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FESTUCO-BROMETEA IN WESTERN BULGARIA WITH AN EMPHASIS ON *CIRSIO-BRACHYPODION PINNATI*

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Abstract
A total of 546 relevés collected in western Bulgaria and referred to *Festuco-Brometea* were classified into the alliances *Festucion valesiacae*, *Saturejion montanae*, *Cirsio-Brachypodion pinnati* and *Chrysopogono-Danthonion calycinae*. All relevés assigned to alliance *Cirsio-Brachypodion pinnati* were further classified towards lower level which resulted in the description of a new association – *Hieracio pilosellae-Festucetum dalmaticae* and two new subassociations added to ass. *Galio lovcense-Artemisietum chamaemelifoliae*. Both associations were ecologically well differentiated on the basis of soil parameters (pH and humus content) as well as some additional factors (exposition, land use, etc.).
Key words: Balkans, dry grasslands, syntaxonomy, vegetation.

Izvleček
V zahodni Bolgariji smo naredili 546 vegetacijskih popisov, ki jih uvrščamo v razred *Festuco-Brometea* in dalje v zveze *Festucion valesiacae*, *Saturejion montanae*, *Cirsio-Brachypodion pinnati* in *Chrysopogono-Danthonion calycinae*. Vse popise, ki smo jih uvrstili v zvezo *Cirsio-Brachypodion pinnati* smo členili na nižje sintaksonomske enote. Opisali smo novo asociacijo – *Hieracio pilosellae-Festucetum dalmaticae* in dodali dve novi subasociaciji k asociaciji *Galio lovcense-Artemisietum chamaemelifoliae*. Obe asociaciji sta ekološko jasno ločeni na podlagi talnih parametrov (pH in vsebnost humusa) in nekaterih dodatnih dejavnikov (ekspozicija, raba tal, itd.).
Ključne besede: Balkan, suha travišča, sintaksonomija, vegetacija.

1. INTRODUCTION

The alliance *Cirsio-Brachypodion pinnati* has been described from Central Europe (Klika 1951) within the class *Festuco-Brometea*. It represents xero-mesophytic grassland communities, occurring in continental and sub-continental parts of Central and Eastern Europe. So far it is reported to be present in Germany (Korneck 1974, Oberdorfer & Kornek 1993, Schubert et al. 2001, Röder et al. 2006), Czech Republic (Chytrý & Tichý 2003, Chytrý et al. 2007), Slovakia (Fiedler 1985, Michálková & Šibík 2006, Jarolímek & Šibik 2008, Škodova & Janišová 2008, Janišová et al. 2010), Poland (Stachurski et al. 2007, Jermaczek-Sitak 2008, 2009), Austria (Kuyper et al. 1978, Mucina & Kolbek 1993), Hungary (Soó 1980, Kovács 1994, Kovács 1995, Borhidi 1996, 2003), Ukraine (Goncharenko & Diduhkh 2003, Didukh & Korotchenko 2003, Solomaha 2008) and Lithuania (Korotkov et al. 1991).

It is known that the alliance borders Bulgaria to the North and West. For Romania it was mentioned in several studies indicating that its distribution is limited to the mountain and sub-mountain regions (Rațiu et al. 1966, Gergely 1970, Cristea & Csürös 1976, Şuteu 1979, Pop et al. 1988, Sanda et al. 1998, 1999, 2008, Kovács 2001, Drágulesku 2004, Kovács 2004). The alliance has not been recognized by researchers in former Yugoslavia (cf. Horvat et al. 1974) but recently some data about its distribution in the mountain regions of Western Balkans were provided by Redžić (1999) and for Croatia by Trinajstić (2008).

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A characteristic common feature of *Cirsio-Brachypodion pinnati* communities is the dominance of *Brachypodium pinnatum*. This species has wide ecological amplitude and takes part in the composition of different associations, but its distribution optimum is within *Cirsio-Brachypodion pinnati*. In Central Europe, the species often forms common stands with *Bromus erectus*, whose distribution is associated with *Bromion erecti* alliance. Heading eastwards, with increasing continentality, the occurrence of *Bromus erectus* in grasslands decreases. In xero-mesophytic Pannonian communities, dominated by *Brachypodium pinnatum,* the species *Bromus erectus* is missing (Illyés et al. 2007). According to Virágh & Bartha (1998), communities formed by *Brachypodium pinnatum* in Hungary represent different stages of succession between forest and steppe vegetation.

So far a comprehensive study of *Festuco-Brometea* in Bulgaria has not been conducted. Tzonev et al. (2009) provided an overview on published syntaxa within the class, but the alliance *Cirsio-Brachypodion pinnati* has not been included.

Cirsio-Brachypodion pinnati was confirmed in Bulgaria and was recently represented by a new association *Galio lovcense-Artemisietum chamaemelifoliae,* located in a very restricted region in western Bulgaria (Pedashenko et al. 2010). Our recent study revealed a much broader distribution of this alliance in central part of western Bulgaria.

The aim of the present study was to review the diversity of alliances within *Festuco-Brometea* in western Bulgaria with special attention to *Cirsio-Brachypodion pinnati*. The studied region is diverse in terms of climate, orography and soil types that determine significant biodiversity. It is much more pronounced regarding dry grasslands as compared to the mesic ones (see also Velev et al. 2010). *Cirsio-Brachypodion pinnati* vegetation has intermediate position between very dry and mesophytic plant communities. It is economically important because it can be managed both as pastures and meadows.

2. MATERIAL & METHODS

2.1 Study Area

The study area occupies sub-mountain and mountain regions in the central part of western Bulgaria (Figure 1). Altitude ranges between 1100 and 1450 m. According to Bulgarian climatic division (Velev 2002), it falls into Temperate-Continental region, which is characterized by warm summer and cold winter and by high annual amplitude of air temperature. The average January temperature varies between 0 °C to -4 °C, while the average temperature in July various between 18 to 20 °C (Nikolova 2002). The average annual precipitation is 500–900 mm, but locally the annual amount of rainfall exceeds 1000 mm (Mateeva 2002). Bedrock types are predominantly limestone and dolomite.

2.2 Field Sampling

A set of 546 relevés were sampled during 2007–2010 following the Braun-Blanquet approach (Braun-Blanquet 1965; Westhoff & van der Maarel 1973). The plot size was 16 m^2, as recommended for grassland communities (Chýtry & Otýpková 2003).

A total of 399 soil samples were collected from relevé stands and were analysed for pH and humus. Soil samples were taken from all corners and the centre of the plot at a depth of 0–10 cm. The samples were air-dried before further analyses (ISO 11464: 1994). pH was measured in water solution with 1 : 5 soil/water ratio and pH-meter Jenway3310 (ISO 10390: 2005). Humus was determined according to the modified Turin method (Kononova 1966). All analyses were performed at the Analytical Laboratory of Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences.

Altitude, slope inclination and location were measured by Garmin eTrex Vista whereas the exposition was determined by a compass. Soil depth was estimated as (1) shallow (<10 cm depth), (2) moderately deep (10–20 cm) or (3) deep (>20 cm). Special attention was paid to recording of grazing as a prevailing management for sampled vegetation. It was marked by presence/absence.

2.3 Data Analysis

All analyses were carried out in JUICE 7.0 software (Tichý 2002). Modified TWINSPAN (Roleček et al. 2009) was applied for clustering the total number of sampled relevés and for analysis of alliance heterogeneity. The diagnostic species were calculated by Phi-coefficient (Chytrý et al. 2002).

