum nummularium* agg., *Inula ensifolia*, *Leontodon incanus*, *Sanguisorba*

minor, *Teucrium chamaeedrys*, *T. montanum*, *Tithymalus cyparissias*). In comparison with the related thermophilous association *Festuco pallentis-Caricetum humilis* Sillinger 1930 corr. Gutermann et Mucina 1993 known from the south-western part of Slovakia and adjacent parts of Moravia and Austria (cf. DÚBRAVKOVÁ et al. 2010, JANIŠOVÁ & DÚBRAVKOVÁ 2010, JANIŠOVÁ 2014), almost the complete group of differential taxa of the latter (*Erysimum diffusum*, *Fumana procumbens*, *Jurinea mollis*, *Hornungia petraea*, *Seseli hippomarathrum*, *Stipa eriocaulis*, *Globularia punctata*) is not occurring in the study area at all. Similarly, several characteristic and constant taxa of the other related association *Poo badensis-Caricetum humilis* (Dostál 1933) Soó ex Michálková in Janišová et al. 2007 restricted to the south-eastern part of Slovakia (JANIŠOVÁ 2014) are completely absent in our stands (*Astragalus vesicarius*, *Eryngium campestre*, *Koeleria macrantha*, *Stipa pulcherrima*) or present only very rarely (*Potentilla arenaria*, *Verbascum lychnitis*). For comparison of all relevés with dominance of *Carex humilis* and the above mentioned, related communities see also Supplement S4.

All previously published data on the plant communities with dominance of *Carex humilis* referred only to the occurrence of the association *Pulsatillo slavicae-Caricetum humilis* in the study area (VALACHOVIČ & JAROLÍMEK 1994, UHLÍŘOVÁ & BERNÁTOVÁ 2003, 2004, BLANÁR 2005, BLANÁR & LETZ 2005). This community includes exclusively natural (often relic) stands developed on limestone rocky slopes in the higher altitude of the study area in close contact with the relic pine-larch forests. Some endemic and/or relic species such as *Daphne arbuscula*, *Pulsatilla slavica*, and *P. subslavica* are restricted to this vegetation type (Table 1, rel. 1–9, Fig. 5e, f). Besides the dominant sedge species *Carex humilis*, also *Sesleria albicans* is regularly present in the association and often occupies the co-dominant position in the herb layer (Table 1, rel. 1, 7, 8). The presence of more montane/subalpine taxa (e.g. *Polygala amara* subsp. *brachyptera*, *Phyteuma orbiculare*, *Thesium alpinum*, *Rhodax rupifragus*, *Kernera saxatilis*, *Thymus pulcherrimus* subsp. *sudeticus*) is characteristic for this association, while the group of thermophilous elements (e.g. *Genista pilosa*, *Salvia verticillata*, *Acosta rhenana*, *Scabiosa ochroleuca*, *Linum tenuifolium*, *Colymbada scabiosa*, *Prunella grandiflora*) regularly occurring in *Orthantho-Caricetum* is almost completely absent (see also Supplement S4). Stands of the *Pulsatillo slavicae-Caricetum humilis* from the Muránska planina Mts were described as a separate subassociation *campanuletosum xylocarpae* Uhlířová et Bernátová 2004, representing the syntaxon of the alliance *Astero-Seslerion* with the closest relation to the thermophilous communities of the class *Festuco-Brometea* (UHLÍŘOVÁ & BERNÁTOVÁ 2003, 2004, KLIMENT et al. 2007a). Almost all our relevés recorded in the study area are in accordance with the original description of this subassociation.

On the other hand, there are more species common to both *Carex humilis*-dominated associations occurring in the study area (e.g. *Carex humilis*, *Tithymalus cyparissias*, *Helianthemum grandiflorum* subsp. *obscurum*, *Anthericum ramosum*, *Leontodon incanus*, *Teucrium montanum*, *Inula ensifolia*). Moreover, in appropriate habitat conditions these two communities very often grow mixed together forming mosaics and/or grasslands of transitional character (as examples, rel. 44–49 from the Supplement S3 could be mentioned). A very similar situation was studied in the contact zone of the Central Carpathians (Veľká Fatra Mts) and the Turčianska kotlina basin in Central Slovakia, where the related association *Globulario cordifoliae-Caricetum humilis* Bernátová et Uhlířová 1994 (*Astero alpini-Seslerion*, *Elyno-Seslerietea*) occurring in higher elevations (500–1370 m a.s.l.) of the Veľká

Fatra Mts and the *Orthantho luteae-Caricetum humilis* (*Bromo pannonici-Festucion*, *Festuco-Brometea*) occurring in lower altitudes of the neighbouring basin (450–530 m a.s.l.) were compared (KLIMENT & BERNÁTOVÁ 2004).

A related community with marked dominance of *Sesleria albicans* (while *Carex humilis* grows there only sporadically with low coverage) and presence of more dealpine taxa (e.g. *Acinos alpinus*, *Carduus glaucinus*, *Saxifraga paniculata*) was described as association *Saxifrago paniculatae-Seslerietum caeruleae* Klika 1941 [alliance *Diantho lumnitzeri-Seslerion* (Soó 1971) Chytrý et Mucina in Mucina et al. 1993, *Festuco-Brometea*]. This association is also characterized as transitional community between colline *Sesleria*-dominated grasslands and the montane suballiance *Pulsatillo slavicae-Caricenion humilis* (JANIŠOVÁ & DÚBRAVKOVÁ 2010). Altogether five relevés from the study area published by VALACHOVIČ & JAROLÍMEK (1994), VALACHOVIČ & MUCINA (2004) and UHLÍŘOVÁ & BERNÁTOVÁ (2003) and originally classified as *Pulsatillo slavicae-Caricetum humilis* have recently been transferred to the *Saxifrago-Seslerietum* (JANIŠOVÁ 2014). Relevés from the study area with transitional features towards the *Saxifrago-Seslerietum* were also recorded by JANIŠOVÁ & DÚBRAVKOVÁ (2010). From the synoptic table (Supplement S4) the accordance with the *Saxifrago-Seslerietum* seems not as strong as in the case of *Pulsatillo-Caricetum humilis*. Several montane/subalpine taxa characteristic for the class *Elyno-Seslerietea* and alliance *Astero-Seslerion*, as well as more Carpathian endemics (e.g. *Bromus monocladus*, *Campanula xylocarpa*, *Cyanus triumfettii*, *Daphne arbuscula*, *Knautia kitaibelii*, *Minuartia langii*, *Phyteuma orbiculare*, *Polygala amara* subsp. *brachyptera*, *Primula auricula*, *Pulsatilla slavica*, *P. subslavica*, *Rhodax rupifragus*, *Sesleria albicans*, *Thesium alpinum*, *Thymus pulcherrimus* subsp. *sudeticus*) are constantly present in stands. The whole group of differential taxa of the association *Pulsatillo-Caricetum humilis* and almost all constantly present accompanying taxa (cf. KLIMENT et al. 2007a) are present as well. Therefore we prefer to classify our relevés of the class *Elyno-Seslerietea* as association *Pulsatillo-Caricetum humilis*. On the other hand, some *Carex humilis*- and *Sesleria albicans*-dominated grasslands of the class *Festuco-Brometea*, namely the group of our 6 relevés of transitional character (Supplement S3, rel. 44–49) are rather similar to the *Saxifrago-Seslerietum* (e.g. in some cases cover percentage of the co-dominant species *Sesleria albicans* reaches to 25–50%). However, the habitat conditions as well as the regular presence of *Carex humilis* and other thermophilous elements (see the synoptic Supplement S4) do not accord with the description of the community *Saxifrago-Seslerietum*.

The most closed natural grasslands in the study area are mostly represented by the association *Convallario-Calamagrostietum* (class *Mulgedio-Aconitetea*, alliance *Calamagrostion variae*) (Fig. 5g). Our relevés classified as this community (Supplement S2, rel. 42–47) are very similar to those sampled by some previous authors (VALACHOVIČ & MUCINA in KLIMENT et al. 2007b). The plant communities of the related alliance *Calamagrostion arundinaceae*, represented by the association *Digitali abiguae-Calamagrostietum arundinaceae* have only rarely been recorded in the study area (KLIMENT 2004).

The natural and semi-natural grasslands dominated by *Festuca pallens*, *Carex humilis* and *Calamagrostis varia*, namely those occurring in the lower altitudes and on the man-influenced habitats, are often in contact with thermophilous extensively used meadows and pastures or thermophilous fringes of the alliances *Arrhenatherion elatioris*, *Bromion erecti*, *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951 and *Geranion sanguinei* R. Tx.

in T. Müller 1962 that have been reported from the study area by several authors (UJHÁZY et al. 2007, KOCHJAROVÁ & VALACHOVIČ 2006, VALACHOVIČ & HEGEDÜŠOVÁ-VANTAROVÁ 2014). For comparison, see also the synoptic table (Supplement S1).

Thanks to the geographical position of the studied area, a great floristic richness and extraordinary diffusion of thermophilous and montane/subalpine elements is characteristic for the majority of the detected plant communities. We often found stands of transitional character between known associations (Supplement S1, Supplement S4). The study area is an important example of the border-territory situated on the crossing of the Carpathian and Pannonian bioregions. Interesting gradients from the Pannonian dry grasslands (e.g. *Campanulo divergentiformis-Festucetum pallentis*) to the montane/subalpine communities (e.g. *Seslerio calcareae-Festucetum tatrae*) were observed nearby on the small area. The associations of transitional character between the classes *Festuco-Brometea* and *Elyno-Seslerietea* such as *Orthantho luteae-Caricetum humilis* and *Pulsatillo slavicae-Caricetum humilis* were identified as the most frequent type among the studied grassland vegetation.

Erweiterte deutsche Zusammenfassung

Einleitung – Auf dem Gebiet der Slowakei treten zwei biogeographische Regionen miteinander in Kontakt, die Karpatische und die Pannonische Region. Das Berggebiet Muránska Planina am Südrand der Westkarpaten wurde als Modellregion gewählt, um die Variabilität und Diversität der thermophilen und montanen waldfreien Vegetation in dieser Grenzsituation zu studieren. Muránska Planina ist ein kleines Karstgebiet mit einer Fläche von etwa 40 km² und Seehöhen zwischen 400 und 1400 m ü.d.M. (Abb. 1). Aufgrund seiner biogeographischen Position, der vielfältigen geologischen und geomorphologischen Bedingungen und einer außergewöhnlichen Vielfalt an Standorten ist das Gebiet von hohem Naturschutzwert.

Material und Methoden – Insgesamt wurden 113 neue Vegetationsaufnahmen angefertigt und mit älteren Daten aus der Slowakischen Vegetationsdatenbank verglichen. Der Datensatz aus neuen und älteren Aufnahmen von Trockenrasen, Halbtrockenrasen und Frischwiesen (265 Aufnahmen) wurde mit Hilfe des Programms JUICE 7.0.98 ausgewertet. Für die numerische Klassifikation wurde die „Beta flexible"-Methode mit relativer Sorensen-Distanz und logarithmischer Transformation der Deckungswerte gewählt. Zur standörtlichen Erklärung der floristischen Gradienten wurde eine DCA mit CANOCO 4.5 gerechnet, wobei die Seehöhe und mittlere Borhidi-Zeigerwerte als passive Umweltvariablen verwendet wurden.