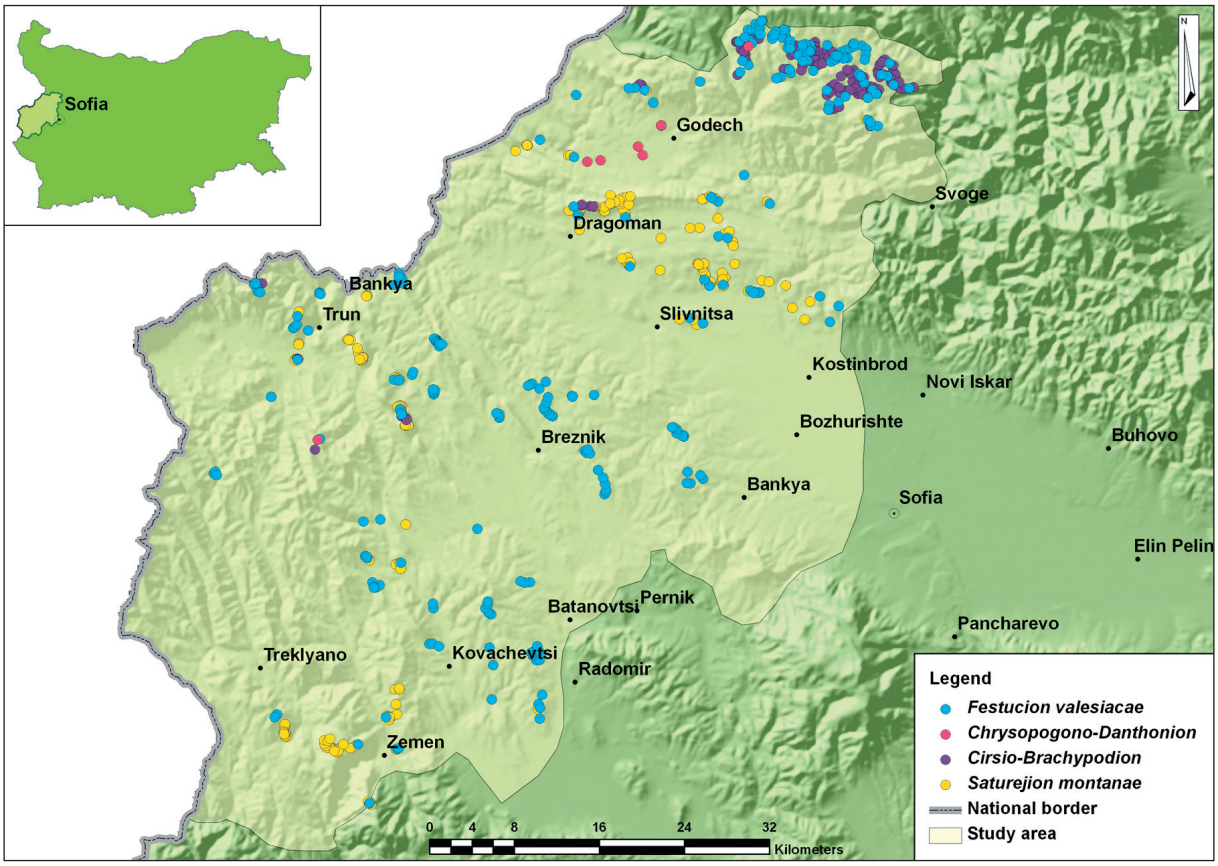

Figure 1: Map of study area. Sampled locations of the vegetation are shown related to alliance level.
Slika 1: Zemljevid obravnavanega območja. Lokacije vegetacijskih popisov so prikazane na nivoju zvez.

Two values were given for each species in the synoptic table: "Fidelity" expressed by the Phi-coefficient and "Constancy" expressed in percentage. All relevé groups were standardized to equal size (Chytrý et al. 2006). Only statistically significant values of Phi-coefficients evaluated with Fisher's exact test ($P<0.05$) are given in the synoptic table. The threshold value for a species to be considered as diagnostic was set up at a Phi-coefficient ≥ 0.3 (multiplied by 100). Species with Phi-coefficient ≥ 0.5 are considered highly diagnostic. All species in synoptic tables were ordered by decreasing value of fidelity. Only accompanying species with constancy >20% are shown. The diagnostic role of the species was also considered on the basis of available literature sources.

Quality of the classified syntaxa were tested by Sharpness and Uniqueness indexes. Their values highlight the well-defined and poorly defined vegetation units, taking into account the diagnostic species (Chytrý & Tichý 2003).

Species with coverage above 50% at least in 5% of the relevés in any cluster were considered as dominants, whereas constant species were those having at least 50% of the presence in a cluster.

For the relevés containing heterogeneous group of diagnostic species and which did not fulfil cluster definition criteria, the Positive Frequency – Fidelity Index (Tichý 2002) was applied for assignment to one of the defined vegetation units. Five relevés which were transitional among *Cirsio-Brachypodion pinnati*, *Festucion valesiacae* and *Saturejion montanae* were excluded from the further analyses.

Detrended Correspondence Analysis (DCA) was used as indirect ordination technique through the CANOCO software package (ter Braak & Šmilauer 2002) to reveal the major environmental gradients determining vegetation distribution. Square root transformation and downweighting or rare species were performed.

2.4 Nomenclature

The nomenclature of vascular plants followed Delipavlov & Cheshmedzhiev (2003) and the nomenclature of the bryophytes followed Ganeva & Düll (2009) and Natcheva & Ganeva (2005). The floristic elements were set up according Assyov & Petrova (2002), while the life forms were assessed on the basis of data about the biological type of the species, according to Kozhuharov (1992).

The following abbreviations for the syntaxa were used in the text and figures: Chry-Dant – *Chrysopogono-Danthonion calycinae*, Cirs-Brach – *Cirsio-Brachypodion pinnati*, Fest Val – *Festucion valesiacae*, Sat Mont – *Saturejion montanae*, GalLov-ArtCha centauretosum – *Galio lovcense-Artemisetum chamaemelifoliae centauretosum*, GalLov-ArtCha typicum – *Galio lovcense-Artemisetum chamaemelifoliae typicum*, HiePil-FesDal – *Hieracio pilosellae-Festucetum dalmaticae*.

3. RESULTS

All relevés referred to *Festuco-Brometea* were classified into alliance level. The alliances *Cirsio-Brachypodion pinnati*, *Chrysopogono-Danthonion calycinae*, *Festucion valesiacae* and *Saturejion montanae* were well distinguished floristically and ecologically (Table 1, Figure 2).

The alliances *Festucion valesiacae* and *Saturejion montanae* were typically found within undulating, dryer and warmer habitats of the study area, where the annual amount of precipitation has lower values (Figure 1). Vegetation of both alliances was represented by dry grasslands, dominated by narrow leaved tussock-forming grasses (e.g. species of the genera *Festuca*, *Stipa*, *Koeleria* and *Poa*). *Festucion valesiacae* is developed mainly on northern and western slopes with slight inclination, at lower altitude, near villages, as compared to *Saturejion montanae* which was sampled mostly on southern remote slopes distant from settlements (Figure 2).

Festucion valesiacae communities were found on limestone or dolomite, on moderately deep soils, with high content of skeletal material. The soil acidity value varies from slightly acidic to slightly alkaline (Figure 3 a, b). These communities are rich of steppe elements (e.g. *Festuca valesiaca*, *Stipa capillata*, *Stipa eriocaulis*). They have a closed horizontal structure and are currently used actively as pastures.

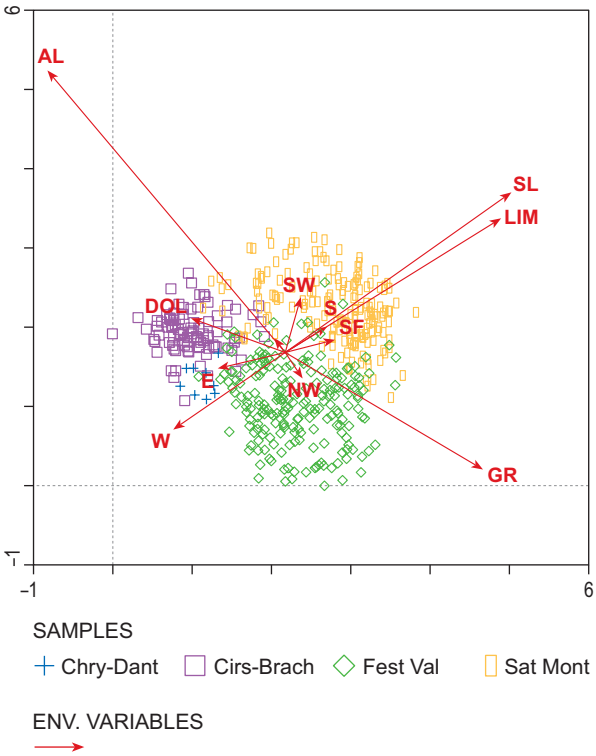

Figure 2: Biplot diagram of DCA at alliance level of class *Festuco-Brometea*. AL – Altitude, GR – Grazed plots, SL – Slope, S – South, W – West, N – North, SE – Southeast, SW – Southwest, NW – Northwest, E – East, LIM – Limestone, DOL – Dolomite. Eigenvalues: Axis 1 – 0.406, Axis 2 – 0.294.

Slika 2: Dvorazsežnostni DCA diagram zvez razreda *Festuco-Brometea*. AL – nadmorska višina, GR – pašene ploskve, SL – naklon, S – jug, W – zahod, N – sever, SE – jugovzhod, SW – jugozahod, NW – severozahod, E – vzhod, LIM – apnenec, DOL – dolomit. Lastne vrednosti: Os 1 – 0.406, Os 2 – 0.294.

Saturejion montanae communities were registered only on limestone. The soils were shallow, with frequent carbonate rocky outcrops, which determined the alkaline soil reaction (Figure 3 a, b). Many Mediterranean and sub-Mediterranean species (e.g. species of the genera *Satureja*, *Thymus*, *Teucrium*, *Astragalus*) were present in the more termophillous communities of *Saturejion montanae*. They usually form an open horizontal structure due to the abundance of rocky outcrops. The economical value of this vegetation was low and most of them are abandoned pastures.