Ergebnisse – Es wurden insgesamt zwölf Gesellschaften, welche zu sechs Klassen gehören, identifiziert (Beilage S1–S3, Tab. 1). Die DCA zeigte eine klare Differenzierung der Rasentypen entlang der standörtlichen Gradienten (Abb. 2 und 3). Der Vergleich von Seehöhen und mittleren Borhidi-Zeigerwerten ergab einige signifikante Unterschiede zwischen den Gesellschaften (Abb. 4).

Folgende Gesellschaften wurden durch eigene Aufnahmen dokumentiert und sind im Text näher beschrieben: *Sedo-Scleranthetea*: *Jovibarbo-Sedetum albi* (offene thermophile Pionierfluren); *Festuco-Brometea*: *Campanulo divergentiformis-Festucetum pallentis* (offene thermophile Felstrockenrasen), *Orthantho luteae-Caricetum humilis* (Trockenrasen über etwas tiefergründigen Böden); *Elyno-Seslerietea*: *Pulsatillo slavicae-Caricetum humilis* (montane *Carex humilis*-Rasen mit einer Mischung aus thermophilen und subalpinen Elementen), *Minuartio langii-Festucetum pallentis* (offene montane Felstrockenrasen); *Thlaspietea rotundifolii*: *Vincetoxicum hirundinaria*-Gesellschaft (Schuttfluren); *Mulgedio-Aconitetea*: *Convallario majalis-Calamagrostietum variae* (Hochgrasfluren auf gut wasserversorgten, steilen Schutthängen).

Diskussion – Die verschiedenen Gesellschaften sind oft mosaikartig entlang von Standortsgradienten angeordnet, welche von Pionierfluren über lückige Felstrockenrasen mit den dominanten Arten *Festuca pallens*, *F. tatrae*, *Carex humilis* und *Sesleria albicans* bis zu geschlossenen Hochgrasfluren mit *Calamagrostis varia* und *C. arundinacea* reichen. Pannonische Trockenrasen des Verbands *Bromo pannonici-Festucion pallentis* und hochmontan-subalpine Rasen des Verbands *Astero alpini-Seslerion calcariae* finden sich im Untersuchungsgebiets oft in enger Nachbarschaft. Für die Mehrzahl der untersuchten Gesellschaften ist ein großer Artenreichtum und eine Durchmischung von thermophilen pannonischen und montan-subalpinen karpatischen Elementen charakteristisch. Zu den häufigsten Vegetationstypen im Gebiet zählen Pionierfluren (*Jovibarbo-Sedetum albi*) sowie Trockenrasen, welche floristisch zwischen den Klassen *Festuco-Brometea* und *Elyno-Seslerietea* vermitteln, wie *Orthantho luteae-Caricetum humilis* und *Pulsatillo slavicae-Caricetum humilis*.

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Supplements

Supplement S1. Comparison of pioneer vegetation, dry, rocky, and mesic grassland communities recorded in Muránska planina Mts.

Beilage S1. Gekürzte Stetigkeitstabelle der Pioniervegetation, (Fels-)Trockenrasen und Frischwiesen im Untersuchungsgebiet (Muránska planina).

Supplement S2. Communities of the *Sedo-Scleranthetea*, *Mulgedio-Aconitetea* and *Thlaspietea rotundifolii* classes**.**

Beilage S2. Gesellschaften der Klassen *Sedo-Scleranthetea*, *Mulgedio-Aconitetea* und *Thlaspietea rotundifolii*.

Supplement S3. Communities of the *Festuco-Brometea* class.

Beilage S3. Gesellschaften der Klasse *Festuco-Brometea.*

Supplement S4. Comparison of *Carex humilis*-dominated grasslands belonging to the *Festuco-Brometea* and *Elyno-Seslerietea* classes.

Beilage S4. Vergleich verschiedener *Carex humilis*-dominierter Rasengesellschaften der Klassen *Festuco-Brometea* und *Elyno-Seslerietea*.

Additional supporting information may be found in the online version of this article.

Zusätzliche unterstützende Information ist in der Online-Version dieses Artikels zu finden.

Supplement E1. The localities and header data of relevés.

Anhang E1. Lokalitäten und Kopfdaten der Vegetationsaufnahmen.

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Supplement S2. Communities of *Sedo-Scleranthetea* , *Mulgedio-Aconitetea* and *Thlaspietea rotundifolii* classes.

Beilage S2. Gesellschaften der Klassen *Sedo-Scleranthetea* , *Mulgedio-Aconitetea* und *Thlaspietea rotundifolii* .

1-38: *Jovibarbo-Sedetum albi*
39-41: Community with *Vincetoxicum hirundinaria*
42-47: *Convallario majalis-Calamagrostietum variae*
48-52: *Parietarion officinalis*

Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Sedo-Scleranthetea
Jovibarbo-Sedetum albi
Sedum album	b	a	b	1	b	b	.	a	b	a	1	a	b	a	+	.	a	b	a	.	+	+	+	1	b	b	3	3	4	b	b	a	a	3	3	b	3	b	1	.	.	.	.	.	.	.	.	.	+	.	.	.
Jovibarba globifera	+	+	1	.	1	+	a	b	a	a	1	b	1	a	+	a	a	a	1	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum acre	.	1	b	3	1	b	.	1	.	.	r	.	.	.	+	.	+	1	a	3	+	+	+	.	1	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Asplenium ruta-muraria	+	.	.	.	r	.	.	+	1	+	a	.	+	.	.	+	1	+	+	.	+	1	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dianthus carthusianorum agg.	.	.	+	.	.	+	.	+	+	r	.	+	+	+	+	.	+	+	+	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Hylotelephium maximum agg.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	1	+	.	1	.	+	+	r	a	.	+	1	1	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.
Seseli osseum	+	.	.	.	.	.	+	.	.	.	.	+	+	+	+	.	+	1	a	1	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Arenaria serpyllifolia agg.	.	+	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Community with *Vincetoxicum hirundinaria*
Vincetoxicum hirundinaria	.	.	1	1	+	.	r	+	.	.	.	+	+	+	.	.	b	.	.	.	a	b	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	4	b	+	+	1	1	+	.	.	.	.	.	.
Mulgedio-Aconitetea
Convallario majalis-Calamagrostietum variae
Calamagrostis varia	.	.	.	.	.	.	.	.	+	.	.	r	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	+	.	+	r	3	4	3	4	4	3	.	.	.	.	.
Convallaria majalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	3	b	+	+	.	.	.	.	.
Bupleurum falcatum	.	.	+	+	+	.	.	+	+	r	.	.	r	.	.	.	.	.	+	.	+	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	+	+	+	.	.	.	.	.	.	.
Polygonatum odoratum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+	.	.	.	.	.	.	.
Securigera varia	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	+	.	+	.	+	+	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	+	.	+	+	1	+	.	.	.	+	.	.	.
Laserpitium latifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	a	1	.	.	.	.	.	.
Brachypodium pinnatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	b	+	.	.	.	.	.	.	.	.	.
Thlaspietea rotundifolii
Parietarion officinalis
Geranium robertianum	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	+	+	+	r	.	.	.	.	.	.	.	.	.	.	a	3	b	4	+
Arabis turrita	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	+	.	+	.
Campanula trachelium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.
Lamium maculatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	r
Parietaria officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Festuco-Brometea
Teucrium chamaedrys	.	.	.	.	.	.	.	+	+	.	.	1	.	+	.	.	+	.	.	.	1	+	1	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	a	1	+	+	.	.	.	.	.	.	.
Festuca pallens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	b	b	3	b	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.
Anthericum ramosum	.	.	.	.	.	.	1	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	1	1	1	1	.	.	.	.	.	.	.
Campanula sibirica	.	.	.	.	.	.	.	+	+	.	.	r	.	.	.	.	+	.	+	.	+	+	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Helianthemum grandifl. ssp. *obscurum*	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Asperula cynanchica	.	.	.	.	.	.	.	.	+	r	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.
Sanguisorba minor	.	.	.	.	.	1	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Melica ciliata	.	.	.	.	.	.	.	.	.	+	+	.	.	+	a	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	a	.	.	.	.	.	.	.	.	.	.
Aster amelloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	a	1	.	.	.	.	.	.	.	.	.
Tithymalus cyparissias	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Salvia verticillata	.	.	.	.	.	.	.	+	.	r	.	.	.	.	+	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acosta rhenana	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Leontodon incanus	.	.	.	.	.	.	.	.	.	.	.	+	r	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium montanum	.	.	.	.	.	.	.	.	.	.	.	a	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inula ensifolia	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Other species
Galium album s.str.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+	a	+	a	1	r	+	+	.	.	.	.	.	+	a	.	+	1	a	a	+	1	+	1	a	b	+	1	a	1	+	.	.	.	1	+	.	.
Origanum vulgare	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	r	.	.	+	.	.	.	.	.	.	.	.	.	.	+	1	+	.	1	1	.	.	1	b	a	.	.	.	.	+	.	.	.
Digitalis grandiflora	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	+	r	r	.	.	r	.	a	a	b	.	+	+	.	+	.	.	.
Thalictrum minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	1	+	1	+	.	1	.	.	.	.	.
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Asplenium trichomanes	.	.	+	1	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.
Cardaminopsis arenosa	+	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	a	.	+	.	.	.	.	1	.	.	+	.	+	.	.	.	+	.	+	.
Silene donetzica	.	.	.	.	.	.	.	.	.	r	.	+	.	+	+	.	.	+	1	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
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Aconitum anthora	.	.	1	+	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Campanula rapunculoides	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	+	r	.	.	.	.	.	1	.
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Sorbus aria	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	+	.	a	.	.	.	.	.	.
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Scabiosa lucida	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Carduus collinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
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Tithymalus epithymoides	r	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Colymbada scabiosa	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
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Allium senescens ssp. *montanum*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Achillea millefolium agg.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbascum chaixii ssp. austriacum	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Campanula carpatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	a	.	1	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Clinopodium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	.	+	.	.	.
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Cornus sanguinea	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	r	.	.	.
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Genista pilosa	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fagus sylvatica	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	r	.	.	.	r	.
Thymus pulcherrimus	.	.	.	.	.	.	.	.	.	.	.	.	b	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Viola hirta	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cystopteris fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Acer pseudoplatanus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+
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Libanotis pyrenaica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala amara ssp. *brachyptera*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
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Prunus mahaleb	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	a	.	.	.
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Anthyllis vulneraria	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Pimpinella major	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	b	.	.	.	.	.
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Leucanthemum vulgare agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
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Bryophytes and lichens
Tortella tortuosa	1	.	1	.	1	.	.	1	.	+	.	a	a	1	.	.	b	a	+	.	3	b	a	+	.	.	.	.	1	+	3	b	.	a	b	a	1	.	.	.	.	1	a	1	.	+	.	.	.	.	.	.
Schistidium apocarpum	+	+	.	.	.	.	.	+	.	+	.	+	+	+	.	1	.	.	.	.	.	+	.	+	.	+	+	.	+	.	+	+	.	.	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Homalothecium philippeanum	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	+	1	.	+	+	1	3	.	.	.	.	.	.	.	1	.	.	.	.	.	.	b	.	.	+	1	.	.	.	.	.	3	.	.	.
Homalothecium lutescens	a	.	b	3	b	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	a	.
Tortula ruralis	.	+	1	+	+	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	b	a	b	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Thuidium abietinum	.	.	.	.	.	+	.	1	.	a	1	.	.	.	.	.	a	b	b	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anomodon viticulosus	.	1	1	3	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.
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Hypnum cupressiforme	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Bryum caespiticium	.	.	.	.	1	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortula muralis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.
Porella platyphylla	.	.	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Cladonia pyxidata	.	.	1	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera rufescens	.	.	.	.	1	.	.	.	+	b	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Grimmia pulvinata	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leptogium lichenoides	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barbula unguiculata	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Encalypta vulgaris	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortella sp.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Homalothecium sericeum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ditrichum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	b	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Rhytidiadelphus triquetrus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	3	+	.	.	.	.	.
Leskea polycarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	1	.	.	.