Cirsio-Brachypodion pinnati and *Chrysopogono-Danthonion calycinae* were considered as transitional vegetation types towards mesic grasslands. Both alliances were locally distributed in the mountain and sub-mountain part of the study region, where higher annual and monthly pre-

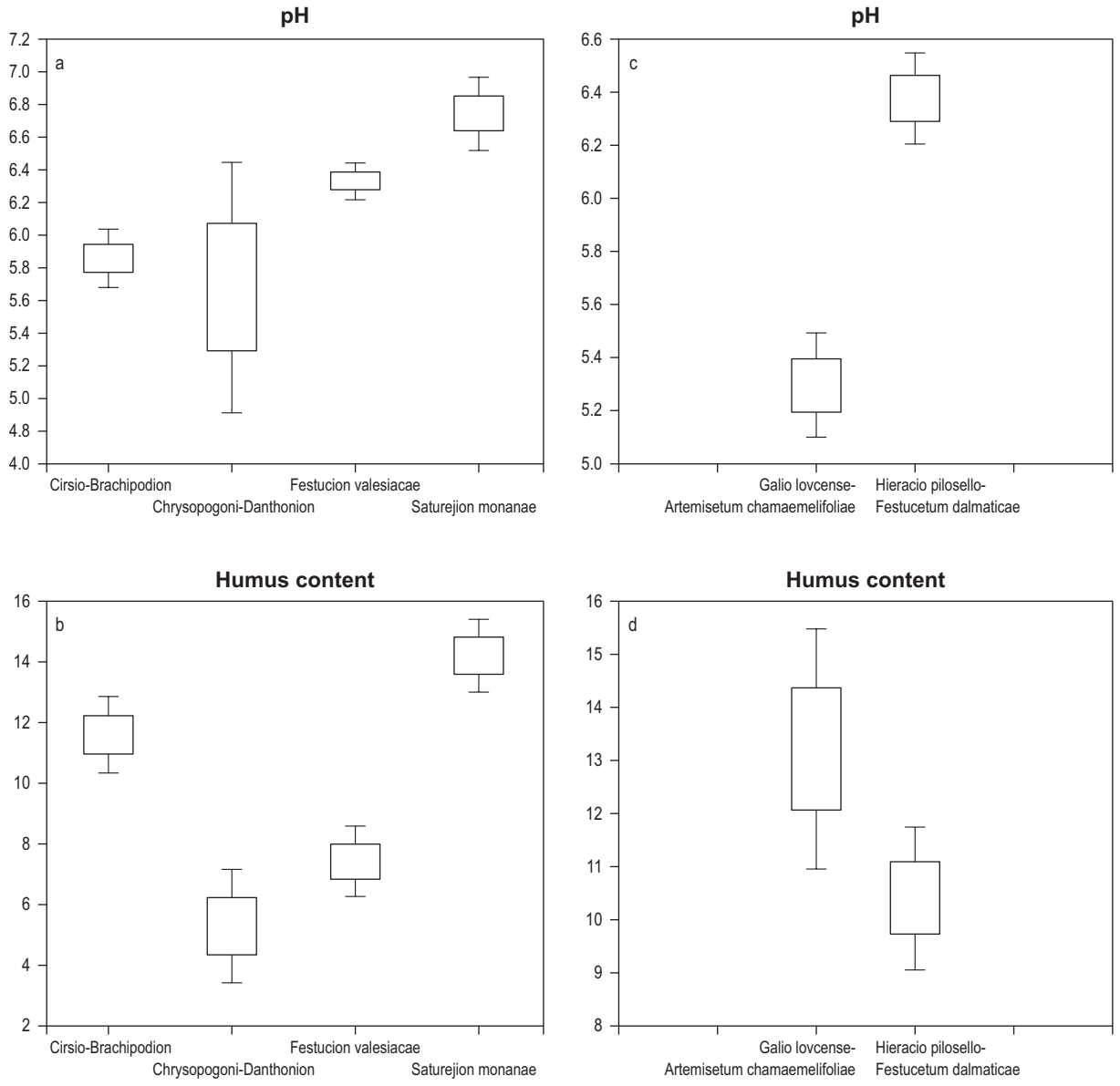

Figure 3: Box and Whiskers diagrams of pH and Humus content for alliances in class *Festuco-Brometea* (a-c) and associations in alliance *Cirsio-Brachypodion* (d-f) where the upper and lower edges of boxes represent the mean ± SE, the points within the boxes are the mean values and the upper and lower whiskers the mean ± 1.96*SE.

a) Differences were significant between *Cirs-Brach* (M = 5.9, SD = 0.8) and *Fest Val* (M = 6.3, SD = 0.6); t(181) = -4.7, p<0.001, *Cirs-Brach* and *Sat Mont* (M = 6.7, SD = 1.2); t(195) = -5.6, p<0.001, *Fest Val* and *Sat Mont*; t(224) = -3.1, p<0.005. **b)** There were significant differences between *Cirs-Brach* (M = 11.6, SD = 5.9) and *Chry-Dant* (M = 5.3, SD = 1.9); t(89) = 2.1, p<0.05, *Cirs-Brach* and *Fest Val* (M = 7.4, SD = 4.8); t(154) = 4.7, p<0.001, *Cirs-Brach* and *Sat Mont* (M = 14.1, SD = 5.9); t(179) = -2.9, p<0.05, *Chry-Dant* and *Sat Mont*; t(96) = -3.0, p<0.05, *Fest Val* and *Sat Mont*; t(161) = -7.7, p<0.001. **c-d)** Differences were significant between associations *GalLov-ArtCha* for pH (M = 5.3, SD = 0.61) and Humus (M = 13.2, SD = 6.9) and *HiePil-FesDal* (M = 6.4, SD = 0.54); t(75) = -8.2, p<0.001, (M = 10.4, SD = 4.9); t(85) = 2.2, p<0.05.

Slika 3: Škatle z ročaji za pH in vsebnost humusa za zveze razreda *Festuco-Brometea* (a-c) in asociacije zveze *Cirsio-Brachypodion* (d-f). Zgornji in spodnji rob škate predstavlja povprečje ± SE, točke v škatlah so povprečne vrednosti, ročaji pa predstavljajo povprečje ± 1.96*SE.

a) Razlike so bile značilne med *Cirs-Brach* (M = 5.9, SD = 0.8) in *Fest Val* (M = 6.3, SD = 0.6); t(181) = -4.7, p<0.001, *Cirs-Brach* in *Sat Mont* (M = 6.7, SD = 1.2); t(195) = -5.6, p<0.001, *Fest Val* in *Sat Mont*; t(224) = -3.1, p<0.005. **b)** Razlike so bile značilne med *Cirs-Brach* (M = 11.6, SD = 5.9) in *Chry-Dant* (M = 5.3, SD = 1.9); t(89) = 2.1, p<0.05, *Cirs-Brach* in *Fest Val* (M = 7.4, SD = 4.8); t(154) = 4.7, p<0.001, *Cirs-Brach* in *Sat Mont* (M = 14.1, SD = 5.9); t(179) = -2.9, p<0.05, *Chry-Dant* in *Sat Mont*; t(96) = -3.0, p<0.05, *Fest Val* in *Sat Mont*; t(161) = -7.7, p<0.001. **c-d)** Razlike so bile statistično značilne med asociacijami *GalLov-ArtCha* za pH (M = 5.3, SD = 0.61) in humus (M = 13.2, SD = 6.9) in *HiePil-FesDal* (M = 6.4, SD = 0.54); t(75) = -8.2, p<0.001, (M = 10.4, SD = 4.9); t(85) = 2.2, p<0.05.

cipitations are typical (Figure 1). *Chrysopogono-Danthonion calycinae* is endemic alliance for the Balkans, characteristic for siliceous bedrock. The study area is geologically diverse and geological features vary significantly within a small area. This is the reason why surveyed communities develop on limestone mixed with silicate patches. This vegetation type is rich in many Balkan species (e.g. *Sesleria latifolia*, *Bromus moesiacus*, etc.). Dominants are *Danthonia alpina*, *Chrysopogon gryllus*, *Agrostis capillaris*. However, *Cirsio-Brachypodion pinnati* includes many Central European species (e.g. *Brachypodium pinnatum*, *Trifolium alpestre*, *Polygala major*, etc.) that retain a strong presence as good character species for the alliance within the Balkans. The vegetation of these two alliances has been used for grazing in the past. Today the pastures are grazed at low intensity or are abandoned.

A subset of 122 relevés (including relevés of Pedashenko et al. 2010), which were classified to alliance *Cirsio-Brachypodion pinnati*, was used for the subsequent analysis. We confirmed the association *Galio lovcense-Artemisetum chamaemelifoliae* Pedashenko et al. 2010 and described *Hieracio pilosellae-Festucetum dalmaticae* as new associaion according to TWINSPAN clustering (Table 2, 3) and DCA ordination (Figure 4). The associations had high Uniqueness value which proved their distinct character. The Sharpness indexes showed similar number that was a result of species congruence.

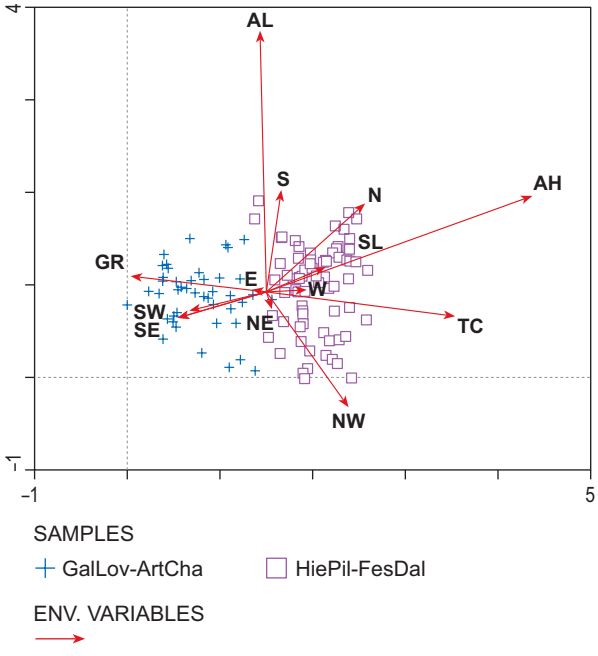

Figure 4: Biplot diagram of DCA for associations. Abbreviations are same as on the Figure 2 excluding AH – Average Height and TC – Total Cover.

Slika 4: Dvorazsežnostni diagram DCA. Okrajšave so enake kot pri sliki 2 razen AH – povprečna višina in TC – skupna pokrovnost.

3.1 Ass. *Galio lovcense-Artemisetum chamaemelifoliae* Pedashenko et al. 2010

Galio lovcense-Artemisetum chamaemelifoliae typicum subass. nova hoc loco

Holotypus Table 1, relevé 25 (Pedashenko et al. 2010)

Galio lovcense-Artemisetum chamaemelifoliae centauretosum triumfetti subass. nova hoc loco

(Holotypus Table 3, relevé 36)

Character species for the association: see Table 3.

Differential species for subassociation *centauretosum triumfetti*: see Table 3, Figure 5.

Constant species of association: *Asperula cynanchica Thymus longicaulis, Briza media, Teucrium chamaedrys, Brachypodium pinnatum, Bromus riparius, Scabiosa columbaria, Sanguisorba minor, Hypericum linarioides*.

Dominant species of association: *Artemisia chamaemelifolia, Brachypodium pinnatum, Festuca paniculata, Festuca rubra, Sesleria latifolia, Stipa pennata*.

Total cover: from 80% to 100%

Altitude range: from 1115 to 1439 m.

Basic rock: limestone and dolomite

Soil pH range: from 4.49 to 6.86, average 5.29

Humus range: from 1.45 to 36, average 13.21

The subassociation *Galio lovcense-Artemisetum chamaemelifoliae typicum* is distributed in the inland territories of Ponor Mt., at south-western or south-eastern slopes as well as on plane areas. The communities are maintained as pastures. Soils are slightly acidic with pronounced humus content (Figure 3 c, d).

The subassociation C*entauretosum triumfetti* could be considered as transitional vegetation type because it is developed at the transition between *Festuco-Brometea* and *Trifolio-Geranietea*. Besides typical diagnostic species for *Festuco-Brometea* there were also abundant *Thalictrum minus* and *Geranium sanguineum* that are diagnostic for *Trifolio-Geranietea*. These communities are long time abandoned pastures and the successional processes leading to shrub and forest vegetation are more advanced.

Figure 5 (Slika 5): *Galio lovcense-Artemisetum chamaemelifoliae centauretosum triumfetti* subass. nova.

3.2 *Hieracio pilosellae-Festucetum dalmaticae* ass. nova hoc loco

Holotypus Table 3, relevé 52
Character species: see Table 3, Figure 6.
Constant species: *Thymus longicaulis*, *Teucrium chamaedrys, Sanguisorba minor, Asperula cynanchica*, *Plantago media, Briza media, Scabiosa columbaria, Plantago lanceolata, Hypericum linarioides, Fragaria viridis, Filipendula vulgaris*.
Dominant species: *Corothamnus procumbens*.
Total cover: from 50% to 100%
Altitude range: from 718 to 1399 m.
Basic rock: limestone and dolomite.
Soil pH range: from 4.8 to 7.02, average 6.37
Humus range: from 2.05 to 21.01, average 10.40

This association has wider distribution in the studied area than *Galio lovcense-Artemisetum chamaemelifoliae*. It occupies the area of West Balkan Mts (Ponor Mt.), in vicinity of Ravna village (close to the town of Godech), Chepan Mt. (close to the town of Dragoman), Lyubash Mt., Ruy Mt. and Erul Mt.

The vegetation is not very dense because of the presence of bare rock and soil which shares up to 50% of the sample plots. The cryptograms are represented by 3–4% of the total cover. At the same time, the sampled communities are floristically rich and comprise in total of 273 vascular plants. The species number per relevé varies between 24 and 53 (average 35). The height of the herbs in different plots is 8–40 cm while the average for the association is 27 cm.

These communities are situated mostly on western or northern slopes (up to 25° inclination) and only occasionally on plane areas. Soils here are shallower and have higher content of skeletal material as well as higher pH and lower humus content compared to the *Galio lovcense-Artemisetum chamaemelifoliae* association stands (Figure 3 c, d).

The continental character of the vegetation is demonstrated by presence of Euro-Mediterranean (23%), Euro-Asiatic (22%), sub-Mediterranean (13%) and Central European (8%) floristic elements. Relatively high presence of Boreal species (11%) is conditioned by the topography of the

Figure 6 (Slika 6): *Hieracio pilosellae-Festucetum dalmaticae* ass. nova.

region. Some regional pattern is evident by the presence of Balkan floristic elements (8%).

The prevalence of hemicriptophytes (H – 73%), followed by therophytes (T – 15%) is typical for the regional climate. Chamaephytes (Ch), biannuals (Bi) and geophytes (G) are presented by 6%, 4% and 3% respectively.

The new association is considered to be transitional vegetation between xero-mesophytic *Cirsio-Brachypodion pinnati* and xerothermic *Festucion valesiacae* and *Saturejion montanae*. This is the reason why some character species are transgressive towards *Festucion valesiacae* (e.g. *Achillea setacea*, *Medicago falcata*) or towards *Saturejion montanae* (e.g. *Leontodon crispus*).

The high presence of *Sesleria latifolia* and *Corothamnus procumbens*, which were dominants in several locations, was a reason for distinguishing of two facieses. Both facieses were localized on the northern slopes of Ponor Mt. *Sesleria latifolia* facies was recognized also in *Galio lovcense-Artemisetum chamaemelifoliae* association (Table 3).

The studied associations are well separated in the ordination space (Figure 4). The first axis (eigenvalue 0.341) is related to the management. At present, the *Galio lovcense-Artemisetum chamaemelifoliae* communities are extensively used as pastures, whereas communities of *Hieracio pilosellae-Festucetum dalmaticae* are mainly abandoned pastures. The variability expressed by the Second axis (eigenvalue 0.159) is not significant. Both associations are distributed at similar altitude. Differences in humus content and pH between associations are determined by the deeper soils developed in locations of *Galio lovcense-Artemisetum chamaemelifoliae* communities. The stands of the ass. *Hieracio pilosellae-Festucetum dalmaticae* are often characterized by shallow soils and higher presence of skeletal component resulting in more alkaline soil reaction.

4. DISCUSSION

The diversity of orographic, climatic and ecological features existing in the study region has determined a significant variety of vegetation types, but the dry grasslands are the most widespread. They are of secondary origin and substitute natural forest vegetation characteristic for the region (Bondev 1991). Historical changes have resulted in large territories being used for agriculture. Remnants of semi-natural vegetation still occur on the hills and sub-mountain regions which are not suitable for plowing.

The distribution of *Cirsio-Brachypodion pinnati* in western Bulgaria and particularly in the studied region is determined primarily by high annual precipitation. It is also connected with the mountain landscape and its climate. Towards South and East directions the altitude and precipitation decrease and the vegetation changes towards more xerophytic alliances *Saturejion montanae* and *Festucion valesiacae*.

It could be assumed that on Balkan Peninsula *Cirsio-Brachypodion pinnati* reaches its southeastern boundary within the studied region. Eastwards it becomes replaced by vegetation types rich in steppe elements.

Regarding the water regime, the vegetation of *Cirsio-Brachypodion pinnati* is ecologically similar to the Balkan alliance *Chrysopogono-Danthonion calycinae*. The major difference between these alliances is that *Cirsio-Brachypodion pinnati* is distributed on carbonate rocks, while *Chrysopogono-Danthonion calycinae* communities are characteristic for siliceous terrains (Rodwell et al. 2002). However, in some cases, the thick soil cover insulates the influence of basic rock and we registered *Chrysopogono-Danthonion calycinae* stands on carbonates as well.

According to some authors (Mucina & Kolbek 1993) *Cirsio-Brachypodion pinnati* could be regarded as sub-continental vicariant of the al-

liance *Bromion erecti*. *Bromion erecti* develops in the Atlantic part of the continent, in some colder habitats and its composition involves large number of Atlantic species (Illyés et al. 2007). In contrast, *Cirsio-Brachypodion pinnati* is widespread in mainland Europe and the composition of its communities is gaining less sub-Mediterranean but more steppe species as compared to *Bromion erecti*, especially in the Pannonian basin (Royer 1991, Mucina & Kolbek 1993, Borhidi 2003).

Oberdorfer & Korneck (1993) subordinate *Cirsio-Brachypodion pinnati* to *Festucetalia valesiacae*. It is described by the authors as "sub-continental xero-mesophytic grasslands", but presumably with significant presence of continental and steppe plant species. Mucina & Kolbek (1993) include this alliance within *Brometalia erecti*. This also characterises the alliance as "subcontinental" unlike *Bromion erecti*, which is sub-Mediterranean and sub-Atlantic vegetation type. Both alliances share many common species. Many Serbian researchers have classified *Bromion erecti* associations as floristically close to *Cirsio-Brachypodion pinnati*, for example *Brometum erecti* association, reported within the areas of Serbian part of Stara Planina Mt. and Kapaonik Mt. (Pavlović 1955, Mišić et al. 1978, Kojić et al. 1998). Further comparative studies are needed to review both alliances within the Balkans.

Dengler et al. (2003) support the decision to combine the mesophytic basiphilous syntaxa of *Bromion erecti* and *Cirsio-Brachypodion pinnati* within *Brachypodietalia pinnati* order. In our opinion such classification scheme well describes the xero-mesophytic vegetation of *Festuco-Brometea* class in the Balkans, where sub-continental, sub-Mediterranean and steppe elements are mixed.

The majority of the studied communities have a secondary origin and substitute *Quercus daleshampii*, *Quercus cerris*, *Fagus sylvatica* and *Carpinus betulus* forests (Tonkov & Bozhilova 1992, Bohn et al. 2004). The presence of some relic species as *Artemisia chamaemelifolia* leads to the assumption of primary origin of some of the grasslands as mentioned by Mucina & Kolbek (1993).

Communities of *Cirsio-Brachypodion pinnati* in Bulgaria contain species of conservation value on a national and international level, such as *Chamaecytisus calcareous*, *Echium russicum*, *Sesleria latifolia*, *Lilium jankae*, *Lilium martagon*, *Thesium linophyllon*, *Tragopogon balcanicus*, *Silene roemeri*. For this reason it is important to give special attention in protecting these communities through appropriate conservation recommendations and management plans Most of the sampled localities are within the NATURA 2000 network and partly represent habitat "6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)".