Species in less than 3 relevés:

E1: *Abies alba* 47: r; *Aconitum moldavicum* 46: r; *A. variegatum* 47: a; *Adenophora liliifolia* 46: 1; *Aegopodium podagraria* 47: +; *Ajuga genevensis* 22: +; *A. reptans* 33: +, 40: +; *Alliaria petiolata* 51: +, 52: r; *Allium flavum* 1: r, 2: r; *A. oleraceum* 11: r; *Alyssum alyssoides* 25: +; *Anchusa officinalis* 6: 1; *Anthriscus sylvestris* 29: r; *Aquilegia vulgaris* 46: +, 47: r; *Artemisia vulgaris* 28: r; *Aruncus vulgaris* 47: +; *Asplenium viride* 32: +; *Avenula pubescens* 25: +, 33: +; *Betula pendula* 28: r; *Campanula glomerata* agg. 43: r; *C. persicifolia* 32: +, 36: r; *Carduus glaucinus* 9: 1, 40: +; *Carex alba* 46: 1; *C. humilis* 13: +, 44: +; *Carlina vulgaris* agg. 17: r; *Chamaecytisus* sp. 42: +; *Chelidonium majus* 27: r, 29: r; *Cirsium erisithales* 46: 1, 47: b; *Clematis alpina* 51: 1; *Cortusa matthioli* 51: a; *Cotoneaster* sp. 51: r; *Crataegus* sp. 4: 1; *Cuscuta epithymum* 42: +, 43: +; *C.* sp. 12: +, 13: +; *Cyanus triumfettii* 42: +; *Dactylis glomerata* 42: +; *D. polygama* 30: r; *Daphne mezereum* 47: r; *Delphinium elatum* 47: +; *Echium vulgare* 17: r, 25: 1; *Epipactis atrorubens* 16: r, 46: +; *E. helleborine* 46: +; *Euphrasia salisburgensis* 32: +; *Fallopia convolvulus* 29: +, 49: +; *Festuca rupicola* 25: 1; *F.* sp. 37: +; *Filipendula vulgaris* 28: +; *Fragaria viridis* 44: +; *Galium aparine* 3: +, 4: 1; *G. mollugo* 6: +; *G. schultesii* 46: +; *Gentiana asclepiadea* 47: +; *Geranium columbinum* 25: 1; *G. pratense* 34: +; *Glechoma hederacea* 24: +; *Gymnadenia conopsea* 46: +; *Hedera helix* 48: +; *Heracleum sphondylium* 47: +, 51: +; *Hieracium bupleuroides* 33: +; *H. murorum* 46: +, 47: 1; *Hippocrepis comosa* 15: +; *Knautia maxima* 47: r; *Lactuca serriola* 28: +; *Lapsana communis* 10: +, 49: +; *Lathyrus vernus* 46: +, 51: r; *Lembotropis nigricans* 41: +; *Leontodon hispidus* 6: +; *Lilium martagon* 46: r; *Linaria vulgaris* 35: +; *Lonicera xylosteum* 47: r, 49: r; *Lotus corniculatus* 33: +, 34: r; *Lunaria rediviva* 51: r; *Melampyrum nemorosum* 44: +, 45: +; *M. sylvaticum* 47: +; *Melica nutans* 47: +; *Melittis melissophyllum* 44: r, 46: +; *Minuartia langii* 14: +, 41: +; *Moehringia muscosa* 16: +; *Parietaria officinalis* 52: 5; *Paris quadrifolia* 47: +; *Picea abies* 46: +, 47: r; *Picris hieracioides* 6: +, 28: r; *Pilosella bauhinii* 12: +; *P. officinarum* 6: +, 25: +; *Pinus sylvestris* 46: +; *Plantago lanceolata* 15: r, 25: +; *P. media* 25: +; *Pleurospermum austriacum* 46: 1; *Poa angustifolia* 37: +; *P. compressa* 27: +, 30: +; *Poa molinerii* 13: +, 15: b; *Polygonatum verticillatum* 47: +; *Polypodium vulgare* 48: +; *Potentilla argentea* agg. 25: 1; *P. heptaphylla* 5: +, 8: r; *P. recta* 19: +; *Prenanthes purpurea* 47: 1; *Primula elatior* 46: +, 47: +; *Pulmonaria obscura* 47: +; *Pyrethrum clusii* 47: +; *P. corymbosum* 17: +; *Quercus petraea* agg. 44: +; *Ranunculus bulbosus* 6: +; *Reseda lutea* 6: +; *Ribes uva-crispa* 24: +; *Rosa pendulina* 40: +; *Rubus idaeus* 16: r; *R. saxatilis* 47: 1; *Salvia pratensis* 25: +; *Scabiosa ochroleuca* 15: r; *Senecio jacobaea* 24: r; *Silene nemoralis* 33: 1; *Solidago virgaurea* 35: +, 47: +; *Spergularia rubra* 29: +; *Stachys recta* 10: r; *Taraxacum* sect. *Ruderalia* 6: r, 33: +; *Thesium alpinum* 9: +; *Thlaspi perfoliatum* 25: +; *Thymus alpestris 25: +; T. pulegioides 32: +; Tofieldia calyculata 46: 1; Tragopogon orientalis 33: r; Trifolium repens 18: +, 19: +; Valeriana stolonifera ssp. angustifolia 39: +, 49: +; V. tripteris 46: 1; Verbascum nigrum 44: +; V. sp. 2: r, 21: r; Veronica austriaca 20: r, 23: +; V. chamaedrys 3: +, 4: +; V. officinalis 35: 1; V. prostrata 25: +; V. teucrium 42: +. E0: Brachythecium oxycladum 47: +; Bryoerythrophyllum recurvirostrum 25: +; Bryum capillare 4: +, 48: +; Collema auriforme 20: +; C. crispum 27: 1; Ctenidium molluscum 32: 1, 46: 3; Dermatocarpon miniatum 33: +; Didymodon acutus 28: +; D. ferrugineus 10: +; Diploschistes muscorum 3: +, 33: +; Distichium capillaceum 14: +, 32: +; Eurhynchium crassinervium 51: a; E. hians 51: 1; Grimmia tergestina 14: +; Hylocomium splendens 46: +; Lecania sp. 3: +; Lepraria sp. 31: +, 33: +; Leptogium schraderi 27: +; Leucodon sciuroides 29: +; Orthotrichum cupulatum 2: a, 5: 1; Peltigera canina 4: a; P. praetextata 48: a; P. sp. 22: 1, 35: +; Plagiochila porelloides 46: +; Plagiomnium cuspidatum 49: +; P. rostratum 51: 1; P. undulatum 47: +; Seligeria donniana 51: +; Solorina saccata 32: +; Thuidium delicatulum 32: 1, 47: 3; Toninia diffracta 3: +; Tortella inclinata 10: 1; Weissia condensa 3: +.*

Supplement S3. Communities of the class *Festuco-Brometea.*

Beilage S3. Gesellschaften der Klasse *Festuco-Brometea.*

1-10: *Campanulo divergentiformis-Festucetum pallentis*
11-42: *Orthantho luteae-Caricetum humilis*
43: Transitional relevé between *Orthantho luteae-Caricetum humilis* and *Convallario majalis-Calamagrostietum variae*
44-49: Transitional relevés between *Orthantho luteae-Caricetum humilis* and *Pulsatillo slavicae-Caricetum humilis*

Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	44	45	46	47	48	49
Campanulo divergentiformis-Festucetum pallentis																																																		
Festuca pallens	3	3	3	b	b	b	3	3	4	+	1	+	+	+	.	.	a	a	b	+	+	+	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		b	+	.	b	1	+
Campanula sibirica	+	+	.	.	r	+	.	.	.	+	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	+	+	+	r	.	.		+	.	.	r	+	.
Cyanus triumfettii	.	.	+	.	+	+	r	.	+	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	+	.	.	.	+	+	r	+	.	.	.	.	.	.	.	.	.	.		1	+	+	.	.	.
Orthantho luteae-Caricetum humilis																																																		
Carex humilis	.	.	1	+	+	+	a	.	a	.	3	4	4	4	3	3	4	3	a	4	4	3	4	3	3	3	4	4	3	4	3	3	4	4	4	3	3	3	3	5	4	4	1		1	a	3	3	3	3
Hippocrepis comosa	+	+	.	.	.	.	.	1	.	b	.	.	+	r	.	a	b	1	+	.	+	+	+	+	.	.	.	1	+	.	.	1	a	.	+	1	+	a	+	1	1	+	.		.	.	a	1	b	+
Colymbada scabiosa	+	.	+	+	.	.	+	.	.	r	.	r	+	+	.	+	+	.	.	.	.	r	r	+	.	r	+	.	.	.	.	.	1	+	+	+	+	+	+	r	.	+	+		+	.	.	.	.	.
Pimpinella saxifraga	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	.	.	.	.	1		.	.	+	+	.	.
Knautia kitaibelii	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	.	.	.	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.		.	+	+	+	.	+
Bromus monocladus	.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	1	+	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	a	.	a	a	.	.	.	.		+	.	+	.	.	.
Leucanthemum vulgare agg.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	+	.	+
Carlina acaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r		.	.	+	+	+	.
Linum catharticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+		.	.	.	.	.	.
Bromo pannonici-Festucion pallentis																																																		
Linum tenuifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.		.	.	.	.	.	.
Allium flavum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.		.	.	.	.	.	.
Melica ciliata	.	.	.	.	.	.	1	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Stipo pulcherrimae-Festucetalia pallentis																																																		
Anthericum ramosum	+	.	+	1	+	+	+	+	+	+	a	+	1	1	+	.	1	a	1	+	b	a	b	a	a	+	+	1	.	b	3	+	1	1	1	+	+	1	1	+	.	1	a		1	1	+	a	1	.
Leontodon incanus	1	+	.	+	.	+	+	+	1	+	.	+	+	+	1	+	1	+	1	+	1	1	+	+	+	+	+	a	+	+	+	a	1	.	.	+	+	+	+	+	+	.	+		.	1	+	+	.	.
Helianthemum grandifl. ssp. *obscurum*	+	+	.	+	.	.	+	.	1	+	.	+	+	+	+	1	+	1	+	+	+	+	+	+	+	.	.	+	+	.	.	+	+	.	1	+	1	+	+	+	+	1	+		1	+	+	1	+	+
Teucrium montanum	+	+	.	1	+	1	1	.	.	+	1	1	1	a	1	.	.	+	+	+	+	+	+	1	1	1	+	.	+	.	.	+	1	.	.	.	.	1	1	+	+	1	.		.	+	+	1	1	+
Inula ensifolia	.	.	+	.	.	1	.	.	+	.	b	.	a	a	+	.	+	.	.	.	+	a	1	1	a	1	1	.	+	+	.	.	.	b	a	+	1	+	+	+	1	a	.		.	.	.	.	.	.
Bupleurum falcatum	.	.	.	+	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Festuco-Brometea																																																		
Teucrium chamaedrys	+	+	+	+	.	+	1	.	1	+	1	a	1	+	+	+	1	1	+	.	+	1	a	1	1	+	+	+	+	+	+	+	1	a	.	1	1	a	1	a	a	b	+		.	+	1	+	+	+
Tithymalus cyparissias	.	+	.	+	+	.	+	r	+	.	+	+	+	.	+	.	1	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	.	.	+	+	+	.	+	+	+	.		.	+	+	+	1	+
Asperula cynanchica	.	+	.	.	+	+	.	.	.	+	+	+	+	a	+	.	+	+	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+		.	+	.	+	+	+
Anthyllis vulneraria	+	.	.	.	.	.	.	+	.	+	.	.	.	+	.	+	+	+	.	.	+	1	1	+	+	+	+	b	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.		.	.	+	+	.	.
Epipactis atrorubens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	+	.	+	+	r	+	r	r	.	+	r	+	+	.	.	.	.	+	.	.	.	.	r	.	+		.	.	.	.	.	.
Dianthus carthusianorum agg.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	+	+	+	+	+		+	.	.	+	+	.
Sanguisorba minor	+	.	.	.	.	.	.	.	+	1	.	.	.	r	.	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	1	+	+	.		.	.	.	.	+	1
Securigera varia	.	r	+	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	+	1	1		.	+	+	.	.	.
Galium glaucum	.	.	1	1	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	+	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	+	.	.
Scabiosa ochroleuca	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	1	+	+	.	.	.	+	.		.	.	.	.	.	.
Tithymalus epithymoides	+	+	+	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.		+	.	.	.	.	.
Acosta rhenana	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	+	+	+	+	.		.	.	.	.	.	.
Arabis hirsuta agg.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.		.	.	.	.	.	.
Pilosella bauhinii	.	r	.	.	.	.	.	+	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Fragaria viridis	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.		.	.	.	.	.	.
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Elyno-Seslerietea																																																		
Sesleria albicans	.	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	a	.	+	+	b	b	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		3	4	3	+	1	3
Polygala amara ssp. *brachyptera*	.	+	.	.	.	r	.	+	+	.	.	.	+	.	.	.	+	.	.	+	+	+	+	+	.	.	+	+	+	1	.	.	.	.	.	.	.	.	.	.	+	.	+		+	+	+	+	+	+
Minuartia langii	.	.	.	.	+	1	+	+	+	+	+	+	.	.	+	.	.	.	+	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.		.	+	.	+	+	.
Pulsatilla subslavica	.	.	.	.	.	r	.	.	.	+	.	.	.	r	+	.	.	.	.	1	a	.	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		b	+	+	+	1	+
Thymus pulcherrimus	.	.	1	.	.	.	+	+	.	.	1	.	.	.	.	.	.	.	.	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.		.	+	.	.	+	1
Campanula xylocarpa	+	+	+	+	+	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.		+	+	.	.	.	.
Acinos alpinus	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	+	.	.		.	.	.	+	+	+
Allium ochroleucum	.	.	.	+	.	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.		.	.	.	.	.	.
Pulsatilla slavica	r	.	+	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Carduus glaucinus	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.		+	.	.	.	.	.
Kernera saxatilis	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Hieracium bupleuroides	+	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.
Scabiosa lucida	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Phyteuma orbiculare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	+	+	.	.	r
Sedo-Scleranthetea																																																		
Asplenium ruta-muraria	+	+	+	+	+	+	+	.	.	+	r	+	+	+	.	.	.	.	.	+	.	.	.	+	.	+	r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.		+	r	.	+	.	.
Jovibarba globifera	1	+	+	+	+	r	+	.	+	1	.	+	.	+	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.		+	.	.	+	.	1
Sedum album	+	1	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Other species																																																		
Vincetoxicum hirundinaria	+	.	1	1	1	.	1	.	+	+	.	3	a	+	r	.	+	+	+	+	1	.	+	+	+	+	+	+	+	+	+	1	+	.	.	.	+	.	.	+	+	+	+		1	+	1	1	b	+
Thalictrum minus	1	.	.	.	+	+	+	.	+	1	+	+	1	+	+	.	+	+	+	1	+	+	1	+	1	1	1	.	.	1	+	.	.	.	.	.	+	.	.	.	.	.	.		.	.	+	+	1	a
Seseli osseum	+	+	+	a	1	1	+	+	.	+	+	+	.	+	+	.	.	+	+	.	+	+	+	+	.	+	.	.	.	.	.	+	+	.	.	.	+	.	.	.	+	.	.		+	+	.	+	+	.
Genista pilosa	+	+	.	.	.	.	.	a	+	.	.	.	.	+	.	.	+	+	+	.	b	+	+	+	+	+	+	a	b	+	.	+	1	b	b	a	.	.	a	.	+	.	a		.	.	+	.	.	.
Erysimum odoratum	.	+	.	.	.	.	+	.	+	.	.	.	.	+	.	.	r	+	+	.	.	.	.	.	+	.	r	.	.	+	.	+	+	.	+	.	.	+	.	+	r	+	+		r	.	.	.	.	.
Calamagrostis varia	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	+	1	+	+	.	.	+	1	+	+	.	.	1	b	.	+	.	.	.	.	1	1	.	4		.	+	.	.	.	.
Salvia verticillata	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	r	+	.	.	+	b	+	+	+	+	a	+	.	+	+		.	.	.	.	.	.
Allium sp.	+	+	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.		+	+	+	+	+	.
Sorbus aria	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.	.	.	.	a	.	a	.	r	r	r	r	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.		r	r	r	.	.	r
Cardaminopsis arenosa	.	+	r	.	.	.	.	.	.	+	+	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.		r	.	.	.	.	+
Poa molinerii	+	.	.	.	.	.	.	+	.	3	.	.	.	.	.	a	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	a	.	.	.	.	a	.	.	+	+	.	.		.	.	.	.	.	.
Polygonatum odoratum	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	r	.	+	.	.	.	.	+	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.		.	.	.	+	.	+	.
Prunella grandiflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	+	+	.	.	.	.	.	1	.	.	.	.	1	a	.	.	1	.		.	.	.	.	.	.
Laserpitium latifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	+	.	.	1	+	+	r	.	.	.	.	.	.	.	.	.	.		.	+	.	.	.	.
Thymus sp.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		+	.	.	+	.	.
Carlina vulgaris agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	+		.	.	.	.	.	.
Viola hirta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	.	+	+	.	.	.		.	.	.	.	.	.
Campanula rapunculoides	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Verbascum sp.	.	+	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.		.	.	.	+	.	.
Geranium sanguineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	.		.	.	.	.	.	.
Lembotropis nigricans	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Pinus sylvestris	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	r	.	.	.	.	.	.	1		.	.	.	.	.	.
Verbascum chaixii ssp. austriacum	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	+	.		.	.	.	.	.	.
Filipendula vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Platanthera bifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	+
Asperula tinctoria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Peucedanum cervaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Galium album s.str.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	+	.		.	.	.	.	.	.
Clinopodium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.	.	.	.		.	.	.	.	.	.
Juniperus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.	.	+		.	.	.	.	.	.
Allium senescens ssp. *montanum*	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Hypericum perforatum	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.		.	.	.	.	.	.
Chamaecytisus hirsutus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Hieracium sp.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Origanum vulgare	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+		.	.	.	.	.	.
Rosa canina agg.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	+	.	.
Silene donetzica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.		.	.	.	.	.	.
Potentilla sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Achillea millefolium agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+		.	.	.	.	.	.
Inula salicina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.	.	.	.	.	.	.	.		.	.	1	.	.	.
Pyrethrum corymbosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	1	.	.		.	.	.	.	.	.
Potentilla arenaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.		.	.	.	.	.	.
Bothriochloa ischaemum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.		.	.	.	.	.	.
Bryophytes and lichens																																																		
Tortella tortuosa	a	a	a	b	b	a	a	+	a	3	a	b	1	1	+	.	4	+	.	1	a	.	.	.	.	.	.	.	.	.	1	b	a	.	b	3	3	b	b	+	1	.	.		a	+	b	3	a	b
Ditrichum flexicaule	.	.	+	+	.	.	.	+	.	1	.	.	.	+	.	+	.	1	b	.	a	1	.	.	.	.	.	3	.	a	.	.	+	.	.	.	.	.	.	+	+	.	.		+	1	+	+	+	a
Cladonia pyxidata	.	.	.	.	.	.	.	.	.	a	.	+	.	.	.	+	.	.	.	+	a	.	1	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.		+	+	+	+	1	a
Tortella inclinata	.	a	.	.	.	.	.	4	.	.	.	.	.	.	.	b	+	3	a	+	.	.	a	b	a	3	+	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Schistidium apocarpum	a	.	.	.	a	b	1	.	1	+	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	+
Cladonia symphycarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.	+	b	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	.	.		.	.	.	.	1	+
Bryum argenteum	+	.	1	+	+	a	a	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Thuidium abietinum	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	a	a	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	b	.	.	.	1		.	.	.	.	.	.
Homalothecium philippeanum	+	.	1	1	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		+	.	.	.	1	.
Homalothecium lutescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		+	+	.	.	.	.
Encalypta streptocarpa	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Hypnum cupressiforme	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Weissia condensa	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Entodon concinnus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	b	.	.	.	.	.	.	.	.	1		.	.	.	.	.	.
Rhytidium rugosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	+	+	+	.