The most serious threats for the studied vegetation are the plowing of grasslands and shrub expansion. Maintenance and supporting of traditional land use could be a relevant tool to ensure the continuation of these favourable conditions as it is generally known to be beneficial to the values of conservation. Vassilev et al. (2011) recommended extensive grazing with sheep density >0.15 ha^{-1} animal units for semi-natural grasslands in the region as advised by the National Standard 4.1 for maintaining the land in good agricultural and ecological condition (Anonymous 2007).

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Tabela 1: Synoptic table of class *Festuco-Brometea*. The species are represented by two indicators: Fidelity measure, expressed by the Phi-coefficient (Chytrý & al. 2002) and Constancy, expressed in percentages. Highly diagnostic species are mark in dark green, whereas diagnostic species are green.

Table 1: Sinoptična tabela razreda *Festuco-Brometea*. Vrste so predstavljene z dvema vrednostima: mero navezanosti (fi-koeficient (Chytrý & al. 2002)) in stalnostjo v odstotkih. Vrste z visoko diagnostično vrednostjo so označene s temno zeleno, diagnostične pa z zeleno.

Number of cluster	1		2		3		4	
Number of relevés	11		122		236		178	
Average species number per relevé	34		36		28		31	
Fidelity / Constancy	Phi	C	Phi	C	Phi	C	Phi	C
Ch. species of All. *Chrysopogono-Danthonion*								
Danthonia alpina	72	73	---	10	---	3	---	1
Briza media	72	100	18	55	---	2	---	1
Carex tomentosa	53	36	---	1	---	1	---	0
Agrostis capillaris	52	55	3	21	---	1	---	0
Linum catharticum	50	64	10	33	---	4	---	2
Chrysopogon gryllus	48	45	---	1	---	9	---	6
Leucanthemum vulgare	45	45	2	18	---	3	---	0
Agrimonia eupatoria	44	45	---	5	---	15	---	2
Trifolium montanum	43	45	6	21	---	2	---	0
Rhinanthus rumelicus	38	27	---	0	---	7	---	0
Ch. species of All. *Cirsio-Brachypodion*								
Thymus longicaulis	---	9	71	71	---	2	---	3
Brachypodium pinnatum	---	9	62	64	---	5	---	4
Hypericum linarioides	---	0	58	43	---	1	---	1
Asperula cynanchica	---	9	57	77	---	14	---	25
Scabiosa columbaria	---	9	51	52	---	6	---	6
Bromus riparius	---	9	47	44	---	2	---	4
Veronica austriaca s. *jacquinii*	---	9	43	49	---	6	---	15
Primula veris	---	9	41	34	---	1	---	2
Sesleria latifolia	---	0	40	28	---	0	---	7
Trifolium alpestre	---	36	39	60	---	8	---	12
Plantago media	---	36	36	54	---	13	---	2
Polygala major	---	0	33	20	---	4	---	1
Carlina vulgaris	---	0	33	21	---	5	---	1
Artemisia chamaemelifolia	---	9	33	24	---	0	---	0
Ch. species of All. *Festucion valesiacae*								
Astragalus onobrychis	---	0	---	2	50	66	---	42
Festuca valesiaca	---	0	---	11	44	44	---	9
Eryngium campestre	---	36	---	33	34	81	---	57
Poa angustifolia	---	18	---	10	33	44	---	12
Chondrilla juncea	---	0	---	0	32	14	---	0
Ch. species of All. *Saturejion montanae*								
Artemisia alba	---	0	---	2	---	3	67	60
Satureja montana s. *kitaibelii*	---	0	---	3	---	6	56	48
Thymus striatus	---	0	---	0	---	5	55	43
Agropyron cristatum	---	0	---	0	---	3	47	31
Stipa eriocaulis	---	0	---	0	---	11	47	40
Melica ciliata	---	0	---	1	---	9	45	37
Hypericum rumeliacum	---	9	---	2	---	18	43	49

Number of relevés	11		122		236		178	
Hyacintella leucophaea	---	0	---	7	---	3	43	34
Astragalus wilmottianus	---	0	---	0	---	0	32	13
Helianthemum nummularium	---	18	---	7	---	5	32	38
Amygdalus nana	---	0	---	0	---	0	30	12
Ch. species of cl. *Festuco-Brometea*								
Festuca dalmatica	---	45	16	66	---	32	17	67
Teucrium chamaedrys	---	27	---	72	---	69	---	69
Leontodon crispus	---	45	---	45	---	52	---	57
Galium verum	24	64	15	56	---	35	---	17
Euphorbia cyparissias	---	18	14	46	---	33	---	41
Koeleria nitidula	---	45	---	5	6	39	15	46
Potentilla cinerea	---	0	38	63	---	13	26	53
Sanguisorba minor	---	55	13	57	5	50	---	21
Filipendula vulgaris	46	82	31	69	---	8	---	12
Thymus callieri	---	64	---	6	31	68	---	28
Carex caryophyllea	---	36	17	44	---	18	---	23
Asperula purpurea	---	0	28	42	---	15	13	31
Fragaria viridis	---	18	32	43	---	15	---	7
Achillea setacea	---	18	32	40	---	13	---	2
Polygala vulgaris	58	45	---	4	---	1	---	0
Hieracium pilosella	---	18	33	45	---	21	---	2
Hieracium praealtum s. *bauchinii*	34	45	---	14	---	20	---	6
Achillea millefolium	---	45	---	21	12	35	---	3
Dorycnium herbaceum	27	45	2	27	---	21	---	7
Medicago falcata	---	0	---	28	27	45	---	26
Muscari neglectum	---	9	---	7	---	3	30	28
Dichantium ischaemum	---	0	---	3	---	23	25	29
Allium sphaerocephalon	---	0	---	1	---	4	28	16
Trinia glauca	---	18	---	10	---	3	17	24
Onobrychis arenaria	---	0	---	25	---	14	15	26
Stipa capillata	---	0	---	1	---	5	15	8
Anthylis vulneraria	---	18	13	29	---	8	6	24
Seseli peucedanoides	---	9	21	27	---	3	5	17
Hypericum perforatum	---	27	20	36	---	16	---	9
Medicago lupulina	---	27	5	20	---	15	---	4
Festuca pseudodalmatica	---	9	---	4	---	4	---	4
Avenula compressa	30	27	---	3	0	11	---	2
Centaurea stoebe	---	18	10	27	12	28	---	7
Potentilla argentea	---	27	---	6	12	21	---	1
Hieracium hoppeanum	---	9	---	1	8	8	---	2
Euphrasia pectinata	---	27	11	24	---	13	---	3
Cerastium banaticum	---	9	30	34	---	3	---	16
Carex humilis	---	0	15	21	---	2	27	28
Orchis morio	42	27	---	2	---	2	---	0
Koeleria macrantha	---	9	39	31	---	1	---	1
Pimpinella tragium	---	0	34	31	---	4	---	13
Rhodax canus	---	9	---	0	---	6	30	26
Other species								
Sideritis montana	---	0	---	20	---	22	40	53
Teucrium polium	---	0	---	1	---	18	38	37
Sedum acre	---	0	---	4	---	14	36	34

Number of relevés	11		122		236		178	
Minuartia hybrida	---	0	---	6	---	8	27	23
Medicago minima	---	0	---	1	23	30	25	31
Arenaria serpyllifolia	---	0	---	7	---	16	23	25
Trifolium aureum	---	0	---	4	35	23	---	2
Anthoxanthum odoratum	68	91	---	31	---	13	---	3
Festuca nigrescens	47	27	---	0	---	0	---	0
Stachys officinalis	46	45	4	19	---	0	---	1
Scorzonera hispanica	41	27	---	3	---	0	---	2
Minuartia viscosa	---	0	47	30	---	1	---	1
Carlina acanthifolia	---	9	44	56	---	22	---	7
Chamaecytisus calcareus	---	9	33	26	---	1	---	1
Chamaespartium sagittale	23	36	33	43	---	2	---	1
Festuca rubra	---	9	31	23	---	1	---	0
Euphorbia niciciana	---	9	---	2	---	8	29	28
Lotus corniculatus	32	55	13	39	---	22	---	1
Alyssum minus	---	0	---	10	---	22	27	34
Corothamnus procumbens	---	9	---	11	---	0	24	24
Euphorbia barrelieri	---	0	---	0	---	2	24	10
Teucrium montanum	---	0	---	11	---	3	23	20
Crupina vulgaris	---	9	---	4	---	10	23	25
Convolvulus cantabrica	---	0	---	1	---	14	23	20
Globularia aphyllanthes	---	0	---	19	---	4	23	25
Scabiosa triniifolia	---	9	---	6	---	16	15	22
Inula salicina	---	18	29	29	---	0	---	2
Coronilla varia	---	18	17	26	---	14	---	4
Cruciata glabra	---	18	24	23	---	0	---	1
Knautia arvensis	---	18	21	27	---	7	---	5
Viola hirta	---	18	21	22	---	1	---	3
Crataegus monogyna	---	36	---	9	---	19	---	21
Rhinanthus angustifolius	25	36	2	20	---	10	---	10
Plantago lanceolata	29	64	16	52	---	33	---	6
Prunus spinosa	---	27	---	3	---	11	---	7
Hypericum maculatum	---	27	10	20	---	4	---	0
Thesium bavarum	---	36	14	39	---	12	---	22
Viola reichenbachiana	---	27	---	20	---	0	---	0
Bromus mollis	---	9	---	1	25	24	---	8
Convolvulus arvensis	---	27	---	1	20	7	---	0
Syntrichia ruralis	---	9	---	6	21	30	---	3
Rosa species	---	0	---	18	21	26	---	3
Thesium arvense	---	0	---	7	22	28	---	15
Petrorhagia prolifera	---	0	---	7	10	29	---	26

Table 2: Summarized statistical components of the associations.
Tabela 2: Zbrani statistični podatki asociacij.

Vegetation unit	Total species number	Average species number	Average positive fidelity	Sharpness index	Uniquiness index
Galio lovcense-Artemisetum chamaemelifoliae	157	37	11	33	1
Hieracio pilosele-Festucetum dalmaticae	175	35	9	26	1

Table 3: Synoptic table of alliance *Cirsio-Brachypodion*. Relevés number marked in grey were originally published by Pedashenko et al. (2010).
Tabela 3: Sinoptična tabela zveze *Cirsio-Brachypodion*. Popisi označeni s sivo so bili objavljeni v Pedashenko et al. (2010).

Life form	Floristic element	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
		Altitude [m]	1303	1360	1400	1364	1338	1278	1359		1303	1347	1290	1271	1353	1427	1245	1390	1261	1354	1260	1281	1374	1260	1417	1418	1342	1312	1375	1268
		Exposure	90	90	225	90	315	45	135	180	270	270	270	270	360	45	45	45	180	180	0	90	0	0	180	270	180	270	180	180
		Inclination [degree]	35	20	15	7	8	12	10	8	10	12	8	10	10	12	15	3	8	8	0	6	0	0	10	20	12	7	10	10
		Total coverage	70	100	90	95	100	100	100	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100	100	100	100	100	100	95
		Cover of herb layer	65	99	89	95	100	100	97	100	75	100	99	100	100	100	100	100	78	100	100	100	100	100	100	100	100	100	100	95
		Cover of mosses	5	1	1	0	0	0	3	0	25	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
		Average height of the herbs	30	30	25	45	40	45	60	35	25	40	30	30	40	55	30	35	30	30	35	30	30	35	55	35	40	35	35	30
		Species number	32	32	41	28	42	51	37	36	33	33	40	40	35	38	40	37	39	46	37	44	37	39	41	41	29	36	42	30
Ch. species of ass. *Galio lovcense-Artemisetum chamaemelifoliae* Pedashenko et al. 2010																														
H	Bal-Anat	*Inula salicina*	.	+	+	.	.	.	.	+	.	1	.	+	+	1	+	1	+	+	.	.	1	.	+	1	+	+	1	+
H	Eur-As	*Potentilla alba*	.	+	.	.	+	.	.	.	.	+	+	+	+	+	.	+	.	+	+	2	1	+	.	+	+	.	+	.
H	Med-OT	*Stachys officinalis*	.	.	.	.	.	.	.	.	.	1	.	+	.	+	.	.	.	.	.	+	+	.	+	+	1	+	+	1
H	Pann-Pont	*Artemisia chamaemelifolia*	2	+	+	+	.	1	2	1	.	+	+	.	+	+	+	1	4	3	+	+	2	+	2	+	2	.	+	.
Ch	Bal	*Seseli peucedanoides*	.	+	.	+	+	.	+	+	.	+	+	+	.	+	.	+	+	+	.	+	+	.	+	+	+	.	+	.
H	subMed	*Polygala major*	+	+	1	+	.	+	.	.	+	.	.	+	.	+	+	.	.	+	.	.	+	.	+	+	.	+	+	.
H	Eur-As	*Veratrum nigrum*	.	.	.	+	+	.	+	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	+	+	.	+	+	.
H	Eur-Sib	*Viola hirta*	.	+	.	.	.	.	.	.	+	.	.	.	+	+	+	+	.	+	+	+	+	+	.	+	+	.	+	.
H	SPont	*Galium lovcense*	+	+	.	.	.	+	+	+	+	1	.	.	1	1	+	.	.	+	.	+	+	.	+	1	.	2	+	+
subass. *centauretosum*																														
H	subMed	*Centaurea triumfetti*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
H	Eur-Sib	*Thalictrum minus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
H	Eur	*Geranium sanguineum*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.
H	subMed	*Prunella grandiflora*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Ch. species of ass. *Hieracio pilosellae-Festucetum dalmaticae* ass. nova																														
H	subMed	*Achillea setacea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
H	Eur-Med	*Hieracium pilosella*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	2	+	.	2	.	.	.	.	.	.
H	Pont-Med	*Leontodon crispus*	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	subMed	*Centaurea stoebe*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-As	*Medicago falcata*	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	subMed	*Asperula purpurea*	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Med	*Carlina vulgaris*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
facies																														
H	Bal	*Sesleria latifolia*	1	4	2	.	4	+	.	.	.	.	.	1	1	3	4	.	.	.	.	.	.	.	.	1	.	.	.	.
Ch	Eur-Med	*Corothamnus procumbens*	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diagnostic species of alliance *Cirsio-Brachypodion*																														
H	Eur-Med	*Asperula cynanchica*	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	+	+	+
H	SSib	*Filipendula vulgaris*	+	1	+	.	+	+	+	1	+	+	+	+	+	+	.	1	.	2	+	1	+	1	+	+	+	2	+	+
H	Boreal	*Brachypodium pinnatum*	.	.	.	.	1	3	1	.	.	2	1	.	.	.	+	.	.	2	1	2	2	1	.	2	2	2	3	2
H	Eur-Med	*Trifolium alpestre*	+	1	+	+	+	1	+	2	1	1	+	+	1	.	+	+	+	.	.	.	+	.	1	1	+	+	+	.
H	Eur-Sib	*Briza media*	.	1	+	.	1	.	.	1	.	1	.	3	2	1	.	1	2	1	3	3	2	3	.	2	1	2	2	2
H	Eur	*Plantago media*	+	+	.	.	+	.	.	+	+	.	+	.	.	.	.	+	+	+	+	.	.	+	.	.	.	+	.	.
H	Eur-Med	*Primula veris*	+	.	+	+	.	+	+	.	+	+	+	+	+	+	+	+	+	+	.	+	.	.	+	+	.	+	+	.
H	Ssib	*Avenula pubescens*	.	.	.	.	+	+	.	.	1	3	.	1	.	.	+	.	.	.	.	.	.	.	.	1	.	.	+	.
H	Eur	*Carex michelii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Diagnostic species of class *Festuco-Brometea*																														
H	Eur	*Potentilla cinerea*	1	.	+	.	.	+	.	.	+	.	1	+	.	+	+	.	+	+	+	.	.	+	.	.	.	+	.	.
H	subMed	*Festuca dalmatica*	.	.	1	1	+	.	.	2	3	.	3	2	.	1	.	.	.	.	1	.	.	.	2	.	3	.	1	.
H	subMed	*Teucrium chamaedrys*	+	.	+	+	.	+	+	+	+	+	.	.	.	+	+	+	+	+	+	.	.	+	+	+	+	+	+	+
H	Med	*Thymus longicaulis*	1	+	+	.	+	1	.	+	1	.	2	.	+	+	+	+	+	.	+	+	+	+	+	+	+	+	.	+
H	Eur-As	*Galium verum*	.	.	.	+	+	+	+	+	+	+	.	+	.	.	.	1	+	+	+	1	+	+	+	+	1	+	+	1