Species in less than 3 relevés:

E1: *Acer pseudoplatanus* 2: +, 43: +; *Aconitum anthora* 1: r, 5: +; *Achillea distans* 30: +, 33: +; *Ajuga genevensis* 40: r; *Arenaria serpyllifolia* agg. 2: +, 7: +; *Arrhenatherum elatius* 34: +; *Asplenium trichomanes* 3: r, 20: r; *A. viride* 48: +; *Aster alpinus* 20: +, 45: +; *A. amelloides* 34: +; *Betonica officinalis* 42: +; *Betula pendula* 8: r; *Brachypodium pinnatum* 35: +, 42: 1; *Campanula carpatica* 6: +, 44: +; *Carduus acanthoides* 10: r; *Carex caryophyllea* 10: 1, 41: +; *Chamaecytisus* sp. 33: r, 44: r; *Colchicum autumnale* 17: r, 40: r; *Convallaria majalis* 30: r; *Cornus mas* 30: r; *C. sanguinea* 18: r; *Cotoneaster* sp. 49: r; *C. tomentosus* 25: r; *Cuscuta epithymum* 13: +; *C.* sp. 39: +; *Daphne arbuscula* 45: +; *Digitalis grandiflora* 31: r; *Echium vulgare* 14: +, 38: +; *Erigeron acris* 29: +; *Euphrasia salisburgensis* 4: r, 13: +; *E.* sp. 7: +; *Fagus sylvatica* 2: +; *Festuca* sp. 16: +; *Frangula alnus* 26: r; *Fraxinus excelsior* 18: r; *Gentiana cruciata* 28: +, 36: r; *Gymnadenia conopsea* 43: +, 46: +; *Hieracium bifidum* 45: +; *Hylotelephium maximum* agg. 2: +, 3: r; *Knautia* sp. 44: +; *Lactuca perennis* 4: +; *Leontodon hispidus* 39: +, 43: +; *Lilium martagon* 27: r, 43: r; *Linum flavum* 32: +, 33: +; *Lotus corniculatus* 28: +; *Medicago falcata* 34: 1, 43: +; *Melampyrum cristatum* 15: +; *M. nemorosum* 32: +; *Melittis melissophyllum* 30: r; *Ophrys insectifera* 22: r; *Pilosella officinarum* 35: 1; *Plantago lanceolata* 16: +, 17: +; *Polygala comosa* 16: +; *Populus tremula* 36: r; *Potentilla heptaphylla* 18: +; *Primula veris* 43: +; *Pseudolysimachion orchideum* 42: +; *P. spicatum* 38: +; *Pteridium aquilinum* 30: +; *Pyrethrum clusii* 32: +, 44: r; *Quercus cerris* 33: r; *Q. petraea* agg. 28: r, 46: r; *Rosa pimpinellifolia* 13: r; *Rosa* sp. 17: r; *Salix caprea* 8: r; *Salvia pratensis* 30: r; *Saxifraga paniculata* 1: +, 3: +; *Scabiosa* sp. 28: +, 29: +; *Scorzonera austriaca* 45: +; *Sedum acre* 1: r, 10: +; *S. sexangulare* 34: +; *Senecio jacobaea* 43: r; *Silene vulgaris* 32: +, 34: +; *Sorbus torminalis* 30: +; *Spergularia rubra* 14: +; *Steris viscaria* 34: +; *Thesium alpinum* 45: +; *Thymus pulegioides* 33: +, 43: +; *Tilia cordata* 43: r; *Tithymalus tommasinianus* 34: +, 38: +; *Verbascum nigrum* 11: +, 13: +; *Veronica austriaca* 32: +; *V. prostrata* 16: +; *V. teucrium* 41: +. **E0:** *Aspicilia contorta* 19: +, 45: +; *Barbula unguiculata* 16: +; *Brachythecium albicans* 8: +; *Bryum caespiticium* 16: +, 18: +; *Caloplaca ammiospila* 48: 1, 49: 1; *C. cerina* var. *chloroleuca* 12: +; *Campylium chrysophyllum* 13: +; *Catapyrenium squamulosum* 18: b; *Cladonia arbuscula* 49: +; *C. fimbriata* 35: +; *C. furcata* 34: +, 43: +; *C.* sp. 3: 1, 14: +; *C. subulata* 21: +; *Didymodon acutus* 16: +; *Encalypta vulgaris* 2: +; *Fissidens dubius* 21: 1; *Fissidens* sp. 39: +; *Grimmia* sp. 15: +; *Hypogymnia physodes* 19: +; *Lecanora argentata* 19: +; *Leptogium lichenoides* 20: +; *Lepraria* sp. 44: +; *Leucodon sciuroides* 33: +; *Mycobilimbia sabuletorum* 44: +, 48: 1; *Peltigera rufescens* 19: +, 49: +; *Physcia adscendens* 18: +; *P. stellaris 18: +; Protoblastenia rupestris 19: +; Psora decipiens 20: +; Racomitrium canescens 49: 1; Thuidium delicatulum 34: a, 43: 4; Toninia sedifolia 49: +; Tortula ruralis 16: +; Verrucaria sp. 49: +.*

Supplement S1. Comparison of pioneer vegetation, dry, rocky, and mesic grassland communities recorded in Muránska planina Mts. Constancies ≥ 20% are in bold.

Beilage S1. Gekürzte Stetigkeitstabelle der Pioniervegetation, (Fels-)Trockenrasen und Frischwiesen im Untersuchungsgebiet (Muránska planina). Stetigkeiten ≥ 20% sind fett gedruckt.

1. *Pulsatillo slavicae-Caricetum humilis* (*Astero alpini-Seslerion calcariae* , *Elyno-Seslerietea*)
2. *Seslerio calcariae-Festucetum tatrae* (*Astero alpini-Seslerion calcariae* , *Elyno-Seslerietea*)
3. *Minuartio langii-Festucetum pallentis* (*Astero alpini-Seslerion calcariae* , *Elyno-Seslerietea*)
4. *Jovibarbo-Sedetum albi* (*Alysso alyssoidis-Sedion albi* , *Sedo-Scleranthetea*)
5. *Convallario majalis-Calamagrostietum variae* (*Calamagrostion variae* , *Mulgedio-Aconitetea*)
6. *Digitali ambiguae-Calamagrostietum arundinaceae* (*Calamagrostion arundinaceae* , *Mulgedio-Aconitetea*)
7. *Parietarion officinalis* (*Thlaspietea rotundifolii*)
8. *Orthantho luteae-Caricetum humilis* , *Campanulo divergentiformis-Festucetum pallentis* (*Bromo pannonici-Festucion* , *Festuco-Brometea*)
9. *Salvio verticillatae-Festucetum rupicolae* (*Bromion erecti* , *Festuco-Brometea*)
10. *Arrhenatherion elatioris* (*Molinio-Arrhenatheretea*)

Group No.	1	2	3	4	5	6	7	8	9	10
No. of relevés	48	10	10	45	6	6	5	65	30	40
Elyno-Seslerietea, Seslerietalia coeruleae										
Pulsatilla subslavica	**79**	**50**	10	.	.	.	.	**37**	.	.
Phyteuma orbiculare	**75**	**80**	10	.	.	**50**	.	5	.	3
Polygala amara ssp. *brachyptera*	**67**	**100**	**40**	7	17	**33**	.	**40**	10	.
Thymus pulcherrimus	**60**	**60**	**20**	7	17	.	.	**31**	.	.
Saxifraga paniculata	**54**	**80**	**70**	.	.	.	.	18	.	.
Thesium alpinum	**31**	**20**	.	2	.	.	.	5	.	.
Gentiana clusii	21	.	.	.	.	.	.	.	.	.
Euphrasia salisburgensis	15	**30**	**20**	2	.	.	.	5	.	.
Ranunculus breyninus	10	**30**	.	.	.	.	.	.	.	.
Scabiosa lucida	4	**20**	**20**	11	17	**33**	.	8	13	.
Carduus glaucinus	2	.	**40**	4	.	.	.	11	.	.
Astero alpini-Seslerion calcariae										
Sesleria albicans	**100**	**70**	**60**	.	.	**33**	.	**43**	.	.
Kernera saxatilis	**46**	.	.	.	.	.	.	8	.	.
Primula auricula	**63**	**30**	**20**	.	.	.	.	6	.	.
Minuartia langii	**29**	10	10	4	.	.	.	**37**	.	.
Dianthus praecox	**25**	**60**	.	.	.	.	.	.	.	.
Allium senescens ssp. *montanum*	8	.	.	11	**33**	.	.	18	.	.
Pulsatillo slavicae-Caricetum humilis										
Daphne arbuscula	**100**	**30**	.	.	.	.	.	8	.	.
Campanula xylocarpa	**38**	10	**60**	7	**50**	**50**	.	**37**	.	.
Allium ochroleucum	19	.	10	7	17	.	.	**22**	.	.
Pulsatilla slavica	15	.	.	.	.	.	.	14	.	.
Rhodax rupifragus	15	.	.	.	.	.	.	.	.	.
Seslerio calcariae-Festucetum tatrae										
Festuca tatrae	19	**100**	**20**	.	.	17	.	.	.	.
Carex ornithopoda	15	**30**	.	.	.	.	.	10	.	.
Asplenium viride	8	**20**	.	2	.	17	.	2	.	.
Campanula cochleariifolia	10	**20**	.	.	.	.	.	.	.	.
Minuartio langii-Festucetum pallentis										
Seseli osseum	**63**	**30**	**40**	**31**	.	.	.	**65**	.	.
Acinos alpinus	4	.	**30**	11	.	.	.	**28**	7	.
Campanula carpatica	6	.	**20**	11	.	.	.	3	.	.
Hieracium bupleuroides	19	10	**30**	2	.	.	.	8	.	.
Libanotis pyrenaica	.	.	**20**	9	.	.	.	.	.	.
Sedo-Scleranthetea, Jovibarbo-Sedetum albi										
Sedum album	.	.	.	**87**	.	.	**20**	**26**	7	.
Jovibarba globifera	**56**	**40**	**60**	**56**	.	.	.	**49**	.	.
Sedum acre	.	.	.	**40**	.	.	**20**	3	.	.
Asplenium ruta-muraria	**67**	**40**	**90**	**40**	.	.	.	**51**	.	.
Hylotelephium maximum agg.	.	**20**	.	**36**	.	**50**	**40**	3	.	.
Arenaria serpyllifolia agg.	.	10	.	**22**	.	.	.	5	**20**	3
Mulgedio-Aconitetea,										
Convallario majalis-Calamagrostietum variae										
Calamagrostis varia	13	**20**	.	**22**	**100**	.	.	**29**	3	.
Convallaria majalis	4	10	10	4	**67**	17	.	3	10	.
Polygonatum odoratum	**21**	10	.	7	**67**	.	.	**28**	7	.
Melampyrum nemorosum	4	.	.	.	**33**	.	.	3	.	.
Pimpinella major	.	.	.	2	**33**	.	.	.	3	10
Chamaecytisus hirsutus	17	.	.	2	**33**	.	.	17	.	.
Melittis melissophyllum	.	.	.	.	**33**	.	.	2	.	.
Aquilegia vulgaris	.	.	.	.	**33**	17	.	.	10	.
Astrantia major	.	.	.	2	**33**	.	.	.	.	.
Cuscuta epithymum	.	.	.	.	**33**	.	.	2	.	.
Aster amelloides	.	.	.	11	**33**	.	.	5	.	.
Digitali ambiguae-Calamagrostietum arundinaceae										
Calamagrostis arundinacea	.	.	10	.	.	**100**	.	.	.	.
Gentiana asclepiadea	.	.	.	.	17	**100**	.	.	.	.
Valeriana tripteris	6	.	.	.	17	**100**	.	.	.	.
Dryopteris filix-mas	.	.	.	.	.	**83**	.	.	.	.
Geranium sylvaticum	.	.	.	.	.	**83**	.	.	.	3
Polygonatum verticillatum	.	.	.	.	17	**83**	.	.	3	.
Mercurialis perennis	.	10	.	.	.	**67**	.	.	.	.
Luzula luzuloides	.	.	.	.	.	**67**	.	.	.	.
Ranunculus platanifolius	.	.	.	.	.	**67**	.	.	.	.
Epilobium montanum	.	.	.	.	.	**50**	.	.	.	.
Rubus saxatilis	2	10	.	.	17	**50**	.	.	.	.
Knautia maxima	.	.	.	.	17	**50**	.	.	3	3
Viola biflora	.	.	.	.	.	**50**	.	.	.	.
Rosa pendulina	2	.	.	2	.	**50**	.	.	.	.
Pulmonaria obscura	.	.	.	.	17	**50**	.	.	.	.
Rubus idaeus	.	.	10	2	.	**50**	.	.	.	.
Sorbus aucuparia	6	10	.	.	.	**50**	.	.	.	.
Senecio fuchsii	.	.	.	.	.	**33**	.	.	.	.
Silene dioica	.	.	.	.	.	**33**	.	.	.	.
Solidago virgaurea	2	.	.	2	17	**33**	.	.	.	3
Aconitum variegatum	.	.	10	.	17	**33**	.	.	.	.
Vaccinium myrtillus	2	.	.	.	.	**33**	.	.	.	.
Milium effusum	.	.	.	.	.	**33**	.	.	.	.
Cardaminopsis halleri	.	.	.	.	.	**33**	.	.	.	5
Phyteuma spicatum	.	.	.	.	.	**33**	.	6	.	3
Urtica dioica	.	.	.	.	.	**33**	.	.	.	3
Gymnocarpium dryopteris	.	.	.	.	.	**33**	.	.	.	.
Daphne mezereum	.	.	.	.	17	**33**	.	.	.	.
Lilium martagon	2	.	.	.	17	**33**	.	3	.	.
Viola tricolor agg.	2	10	.	2	.	**33**	.	.	.	10
Thlaspietea rotundifolii, Parietarion officinalis										
Geranium robertianum	.	10	10	20	.	.	**100**	.	.	.
Parietaria officinalis	.	.	.	.	.	.	**20**	.	.	.
Arabis turrita	.	.	.	9	.	.	**60**	2	.	.
Campanula trachelium	.	.	10	7	17	.	**40**	.	.	.
Alliaria petiolata	.	.	.	.	.	.	**40**	.	.	.
Mycelis muralis	.	.	10	4	.	.	**40**	.	.	.
Lamium maculatum	.	.	.	2	.	.	**40**	.	.	.
Carduus collinus	.	.	.	13	.	.	**20**	.	.	.
Valeriana stolonifera ssp. *angustifolia*	.	.	.	2	.	.	**20**	.	.	.
Fallopia convolvulus	.	.	.	4	.	.	**20**	2	.	.
Acer pseudoplatanus	8	10	10	4	17	17	**20**	3	17	10
Lathyrus vernus	.	10	.	.	17	17	**20**	.	.	.
Hedera helix	.	.	.	.	.	.	**20**	.	.	.
Cortusa matthioli	.	.	.	.	.	.	**20**	.	.	.
Lapsana communis	.	.	.	2	.	.	**20**	.	.	.
Prunus mahaleb	4	.	.	7	.	.	**20**	5	.	.
Lunaria rediviva	.	.	.	.	.	.	**20**	.	.	.
Cornus sanguinea	.	.	.	4	17	.	**20**	2	.	.
Festuco-Brometea										
Teucrium chamaedrys	10	.	10	**31**	**67**	.	.	**82**	**33**	.
Tithymalus cyparissias	**33**	**20**	**20**	13	17	.	.	**80**	**20**	3
Asperula cynanchica	**56**	**30**	10	18	**50**	.	.	**63**	7	.
Securigera varia	6	**30**	**30**	**27**	**67**	.	**20**	**29**	**83**	**20**
Dianthus carthusianorum agg.	6	10	**20**	**38**	**33**	.	.	**37**	**50**	3
Anthyllis vulneraria	19	**40**	.	7	.	.	.	**31**	**60**	8
Sanguisorba minor	.	.	**20**	18	17	.	.	**25**	**63**	10
Plantago media	.	.	.	2	.	.	.	6	**73**	**45**
Salvia pratensis	.	.	.	2	.	.	.	3	**90**	**20**
Carex caryophyllea	.	.	.	.	.	.	.	3	**70**	15
Fragaria viridis	.	.	10	.	17	.	.	6	**53**	8
Galium verum	.	.	.	.	.	.	.	.	**47**	**28**
Scabiosa ochroleuca	.	.	.	2	.	.	17	**33**	.	.
Medicago falcata	.	.	.	.	.	.	3	**43**	10	.
Stipo pulcherrimae-Festucetalia pallentis										
Carex humilis	**56**	.	10	4	17	.	.	**89**	.	.
Helianthemum grandiflorum ssp. *obscuru*	**31**	.	.	**20**	**33**	17	.	**78**	**20**	5
Anthericum ramosum	**29**	.	.	16	**67**	.	.	**85**	17	.
Leontodon incanus	**31**	.	10	11	.	.	.	**72**	3	.
Teucrium montanum	**23**	.	10	9	.	.	.	**68**	.	.
Inula ensifolia	**21**	.	.	4	17	.	.	**43**	3	.
Bupleurum falcatum	17	.	**30**	**29**	**67**	.	.	18	.	.
Bromo pannonici-Festucion pallentis										
Festuca pallens	**60**	**40**	**100**	**29**	**33**	.	.	**63**	.	.
Campanula sibirica	2	.	.	**20**	17	.	.	**40**	.	.
Allium flavum	8	.	.	9	.	.	.	17	.	.
Melica ciliata	.	.	.	18	17	.	.	14	.	.
Linum tenuifolium	.	.	.	.	.	.	.	12	.	.
Orthantho luteae-Caricetum humilis and Campanulo divergentiformis-Festucetum pallentis										
Colymbada scabiosa	.	.	10	7	33	.	.	**54**	**37**	15
Hippocrepis comosa	4	.	.	2	.	.	.	**51**	**20**	.
Cyanus triumfettii	19	.	10	2	17	.	.	**38**	.	.
Galium glaucum	15	.	.	2	.	.	.	**29**	.	.
Epipactis atrorubens	6	10	.	2	17	.	.	**25**	.	.
Tithymalus epithymoides	4	.	.	11	17	.	.	**22**	.	.
Knautia kitaibelii	.	.	.	.	.	.	.	17	7	.
Bromus monocladus	.	.	.	.	.	.	.	17	.	5

Group No.	1	2	3	4	5	6	7	8	9	10
No. of relevés	48	10	10	45	6	6	5	65	30	40
Bromion erecti, Salvio verticillatae-Festucetum rupicolae										
Pimpinella saxifraga	6	.	**20**	9	.	.	.	18	**93**	**55**
Lotus corniculatus	.	10	10	4	.	.	.	2	**90**	**60**
Leucanthemum vulgare agg.	8	.	.	4	17	.	.	12	**80**	**80**
Festuca rupicola	.	.	.	2	.	.	.	.	**63**	10
Arabis hirsuta agg.	.	10	10	11	.	17	.	11	**57**	5
Linum catharticum	.	10	10	.	.	.	.	8	**57**	8
Silene nutans	.	.	.	.	.	.	.	.	**53**	3
Thymus pulegioides	6	.	.	2	.	.	.	3	**53**	10
Bromus erectus	.	.	.	.	.	.	.	.	**50**	8
Potentilla heptaphylla	.	.	.	4	.	.	.	2	**47**	5
Polygala comosa	.	.	.	.	.	.	.	2	**43**	10
Trifolium montanum	.	.	.	.	.	.	.	.	**40**	18
Pilosella officinarum	.	.	.	4	.	.	.	2	**33**	.
Primula veris	.	.	.	.	.	.	.	3	**33**	10
Briza media	.	.	10	.	.	.	.	.	**33**	**25**
Carlina acaulis	.	10	**20**	.	.	.	.	11	**30**	13
Potentilla collina	.	.	.	.	.	.	.	.	**23**	.
Medicago sativa	.	.	.	.	.	.	.	.	**23**	13
Brachypodium pinnatum	.	.	10	2	**33**	.	.	5	**23**	.
Carex tomentosa	.	.	.	.	.	.	.	.	**23**	5
Carex muricata agg.	.	10	.	.	.	.	.	.	**20**	.
Tithymalus esula	.	.	.	.	.	.	.	.	**20**	8
Carex pallescens	.	.	.	.	.	.	.	.	**20**	18
Molinio-Arrhenatheretea										
Trifolium pratense	.	.	.	.	.	17	.	.	**77**	**100**
Plantago lanceolata	.	.	.	4	.	.	.	3	**90**	**73**
Trifolium repens	.	.	.	4	.	.	.	.	**57**	**100**
Acetosa pratensis	.	.	.	.	.	.	.	.	**47**	**90**
Ranunculus acris	.	.	.	.	.	.	.	.	**33**	**90**
Festuca pratensis	.	.	.	.	.	.	.	.	**57**	**73**
Carum carvi	.	.	.	.	.	.	.	.	7	**58**
Lathyrus pratensis	.	.	.	.	.	.	.	.	17	**48**
Alopecurus pratensis	.	.	.	.	.	.	.	.	3	**33**
Rhinanthus minor	.	.	10	.	.	.	.	.	**53**	**45**
Arrhenatherion elatioris										
Alchemilla spec. div.	.	.	.	.	.	.	.	.	13	**83**
Phleum pratense	.	.	.	.	.	.	.	.	17	**60**
Tragopogon orientalis	.	.	.	2	.	.	.	.	17	**53**
Lychnis flos-cuculi	.	.	.	.	.	.	.	.	.	**38**
Vicia sepium	.	.	.	.	.	.	.	.	3	**35**
Ranunculus repens	.	.	.	.	.	.	.	.	.	**33**
Poa trivialis	.	.	.	.	.	.	.	.	.	**28**
Lysimachia nummularia	.	.	.	.	.	.	.	.	3	**28**
Thlaspi caerulescens	.	.	.	.	.	.	.	.	7	**25**
Anthriscus sylvestris	.	.	.	2	.	.	.	.	.	**23**
Ranunculus auricomus agg.	.	.	.	.	.	.	.	.	.	**20**
Holcus lanatus	.	.	.	.	.	.	.	.	10	**20**
Pastinaca sativa	.	.	.	.	.	.	.	.	10	**20**
Other species										
Carex digitata	8	**40**	.	.	.	**33**	.	.	3	.
Melica nutans	.	**30**	.	.	17	**50**	.	.	.	.
Hieracium bifidum	6	**20**	10	.	.	**50**	.	3	.	.
Polypodium vulgare	6	**20**	10	.	.	17	**20**	.	.	.
Viola hirta	10	10	**40**	9	.	17	.	17	**57**	13
Laserpitium latifolium	6	.	**30**	4	**50**	17	.	12	3	.
Centaurea montana	2	10	**20**	.	.	**50**	.	.	.	.
Spiraea media	.	.	.	4	**33**	.	**20**	2	.	.
Fraxinus excelsior	6	.	.	9	**33**	.	**20**	3	.	8
Silene vulgaris	.	.	.	7	**33**	.	.	5	**43**	10
Cirsium eriisithales	.	.	.	.	**33**	**83**	.	.	3	10
Fagus sylvatica	8	.	.	.	2	**33**	.	**20**	2	3
Picea abies	10	.	.	.	.	**33**	**33**	.	.	3
Hypericum maculatum	.	.	10	.	.	.	**83**	.	.	13
Poa nemoralis	2	10	10	11	17	**33**	**40**	2	.	.
Lonicera xylosteum	.	.	.	.	.	17	**33**	**20**	.	.
Salvia verticillata	2	.	.	11	.	.	.	**23**	**67**	5
Prunella vulgaris	.	.	.	.	.	.	.	.	**30**	**23**
Campanula rapunculoides	.	.	**30**	9	**33**	17	**20**	11	**30**	**28**
Origanum vulgare	.	**20**	10	**24**	**50**	**33**	**20**	8	17	5
Digitalis grandiflora	2	**20**	**20**	16	**83**	**83**	**20**	2	.	.
Erysimum odoratum	19	**20**	**20**	24	.	.	**20**	**43**	.	.
Achillea distans	.	**40**	**40**	4	**33**	**67**	**20**	3	.	.
Cardaminopsis arenosa	8	**60**	**70**	27	**33**	**33**	**40**	**22**	10	3
Clematis alpina	10	**30**	**20**	.	.	**83**	**20**	.	.	.
Sorbus aria	**27**	**30**	10	9	**33**	.	.	**23**	.	.
Vincetoxicum hirundinaria	**35**	.	.	**40**	**83**	.	.	**77**	7	.
Genista pilosa	**42**	10	**30**	9	.	.	.	**54**	.	.
Hieracium murorum	**25**	.	.	.	**33**	**33**	.	.	.	.
Melampyrum sylvaticum	**21**	**20**	.	.	17	**50**	.	.	.	.
Galium mollugo agg.	2	**30**	10	.	.	17	.	6	**57**	**68**
Hypericum perforatum	.	**20**	.	7	17	.	20	6	**30**	3
Asplenium trichomanes	15	**20**	10	**20**	.	.	20	3	.	.
Cystopteris fragilis	6	**20**	**30**	7	.	17	20	.	.	.
Galium schultesii	.	**20**	**20**	.	17	**83**	.	.	.	.
Fragaria vesca	.	10	**30**	**20**	17	**100**	.	.	3	5
Galium album s.str.	.	.	10	**53**	**67**	.	**40**	6	.	.
Thalictrum minus	8	.	.	7	**83**	**50**	.	**58**	.	.
Clinopodium vulgare	.	.	.	2	**50**	17	**20**	6	**20**	.
Primula elatior	.	.	.	.	**33**	**50**	.	.	.	**20**
Heracleum sphondylium	.	10	10	.	17	**67**	20	.	.	**38**
Dactylis glomerata	.	.	.	.	17	**33**	.	.	**90**	**100**
Achillea millefolium agg.	.	.	.	11	.	.	.	5	**93**	**95**
Trisetum flavescens	.	.	.	.	.	.	.	.	**83**	**93**
Vicia cracca	.	.	.	.	.	.	.	.	**57**	**93**
Taraxacum sect. *Ruderalia*	.	.	.	4	.	.	.	.	**90**	**88**
Poa pratensis	.	.	.	.	.	.	.	.	**70**	**88**
Veronica chamaedrys	.	.	.	7	.	17	.	.	**77**	**88**
Arrhenatherum elatius	.	.	.	7	.	.	.	2	**77**	**83**
Avenula pubescens	.	.	.	4	.	.	.	.	**80**	**78**
Festuca rubra agg.	.	.	.	.	.	.	.	.	**27**	**75**
Knautia arvensis	.	.	.	.	.	.	.	3	**73**	**70**
Stellaria graminea	.	.	.	.	.	.	.	.	**40**	**68**
Cruciata glabra	.	.	.	.	.	.	17	.	**57**	**68**
Crepis biennis	.	.	.	.	.	.	.	.	**40**	**65**
Leontodon hispidus	.	.	.	2	.	.	.	3	**83**	**60**
Cerastium holosteoides	.	.	.	.	.	.	.	.	**33**	**58**
Campanula patula	.	.	.	.	.	.	.	.	**23**	**58**
Colchicum autumnale	.	.	.	.	.	.	.	3	**63**	**50**
Centaurea phrygia agg.	.	.	.	.	.	.	.	.	**33**	**48**
Glechoma hederacea	.	10	.	2	.	.	.	.	**27**	**45**
Agrostis capillaris	.	.	.	.	.	.	.	.	**30**	**43**
Anthoxanthum odoratum	.	.	.	.	.	.	.	.	**27**	**30**
Luzula campestris s. lat.	.	.	.	.	.	.	.	.	**33**	**30**
Ranunculus bulbosus	.	.	.	2	.	.	.	.	**80**	**28**
Agrimonia eupatoria	.	.	.	.	.	.	.	.	**47**	**25**
Medicago lupulina	.	.	.	.	.	.	.	.	**60**	**25**
Myosotis arvensis	.	.	.	2	.	.	.	.	**20**	**25**
Convolvulus arvensis	.	.	.	.	.	.	.	.	**27**	**25**
Daucus carota	.	.	.	.	.	.	.	.	**57**	**23**
Bryophytes and lichens										
Cladonia pyxidata	**33**	**40**	**40**	11	.	.	.	**37**	.	.
Tortella tortuosa	**90**	**90**	**100**	**53**	**67**	17	.	**77**	7	.
Homalothecium philippeanum	6	10	**20**	**22**	**33**	.	**20**	**22**	.	.
Rhytidium rugosum	**44**	**60**	**20**	.	.	.	.	8	3	.
Homalothecium sericeum	**31**	**20**	.	7	.	.	**20**	12	3	.
Plagiomnium cuspidatum	.	.	.	.	.	.	**20**	.	**40**	**35**
Cladonia squamosa	10	**40**	.	.	.	.	.	.	.	.
Hylocomium splendens	2	**20**	.	.	.	17	.	.	3	.
Polytrichum sp.	2	**20**	.	.	.	.	.	.	.	.
Tortula intermedia	2	.	**20**	2	.	.	.	3	.	.
Schistidium apocarpum	8	.	10	**38**	.	.	.	17	3	.
Tortula ruralis	2	.	10	**24**	.	.	.	2	7	.
Thuidium abietinum	.	.	.	**22**	.	.	.	12	.	.
Rhytidiadelphus triquetrus	6	10	.	2	**33**	.	.	.	3	.
Anomodon viticulosus	.	.	.	16	.	.	**40**	.	.	.
Porella platyphylla	2	.	.	7	.	.	**40**	2	.	.
Hypnum cupressiforme	17	10	.	7	.	.	**40**	12	.	.
Leskea polycarpa	.	.	.	4	17	.	**20**	5	.	.
Eurhynchium crassinervium	.	.	.	.	.	.	**20**	.	.	.
Seligeria donniana	.	.	.	.	.	.	**20**	.	.	.
Peltigera praetextata	.	.	.	.	.	.	**20**	.	.	.
Plagiomnium rostratum	.	.	.	.	.	.	**20**	.	.	.
Bryum capillare	.	10	.	2	.	.	**20**	.	.	.
Ditrichum flexicaule	8	.	10	4	17	.	.	**32**	.	.
Tortella inclinata	2	.	10	2	.	.	.	**20**	.	.
Brachythecium rutabulum	.	.	.	.	.	.	.	.	.	**25**
Plagiomnium affine	.	.	.	.	.	.	.	.	10	**20**
Thuidium delicatulum	.	.	.	2	17	.	.	3	**37**	15
Ditrichium flexicaule	**48**	**40**	10	.	.	.	.	15	.	.
Peltigera rufescens	.	**20**	**30**	9	.	.	.	5	.	.
Cladonia sp.	10	10	**20**	7	17	.	**20**	3	3	.
Bryum argenteum	.	10	10	**29**	.	.	.	**20**	.	.
Homalothecium lutescens	4	10	.	**20**	.	.	**40**	8	.	.
Eurhynchium hians	.	.	.	.	.	.	**20**	.	13	**20**
Rhytidiadelphus squarrosus	.	.	.	.	.	.	.	.	**20**	**28**
Brachythecium salebrosum	.	.	.	.	.	.	.	.	**43**	**28**
Abietinella abietina	2	10	.	2	.	.	.	2	**53**	**23**