29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64				
1314	1402	1318	1266	1311	1115	1407	1251	1332	1335	1298	1321	1439	1418	1225	1221	1176	1248	1214	1168	1202	1232	1229	1218	1259	1291	1246	1345	1212	1240	1198	1287	1349	1289	1361	1384				
180	315	45	90	135	90	315	180	270	225	315	315	180	270	W	S	W	SW	SE	W	NE	NE	SE	S	SW	NW	SW	SW	W	S	NW	SE	NE	W	NE	S				
5	10	10	8	10	10	20	12	8	10	8	12	15	20	2	10	7	8	20	10	9	15	15	15	10	10	8	10	10	15	7	10	2	8	15	10				
100	90	90	100	100	80	100	100	100	95	100	100	100	100	95	100	95	85	70	100	100	80	100	90	100	80	100	90	95	85	100	100	95	95	95	90				
80	90	90	95	100	79	100	100	100	95	99	99	100	100	93	100	94	83	68	100	99	79	99	89	100	88	99	88	95	83	100	99	94	93	94	90				
20	0	0	5	0	0	0	0	0	0	1	1	0	0	2	0	1	2	2	0	2	1	1	1	0	2	1	2	0	2	0	1	1	2	1	0				
	35	40	35	30	35	45	35	30	35	40	35	55	50	30	28	35	23	25	20	30	20	26	20	35	30	30	30	25		35	45	20	30	25	30				
40	30	15	35	30	32	39	42	30	33	59	46	33	30	51	37	38	41	38	45	31	40	36	40	28	28	41	26	37	39	38	28	26	38	29	31	**Phi**	**C (%)**	**Phi**	**C (%)**
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+	+	+	+	+	+	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	38	26	---	0
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+	+	+	+	+	+	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	.	+	+	.	.	+	+	+	+	+	+	+	.	.	.	---	88	---	73
+	1	.	+	1	1	+	2	+	+	+	+	+	+	+	.	.	+	.	1	.	+	1	.	+	.	1	.	+	+	+	+	+	.	.	.	39	90	---	55
.	.	+	2	4	.	3	4	3	.	1	.	2	+	2	+	2	1	+	3	3	3	3	3	1	2	+	+	2	1	2	3	+	1	+	+	---	60	50	100
.	+	.	+	.	+	+	+	+	+	+	+	.	+	.	.	+	.	.	+	+	.	+	.	+	.	+	+	+	+	.	.	.	.	+	.	35	76	---	45
+	.	+	1	1	.	1	2	1	3	1	.	.	.	1	+	.	1	.	1	.	1	.	.	1	.	+	.	+	1	.	.	+	+	+	+	---	69	---	59
.	.	.	.	.	+	.	+	.	.	+	+	.	.	+	+	.	+	.	+	+	+	+	+	+	.	+	.	+	.	+	.	.	+	.	+	---	38	---	64
+	+	.	+	.	.	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	50	69	---	14
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.	2	.	.	.	2	2	.	.	.	.	.	.	1	2	3	2	3	2	2	2	1	2	2	+	2	2	+	2	2	2	1	.	2	.	.	---	38	47	86
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1	+	+	1	+	.	+	+	1	1	+	+	1	1	2	2	1	1	1	+	.	1	+	.	+	2	1	1	2	2	.	.	+	1	+	1	---	83	---	82
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		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
H	subBoreal	*Sanguisorba minor*	+	.	.	+	+	.	+	+	+	.	.	+	+	.	+	.	+	.	+	.	+	+	+	.	.	+	.	.
H	Eur-Med	*Scabiosa columbaria*	.	+	+	.	+	+	+	.	+	+	+	.	.	+	.	+	+	.	+	.	.	+	+	+	.	.	.	+
H	Eur	*Euphorbia cyparissias*	+	+	+	+	+	+	+	.	.	.	+	+	+	.	+	.	.	+	.	.	+	.	+	+	.	.	+	.
H	Eur	*Carlina acanthifolia*	.	.	+	.	+	+	.	.	.	.	+	.	.	.	+	.	+	.	+	+	.	+	.	.	.	.	+	+
H	Eur-Med	*Veronica austriaca* s. *jacquinii*	+	+	+	+	+	+	+	+	+	+	+	.	+	+	.	+	+	+	.	+	+	.	+	.	+	+	+	+
H	Pont-Med	*Eryngium campestre*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur	*Koeleria macrantha*	.	.	.	1	.	.	+	1	1	+	.	+	+	.	+	.	.	1	+	.	.	+	+	.	+	.	.	.
H	Boreal	*Carex caryophyllea*	+	+	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
H	Eur-Sib	*Fragaria viridis*	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	+	+	.	.
T	Eur-Med	*Minuartia viscosa*	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	+	.	.	+	+	.	+	.	.	.	.	.	.
H	Eur-Med	*Anthylis vulneraria*	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
H	Eur-Med	*Dorycnium herbaceum*	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	2	.	.	+	.	.	.	.	.	.	.	.
T	subMed	*Euphrasia pectinata*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
H	Eur-Sib	*Achillea millefolium*	+	.	.	.	+	+	.	+	.	+	.	+	.	.	.	+	.	.	1	+	.	1	.	.	.	.	.	+
H	Kos	*Hypericum perforatum*	.	.	.	.	.	+	+	+	.	+	.	.	.	+	.	+	+	.	+	+	+	+	+	.	+	+	.	+
H	subMed	*Teucrium montanum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Med	*Hieracium praealtum* s. *bauchinii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
H	Eur-As	*Carex humilis*	+	.	+	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Kos	*Poa angustifolia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	SPont	*Onobrychis arenaria*	.	.	+	+	.	1	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.
H	Pont	*Festuca valesiaca*	2	.	.	.	.	2	+	.	.	.	.	.	.	.	1	.	1	1	.	1	2	1	.	.	.	.	1	.
H	subMed	*Thesium linophyllon*	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.
H	subMed	*Trinia glauca*	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Ch	Alp-Med	*Helianthemum nummularium*	.	.	+	.	+	.	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Med	*Inula oculus-christi*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-OT	*Campanula glomerata*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
H	Eur	*Stipa pennata*	.	.	.	3	.	.	3	.	.	+	.	.	.	3	.	.	.	.	.	.	.	.	.	4	.	.	.	.
H	Eur	*Danthonia alpina*	.	.	.	.	+	.	.	.	.	.	1	+	.	.	.	.	.	.	+	1	.	+	.	.	.	.	+	.
H	Eur-As	*Medicago lupulina*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																														
H	Eur-As	*Chamaecytisus calcareus*	1	.	.	+	.	.	+	.	+	.	+	+	+	+	+	+	.	+	.	+	.	.	+	+	+	+	.	+
Ch	Eur	*Chamaespartium sagittale*	.	+	+	+	1	.	+	+	1	+	+	+	1	+	+	2	1	+	.	2	1	.	+	+	+	1	+	1
H	sMed-Cas	*Cruciata glabra*	.	+	.	.	+	.	.	.	.	+	+	+	+	+	.	+	.	.	.	+	+	.	.	+	+	+	+	+
H	Boreal	*Festuca rubra*	1	.	.	1	.	.	.	4	.	3	+	.	3	.	.	3	2	1	1	1	.	1	.	2	.	2	.	2
T	subBoreal	*Linum catharticum*	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
T	subMed	*Sideritis montana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		Tortella tortuosa	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
T	Med	*Cirsium ligulare*	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	SPont	*Trifolium montanum*	.	.	+	.	.	+	+	.	+	.	.	.	.	+	+	.	.	+	+	+	.	+	+	.	.	1	+	1
H	Kos	*Convolvulus arvensis*	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
T	Eur-CAs	*Vicia villosa*	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	1	+	.	.	.
H	Med	*Scorzonera hispanica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Alp-Carp-Bal	*Festuca paniculata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		Schistidium apocarpum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch	Eur-Sib	*Genista tinctoria*	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	+	+	+	.	+	.	.	+	+	.	.	+	.
H	Boreal	*Agrostis capillaris*	.	.	.	.	1	.	.	1	.	1	+	.	1	.	.	.	+	1	2	1	.	2	+	.	+	1	.	2
H	subBoreal	*Luzula campestris*	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	+	+	+	+	+	.	+	.	+	.	.	.	.
		Hypnum cupressiforme	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Sib	*Leontodon autumnalis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Med	*Acinos alpinus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-As	*Poa badensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-OT	*Salvia nemorosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Boreal	*Elymus repens*	+	.	.	1	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Sib	*Cichorium intybus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur	*Globularia aphyllanthes*	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
H	sMed-As	*Dichantium ischaemum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-subMed	*Phleum pratense*	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
H	SPont	*Potentilla argentea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.

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		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
G	Pont-Med	*Hyacintella leucophaea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+
H	Bal	*Pedicularis grisebachii*	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Ap-Bal	*Verbascum lichnitis*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
H	SPont	*Ajuga genevensis*	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.
H	Eur-Med	*Stachys recta*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
G	Med	*Allium flavum*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Bi	Boreal	*Arabis hirsuta*	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
H	Pont-Bal	*Asyneuma canescens*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
T	Eur	*Rhinanthus angustifolius*	.	.	+	+	.	+	.	+	.	+	.	.	.	+	.	.	.	.	.	.	3	.	.	.	.	+	.	.
H	subMed	*Cerastium banaticum*	+	.	.	.	+	.	+	.	+	.	.	.	+	+	+	.	+	+	+	.	+	+	+	.	.	.	.	.
H	Eur-Sib	*Leucanthemum vulgare*	.	.	.	.	.	+	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
G	Med-OT	*Muscari neglectum*	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	+	.	.	.	.	.
H	Eur-subMed	*Achillea collina*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.
H	Eur-subMed	*Rumex acetosella*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
H	Kos	*Poa pratensis*	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
H	Kos	*Plantago lanceolata*	.	.	.	.	.	+	+	.	+	+	.	+	+	+	+	+	+	.	+	+	.	+	+	+	.	+	+	.
H	Boreal	*Festuca pratensis*	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Boreal	*Festuca panciciana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
T	Med-CAs	*Acinos rotundifolius*	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Boreal	*Viola canina*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	subMed	*Anthericum liliago*	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Bal	*Pastinaca hirsuta*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
H	Pont-Med	*Hypericum linarioides*	+	+	.	1	+	1	1	.	.	.	1	1	+	+	+	+	1	+	.	+	+	.	.	1	.	.	.	.
H	Eur-As	*Dactylis glomerata*	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Med	*Scorzonera cana*	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.
H	Pont-subMed	*Pimpinella tragium*	.	.	+	.	+	+	.	.	.	.	+	+	.	.	+	+	+	.	.	+	+	.	.	+	+	.	.	.
H	Eur-Med	*Coronilla varia*	.	.	.	.	.	+	1	+	.	1	.	.	.	.	.	.	.	+	+	.	+	+	.	.	+	.	.	.
H	Pont	*Bromus riparius*	.	.	.	3	.	1	+	+	3	1	1	.	1	.	1	.	.	1	1	.	+	1	2	2	2	+	1	.
T	Eur-As	*Alyssum minus*	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	+	+
H	Eur-As	*Rumex thyrsiflorus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
H	Eur-Sib	*Ferulago campestris*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
H	subMed	*Thlaspi praecox*	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
H	subMed	*Mercurialis ovata*	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	subMed	*Thesium bavarum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.
H	Kos	*Ranunculus acris*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	+	.	.	.	.	.	.
H	Eur-Med	*Hypochaeris maculata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
H	Med	*Potentilla pedata*	.	.	.	.	.	+	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
H	Eur-As	*Anthoxanthum odoratum*	.	.	.	.	.	.	.	.	.	+	.	.	1	1	.	1	1	2	1	1	1	1	.	1	.	1	1	1
H	Eur-Sib	*Carex montana*	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
H	Bal	*Silene roemeri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
H	subMed	*Inula germanica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.
		Centaurea sp.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.
H	Boreal	*Hypericum maculatum*	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
H	Eur-As	*Bromus barcensis*	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	+	2	.	.	.	.	+	.	.	.	.	.
Bi	Eur	*Carduus acanthoides*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-Sib	*Knautia arvensis*	.	.	+	+	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Kos	*Prunella vulgaris*	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		Ditrichum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
G	Eur-subMed	*Ornithogalum kochii*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
G	Med-OT	*Centaurea pannonica*	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	.
H	Boreal	*Stellaria alsine*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
H	subBoreal	*Lathyrus pratensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
H	Eur-As	*Veronica chamaedrys*	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.
H	Eur-Med	*Lotus corniculatus*	+	+	.	.	+	.	.	+	.	.	+	.	+	.	.	.	.	+	+	.	+	+	.	+	.	.	.	+
H	subMed	*Ranunculus repens*	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch	Boreal	*Juniperus sibirica*	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Pont	*Alchemilla erythropoda*	.	.	.	.	+	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch	Bal	*Chamaecytisus jankae*	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
H	Eur-subMed	*Poa compressa*	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