Sources of relevés:
1: 30 – Valachovič & Jarolímek (1994), 6 – Valachovič & Mucina (2004), 3 – Uhlířová & Bernátová (2003), 9 – new relevés.
2: 9 – Valachovič & Mucina (2004), 1 – Valachovič & Jarolímek (1994).
3: 7 – Valachovič & Mucina (2004), 3 – new relevés.
4: 2 – Hrivnák (1997), 1 – Blanár & Letz (2005), 1 – Blanár (2005), 41 – new relevés.
5: 6 – new relevés.
6: 6 – Kliment (2004).
7. 5 – new relevés.
8. 5 – Blanár & Letz (2005), 3 – Valachovič & Mucina (2004), 7 – Uhlířová & Bernátová (2003), 1 – Blanár (2005), 42 – new relevés.
9. 30 – Ujházy et al. (2007).
10. 40 – Ujházy et al. (2007).

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Supplement S4. Comparison of *Carex humilis* -dominated grasslands belonging to the *Festuco-Brometea* and *Elyno-Seslerietea* classes.

Beilage S4. *Vergleich verschiedener Carex humilis-dominierter Rasengesellschaften der Klassen Festuco-Brometea und Elyno-Seslerietea.*

1. *Orthantho luteae-Caricetum humilis* (Supplement S3, relevés 11−42)
2. *Festuco pallentis-Caricetum humilis* (Hegedüšová Vantarová & Škodová 2014)
3. *Orthantho luteae-Caricetum humilis* (Hegedüšová Vantarová & Škodová 2014)
4. *Poo badensis-Caricetum humilis* (Hegedüšová Vantarová & Škodová 2014)
5. *Pulsatillo slavicae-Caricetum humilis* (Tab. 1, relevés 1−9)
6. *Saxifrago paniculatae-Seslerietum cearuleae* (Hegedüšová Vantarová & Škodová 2014)
7. *Pulsatillo slavicae-Caricetum humilis* (Kliment & Valachovič 2007)

Group No.	1	2	3	4	5	6	7
No. of relevés	32	99	30	64	9	20	43
Festuco-Brometea							
Tithymalus cyparissias	**84**	**68**	**73**	**78**	**78**	**80**	**88**
Teucrium chamaedrys	**94**	**59**	**87**	**89**	**44**	**45**	**35**
Asperula cynanchica	**59**	**65**	**53**	**69**	**33**	**35**	**51**
Sanguisorba minor	**28**	**90**	**73**	**34**	.	**30**	19
Potentilla arenaria	9	**58**	10	**100**	.	**25**	.
Anthyllis vulneraria	**44**	**45**	**63**	**42**	.	**30**	**30**
Scabiosa ochroleuca	**28**	**41**	**20**	**55**	.	.	2
Salvia pratensis	3	**23**	**70**	**61**	.	10	.
Securigera varia	**25**	**25**	10	16	11	**45**	**65**
Koeleria macrantha	.	**29**	**33**	**63**	.	5	.
Pilosella bauhinii	6	**45**	**30**	**28**	.	15	5
Acosta rhenana	**28**	**20**	.	**48**	.	.	.
Dianthus carthusianorum agg.	**28**	2	**50**	**20**	11	**35**	19
Bothriochloa ischaemum	9	**37**	13	.	.	.	.
Medicago falcata	3	10	**37**	31	.	.	2
Salvia verticillata	**44**	5	**33**	2	11	**20**	2
Carlina vulgaris	19	13	**20**	5	.	.	12
Plantago media	9	5	**67**	2	.	.	.
Thesium linophyllon	.	17	**23**	3	.	10	.
Carex caryophyllea	3	6	**30**	9	.	.	.
Fragaria viridis	9	2	10	11	.	.	.
Galium verum	.	1	**20**	2	.	.	.
Stipo pulcherrimae-Festucetalia pallentis							
Carex humilis	**100**	**100**	**100**	**100**	**100**	**30**	**100**
Anthericum ramosum	**91**	**63**	**77**	**52**	**78**	**75**	**100**
Teucrium montanum	**72**	**90**	**63**	**67**	**56**	**30**	**65**
Helianthemum nummularium agg.	**81**	**68**	**67**	**59**	**67**	**25**	**56**
Leontodon incanus	**88**	**65**	**67**	.	**89**	.	**58**
Inula ensifolia	**72**	**43**	**57**	**39**	**67**	**70**	**63**
Thymus praecox	.	**96**	**40**	**34**	.	5	7
Globularia punctata	.	**68**	**63**	3	.	.	.
Bupleurum falcatum	**16**	**28**	**20**	19	**44**	15	**21**
Rhodax canus	.	**34**	10	**41**	.	.	.
Bromo pannonici-Festucion pallentis							
Festuca pallens s. lat.	**34**	**82**	**20**	**75**	**67**	**65**	**53**
Linum tenuifolium	**25**	**81**	**37**	16	.	.	.
Melica ciliata	6	**39**	3	**73**	.	15	9
Allium flavum	9	**27**	.	**63**	.	10	2
Stachys recta	.	19	3	**61**	.	**25**	16
Stipa pulcherrima	.	**24**	7	**27**	.	5	.
Silene otites agg.	.	**30**	.	9	.	.	12
Draba lasiocarpa	.	10	.	.	.	5	.
Festuco pallentis-Caricetum humilis							
Fumana procumbens	.	**60**	.	.	.	.	.
Scorzonera austriaca	.	**57**	.	6	.	10	.
Jurinea mollis	.	**31**	.	9	.	.	.
Seseli hippomarathrum	.	17	.	.	.	.	.
Erysimum diffusum agg.	.	11	.	.	.	.	.
Hornungia petraea	.	10	.	.	.	.	.
Stipa eriocaulis	.	6	.	.	.	.	.
Orthantho luteae-Caricetum humilis							
Potentilla heptaphylla	3	**35**	**97**	.	.	10	9
Hippocrepis comosa	**69**	18	**87**	16	.	10	**37**
Pimpinella saxifraga	**22**	**23**	**70**	5	.	**20**	9
Brachypodium pinnatum	6	8	**63**	3	.	10	5
Lotus corniculatus	3	12	**60**	5	.	10	**26**
Colymbada scabiosa	**59**	8	**60**	14	.	10	**56**
Bromus monocladus	**22**	2	**57**	.	.	.	.
Festuca rupicola	.	3	**50**	6	.	5	2
Carlina acaulis	6	6	**47**	.	.	5	**30**
Knautia kitaibelii	19	2	**43**	.	.	.	**35**
Briza media	.	1	**40**	.	.	.	2
Leucanthemum vulgare agg.	13	.	**40**	.	11	**25**	**42**
Cirsium pannonicum	.	4	**37**	.	.	.	.
Linum catharticum	9	8	**33**	3	.	15	**26**
Ophrys insectifera	3	3	**27**	.	.	5	2
Trifolium montanum	.	.	**23**	.	.	.	.
Platanthera bifolia	9	1	**23**	.	**22**	10	5
Senecio umbrosus	.	.	**20**	.	.	.	.
Polygala major	.	2	**20**	2	.	.	.
Campanula sibirica	**25**	**28**	.	**83**	11	10	14
Eryngium campestre	.	17	.	**48**	.	.	.
Poa badensis	.	17	.	**42**	.	.	.
Diantho lumnitzeri-Seslerion							
Campanula rotundifolia agg.	16	**23**	3	9	**22**	**40**	7
Hieracium bupleuroides	6	3	.	2	11	**20**	**49**
Saxifrago paniculatae-Seslerietum caeruleae							
Vincetoxicum hirundinaria	**75**	**35**	**50**	**44**	**89**	**95**	**81**
Seseli osseum	**47**	**56**	**20**	**81**	**67**	**75**	**67**
Jovibarba globifera	16	**35**	**27**	**73**	**67**	**80**	**91**
Polygonatum odoratum	**25**	9	7	**22**	**67**	**60**	**81**
Cyanus triumfettii	**25**	4	7	5	**33**	**65**	**70**
Calamagrostis varia	**44**	.	7	.	.	**20**	**37**
Primula auricula	.	1	.	.	11	10	**42**
Saxifraga paniculata	.	.	.	3	11	**35**	**21**
Asplenium x alternifolium	.	6	3	**27**	.	**40**	.

Group No.	1	2	3	4	5	6	7
No. of relevés	32	99	30	64	9	20	43
Elyno-Seslerietea, Seslerietalia caeruleae							
Polygala amara	**38**	3	**23**	.	**67**	15	**30**
Thesium alpinum	.	4	.	.	**33**	15	**70**
Thymus pulcherrimus	**31**	1	.	.	**56**	5	**42**
Carduus glaucinus	9	1	13	.	11	15	**58**
Phyteuma orbiculare	.	6	17	.	**67**	5	**37**
Biscutella laevigata	.	13	.	.	.	**30**	7
Scabiosa lucida	3	.	3	.	.	**35**	**28**
Galium anisophyllon	.	.	.	.	.	.	**42**
Euphrasia salisburgensis	3	.	.	.	.	5	14
Ranunculus breyninus	.	.	.	.	.	5	14
Astero-Seslerion calcariae							
Sesleria albicans	**22**	15	**50**	2	**100**	**100**	**91**
Erysimum witmannii	.	3	**20**	.	.	**20**	**74**
Allium ochroleucum	13	5	17	.	.	.	**60**
Minuartia langii	**28**	4	17	.	**22**	**25**	**49**
Kernera saxatilis	16	4	.	.	**89**	5	**33**
Coronilla vaginalis	.	.	.	.	.	5	**30**
Festuca tatrae	.	.	.	.	.	**20**	**23**
Buphthalmum salicifolium	.	.	7	.	.	.	**23**
Acinos alpinus	**25**	15	**57**	.	.	10	19
Allium senescens ssp. *montanum*	6	**20**	17	6	11	10	16
Dianthus praecox	.	17	7	.	.	25	16
Rhodax rupifragus	.	.	.	.	**78**	5	16
Aster alpinus	3	1	.	.	.	**20**	12
Pulsatillo slavicae-Caricetum humilis							
Pulsatilla slavica	3	3	10	3	**78**	15	**93**
Thalictrum minus	**59**	4	7	**20**	.	5	**49**
Viola hirta	**22**	14	**53**	9	11	**40**	**35**
Daphne arbuscula	.	.	.	.	**100**	.	.
Other species up 20%							
Genista pilosa	**66**	**35**	**67**	5	**33**	15	**21**
Galium glaucum	**22**	8	3	**45**	**33**	**45**	12
Erysimum odoratum	**44**	4	3	**28**	**33**	10	.
Asplenium ruta-muraria	**28**	.	.	.	**56**	.	**49**
Sorbus aria agg.	**25**	.	.	.	11	.	**33**
Epipactis atrorubens	**47**	3	10	.	**22**	**20**	**33**
Pulsatilla subslavica	**28**	5	17	.	**67**	5	.
Laserpitium latifolium	**22**	.	.	.	.	10	**49**
Dorycnium pentaphyllum agg.	.	**47**	**33**	14	.	.	.
Pilosella officinarum	3	**36**	**20**	11	.	5	2
Genista germanica	.	**35**	**67**	5	.	15	.
Galium mollugo agg.	.	3	**43**	16	.	**35**	.
Asperula tinctoria	13	11	**27**	.	11	**20**	**79**
Origanum vulgare	3	.	**20**	**23**	.	15	**28**
Prunella grandiflora	**28**	.	17	2	.	.	7
Poa molinerii	**25**	.	.	.	.	.	.
Cardaminopsis arenosa agg.	**25**	2	7	3	.	15	**23**
Alyssum montanum	.	**65**	3	**36**	.	10	.
Arenaria serpyllifolia agg.	.	**24**	7	16	.	5	5
Stipa joannis	.	**23**	.	**22**	.	.	.
Linaria genistifolia	.	**21**	.	9	.	.	.
Stipa capillata	.	**21**	.	**25**	.	.	.
Juniperus communis	9	9	**33**	6	.	5	14
Plantago lanceolata	6	4	**23**	13	.	5	.
Achillea millefolium agg.	6	15	**20**	**34**	.	5	2
Thymus pannonicus	.	5	.	**48**	.	5	.
Acinos arvensis	.	19	3	**41**	.	5	.
Verbascum lychnitis	.	2	.	**41**	.	.	5
Lactuca perennis	.	1	.	**38**	.	10	7
Echium vulgare	6	17	7	**36**	.	10	.
Botriochloa ischaemum	.	.	.	**36**	.	.	.
Pseudolysimachion spicatum	3	10	3	**33**	.	.	2
Artemisia campestris	.	10	.	**31**	.	5	.
Hypericum perforatum	3	16	10	**30**	.	5	7
Sedum acre	.	12	3	**25**	.	10	.
Sedum sexangulare	3	17	17	**25**	.	5	.
Veronica austriaca	3	3	.	**22**	.	.	2
Festuca valesiaca s. lat.	.	16	3	**45**	.	**20**	.
Geranium sanguineum	19	9	17	**25**	.	**25**	**21**
Chamaecytisus sp.	3	.	.	.	**67**	.	.
Thymus sp.	13	.	.	.	**44**	.	.
Rosa pimpinellifolia	3	1	.	.	**33**	5	2
Campanula rapunculoides	13	2	10	.	.	**20**	**40**
Campanula carpatica	.	.	.	.	.	.	**35**
Chamaecytisus hirsutus	6	3	.	17	11	.	**28**
Arabis hirsuta agg.	19	16	17	11	.	5	**26**
Hieracium bifidum	.	3	10	.	.	.	**21**
Pinus sylvestris	9	.	17	.	.	.	**26**
Libanotis pyrenaica	.	.	.	.	.	10	**26**
Cotoneaster tomentosus	3	3	3	.	.	5	**21**
Cleistogenes serotina	.	.	.	16	.	.	.
Bryophytes and lichens up 20%							
Tortella tortuosa	**59**	15	.	14	**100**	**30**	**79**
Ditrichum flexicaule	**34**	6	3	2	**44**	10	**40**
Rhytidium rugosum	.	.	3	8	11	**20**	**49**
Cladonia pyxidata	**22**	3	.	3	11	10	**14**
Tortella inclinata	**34**	8	.	2	11	.	12
Schistidium apocarpum	13	.	.	6	11	.	**33**
Homalothecium philippeanum	3	.	.	.	**33**	10	**28**
Bryum argenteum	6	1	.	2	.	.	**28**
Cladonia sp.	3	.	.	.	.	.	**28**
Encalypta streptocarpa	6	.	.	.	.	5	**21**
Cladonia symphycarpa	**22**	.	.	2	11	.	.
Orthotrichum anomalum	.	.	.	.	.	.	21
Homalothecium lutescens	9	.	.	2	**22**	.	.

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Zoologisch-Botanische Datenbank/Zoological-Botanical Database

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