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Species in less than 3 relevés: Scleranthus perennis 51: +, 54: +; Rosa sp. 49: r; Crataegus monogyna 57: r; Thesium divaricatum 52: +; Vicia sativa 52: +, 65: +; Stachys germanica 53: +, 58: +; Verbascum phoeniceum 52: +; Petrorhagia saxifraga 54: +; Satureja montana s. kitaibelii 1: 2; Poa trivialis 29: +; Centaurea jacea 6: +; Sedum album 54: +; Echium vulgare 51: +; Vincetoxicum hirundinaria 16: r; Hypochaeris radicata 35: +, 39: +; Hypochaeris glabra 26: +; Plantago argentea 35: +; Orchis morio 30: +, 61: +; Carex hallerana 14: 3; Agrimonia eupatoria 49: +; Orchis tridentata 19: +, 20: +; Allium carinatum 44: +; Orobanche elatior 30: +, 37: +; Festuca pseudodalmatica 36: +; Thesium arvense 44: +, 45: +; Ranunculus bulbosus 36: +; Gymnadenia conopsea 3: +; Muscari tenuiflorum 58: +; Campyliadelphus chrysophyllus 68: +; Polygala oxyptera 49: +; Myosotis laxa 44: +; Tragopogon pterodes 20: +, 65: +; Avenula compressa 32: +, 39: +; Centaurea chrysolepis 32: +; Botrychium lunaria 2: +, 61: +; Iris reichenbachii 9: +; Potentilla erecta 31: +, 47: 1; Bistorta major 33: +; Viola reichenbachiana 38: +; Agrostis stolonifera 59: +; Arrhenatherum elatius 41: +; Campanula sparsa 34: +, 40: +; Hypericum rumeliacum 44: +; Linum nervosum 34: +; Ononis arvensis 13: +; Mentha spicata 23: +; Bromus squarrosus 4: 1; Trifolium incarnatum 56: +; Helleborus odorus 44: +, 57: +; Elymus hispidus 49: +; Trifolium sp. 33: +; Anthriscus sylvestris 44: +; Linum tauricum 3: 2, 14: 1; Potentilla rupestris 34: +; Polygala vulgaris 56: +; Antennaria dioica 13: +; Brachythecium velutinum 34: +; Bromus moesiacus 32: 1; Helianthemum salicifolium 25: +; Campanula persicifolia 2: +, 39: +; Cotoneaster nebrodensis 1: +, 2: r; Scabiosa triniifolia 41: +, 61: +; Agrostis gigantea 44: 2; Cirsium vulgare 21: +, 24: +; Sanguisorba officinalis 6: +; Cerastium fontanum 47: +; Juniperus communis 18: r; Filipendula ulmaria 17: 1; Chamaecytisus lejocarpus 60: +; Gentianella lutescens 60: +, 61: +; Cetraria islandica 49: +, 53: +; Prunus spinosa 67: r; Crupina vulgaris 1: +, 23: +; Clinopodium vulgare 21: +; Tanacetum corymbosum 44: +; Comandra elegans 45: +; Cynoglossum hungaricum 44: +; Orthotrichum anomalum 52: +; Weissia sp. 54: +, 62: +; Nepeta nuda 37: +; Agrostis canina 34: 1; Bellardiochloa violacea 22: +; Taraxacum sp. 52: +; Bryum moravicum 2: +; Euphorbia niciciana 8: +, 17: +; Carduus nutans 41: +; Cirsium arvense 19: +, 22: +; Stellaria graminea 5: +; Sedum hispanicum 1: 1, 20: +; Viola dacica 28: +, 48: +; Rhytidium rugosum 13: +; Molinia arundinacea 34: +; Viola sp. 33: 1; Knautia drymeja 32: +; Grimmia pulvinata 53: +; Pinus sylvestris 53: r, 68: r; Cuscuta approximata 48: +; Abietienella abietina 13: +, 60: +; Rhinanthus minor 1: +; Nardus stricta 27: 1; Carex hirta 22: +; Echium russicum 32: +; Polygala comosa 44: +; Hedwigia ciliata 54: +; Trifolium repens – 14 (+), 49 (+); Scorzonera hispanica – 17 (+), 18 (+); Centaurea orientalis – 51 (+), 63 (+); Thlapsi kovatchii – 2 (+), 50 (+);

1 – 02.07.2009, N43.07611, E 23.19072; 2 – 05.07.2009, N43.08124, E 23.20570; 3 – 05.07.2009, N43.08278, E 23.19751;
4 – 02.07.2009, N43.07979, E 23.19936; 5 – 14.07.2009, N43.07379, E 23.24232; 6 – 02.07.2009, N43.07144, E 23.18933,
7 – 02.07.2009, N43.08059, E 23.20518; 8 – 05.07.2009, N43.08851 E 23.20730; 9 – 24.06.2009, N43.09267, E 23.12220;
10 – 30.06.2009, N43.08862, E 23.20363; 11 – 14.07.2009, N43.05858, E 23.23424; 12 – 14.07.2009, N43.05416, E 23.22411;
13 – 02.07.2009, N43.08393, E 23.20358; 14 – 30.06.2009, N43.08946, E 23.21773; 15 – 14.07.2009, N43.05635, E 23.24172;
16 – 26.06.2009, N43.05635, E 23.24172; 17 – 02.07.2009, N43.09226, E 23.18225; 18 – 30.06.2009, N43.07670, E 23.20835;
19 – 02.07.2009, N43.08834, E 23.22453; 20 – 01.07.2009, N43.07850, E 23.21309; 21 – 01.07.2009, N53.08380, E 23.22468;
22 – 03.07.2009, N43.08392, E 23.22047; 23 – 30.06.2009, N43.08851, E 23.20730; 24 – 30.06.2009, N43.09205, E 23.20390;
25 – 26.06.2009, N43.08918, E 23.18425; 26 – 25.06.2009, N43.09676, E 23.13872; 27 – 30.06.2009, N43.08892, E 23.22125;
28 – 24.06.2009, N43.09784, E 23.13198; 29 – 05.07.2009, N43.08277, E 23.28351; 30 – 04.07.2009, N43.02832, E 23.27383;
31 – 02.07.2009, N43.09150, E 23.12836; 32 – 24.06.2009, N43.09730, E 23.12607; 33 – 24.06.2009, N43.09917, E 23.12813;
34 – 04.07.2009, N43.06542, E 23.30272; 35 – 02.07.2009, N43.09605, E 23.20374; 36 – 14.07.2009, N43.06807, E 23.23543;
37 – 30.06.2009, N43.09205, E 23.20390; 38 – 25.06.2009, N43.10619, E 23.13399; 39 – 13.07.2009, N43.08379, E 23.28529;
40 – 13.07.2009, N43.08149, E 23.28232; 41 – 01.07.2009, N43.08632, E 23.21497; 42 – 02.07.2009, N43.09579, E 23.13183;
43 – 14.07.2009, N43.07958, E 23.12306; 44 – 15.07.2009, N43.06050, E 23.26979; 45 – 13.07.2009, N43.07133, E 23.29821;
46 – 23.06.2009, N43.07720, E 23.12565; 47 – 16.07.2009, N43.05607, E 23.26969; 48 – 15.07.2009, N43.05838, E 23.25244;
49 – 15.07.2009, N43.05377, E 23.26181; 50 – 13.07.2009, N43.07084, E 23.28555; 51 – 15.07.2009, N43.06817, E 23.26210;
52 – 15.07.2009, N43.05601, E 23.26008; 53 – 14.07.2009, N43.05165, E 23.22029; 54 – 13.07.2009, N43.07447, E 23.27767;
55 – 15.07.2009, N43.06029, E 23.25981; 56 – 13.07.2009, N43.07493, E 23.27945; 57 – 15.07.2009, N43.05604, E 23.25277;
58 – 14.07.2009, N43.06120, E 23.22855; 59 – 16.07.2009, N43.05458, E 23.27213; 60 – 14.07.2010, N43.06403, E 23.24892;
61 – 02.07.2009, N43.09245, E 23.11606; 62 – 23.06.2009, N43.08713, E 23.11847; 63 – 02.07.2009, N43.09290, E 23.11411;
64 – 16.07.2009, N43.09324, E 23.11292;