HACQUETIA 9/2 • 2010, 185–206

DOI: 10.2478/v10028-010-0010-2

BROMO MOESIACAE-STIPETUM EPILOSAE – A NEW ASSOCIATION FROM THE RELICT MOUNTAIN STEPPE VEGETATION IN SOUTH-WESTERN BULGARIA

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Abstract

A syntaxonomical analysis of the dry grasslands (*Festuco-Brometea*) in Bosnek karst region, Mt Vitosha (SW Bulgaria) has been carried out. These grasslands are part of the intrazonal vegetation distributed within the belts of xerophilous oak and mesophilous beech forest in the south-western foothills of the mountain. The bedrock is carbonate, the soils are dry and shallow, climate – moderate continental. This vegetation grows mostly on steep slopes, with southern and south-western exposition. Apart from the typical for *Festuco-Brometea* calcicoles, the studied vegetation is characterized by many endemic (regional and local) species and at the same time includes a lot of Mediterranean species. As a result of the analysis, a new association, *Bromo moesiacae-Stipetum epilosae* ass. nova, has been established that belongs to the alliance *Saturejon montanae*. A comparison with related syntaxa from other karst mountains from SW Bulgaria and E Serbia is made, and some conclusions about the origin of the steppe vegetation in that region are drawn.

Keywords: calcareous grasslands, dry grasslands, phytosociology, syntaxonomy, *Festuco-Brometea*, *Saturejon montanae*.

Izvleček

Naredili smo sintaksonomsko analizo suhih travnikov (*Festuco-Brometea*) v kraškem območju Bosnek v gorovju Vitoša (jugozahodna Bolgarija). Ti travniki so del intraconalne vegetacije, razširjene v pasu kserofilnih hrastovih in mezofilnih bukovih gozdov na jugozahodnih vznožjih hribovja. Matična podlaga je karbonatna, tla so suha in plitva, podnebje je zmerno celinsko. Vegetacija uspeva na strmih naklonih z južno in jugozahodno ekspozicijo. Poleg značilnih vrst razreda *Festuco-Brometea* označujejo preučevano vegetacijo številne endemične (regionalne in lokalne) vrste in številne sredozemske vrste. Kot rezultat smo opisali novo asociacijo *Bromo moesiacae-Stipetum epilosae* ass. nova, ki jo uvršč amo v zvezo *Saturejon montanae*. Naredili smo tudi primerjavo s sorodnimi sintaksoni s kraških gorovij jugozahodne Bolgarije in vzhodne Srbije in podali nekaj zaključkov o izvoru stepske vegetacije v preučevanem območju.

Ključne besede: apnenčasti travniki, suhi travniki, fitosociologija, sintaksonomija, *Festuco-Brometea*, *Saturejon montanae*.

1. INTRODUCTION

The Bosnek karst region (Mt Vitosha, SW Bulgaria) is the only site on the mountain built up from calcareous bedrock and covered, even though partially, by steppe vegetation. Surprisingly, up to now it has not been explored from a phytosociological point of view, although quite a few similar phytocoenoses have been described from other low-hilly mountains in the same region (SW Bulgaria): Dragoman region (Velchev 1962), Mt Golo bardo (Apostolova-Stoyanova et al. 2005) and Mt Lozenska (Pedaschenko et al. 2009) (see the discussion in chapter 3). The aim

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of the present study was to find out the syntaxonomical position of the dry grasslands, their relation to similar syntaxa described from SW Bulgaria and SE Serbia and, at the end, to give some reasonable explanation for their species composition and origin.

2. METHODS AND MATERIALS

The principles and methods of the Zürich-Montpellier School (Braun-Blanquet 1951, Mueller-Dombois & Ellenberg 1974, Westhoff & van der Maarel 1980) were applied. We chose the plot size of 10×10 sq. m as most adequate to make a more or less typical description of dry grasslands (Westhoff & van der Maarel 1980). As a result of the sampling 38 relevés were made, which makes up to approximately 80 % of the Bosnek karst region's territory covered with dry grasslands. At each sampling plot a complete list of the present species (vascular plants) was recorded, together with their cover-abundance value according to the 7-degree Braun-Blanquet scale - the one transformed by Barkman et al. (1964). For facilitating the statistical computer programs, the same scale is used, but transformed into ordinal numbers (Westhoff & van der Maarel 1980).

For digitalizing and storing of the data we used the computer software TurboVeg (Hennekens & Schamineé 2001). The sorting of the relevés was made in JUICE software (Tichý 2002). For the purpose of the numerical classification the TWINSPAN method is applied (TWo-way INdicator SPecies ANalysis) (Hill 1979) integrated in JUICE software. The results of the TWINSPAN analysis were compared with the cluster analysis made with the computer program SYN-TAX (Podani 2002), which was kindly provided by Dr. Marius Dimitrov (University of Forestry).

The diagnostic species of the published syntaxa were identified according to Horvat et al. (1974) and other referenced literature (see Chapter 3 – Syntaxonomical position). The syntaxa names and the names of their authors are given according to ICPN (Weber et al. 2000). The names of

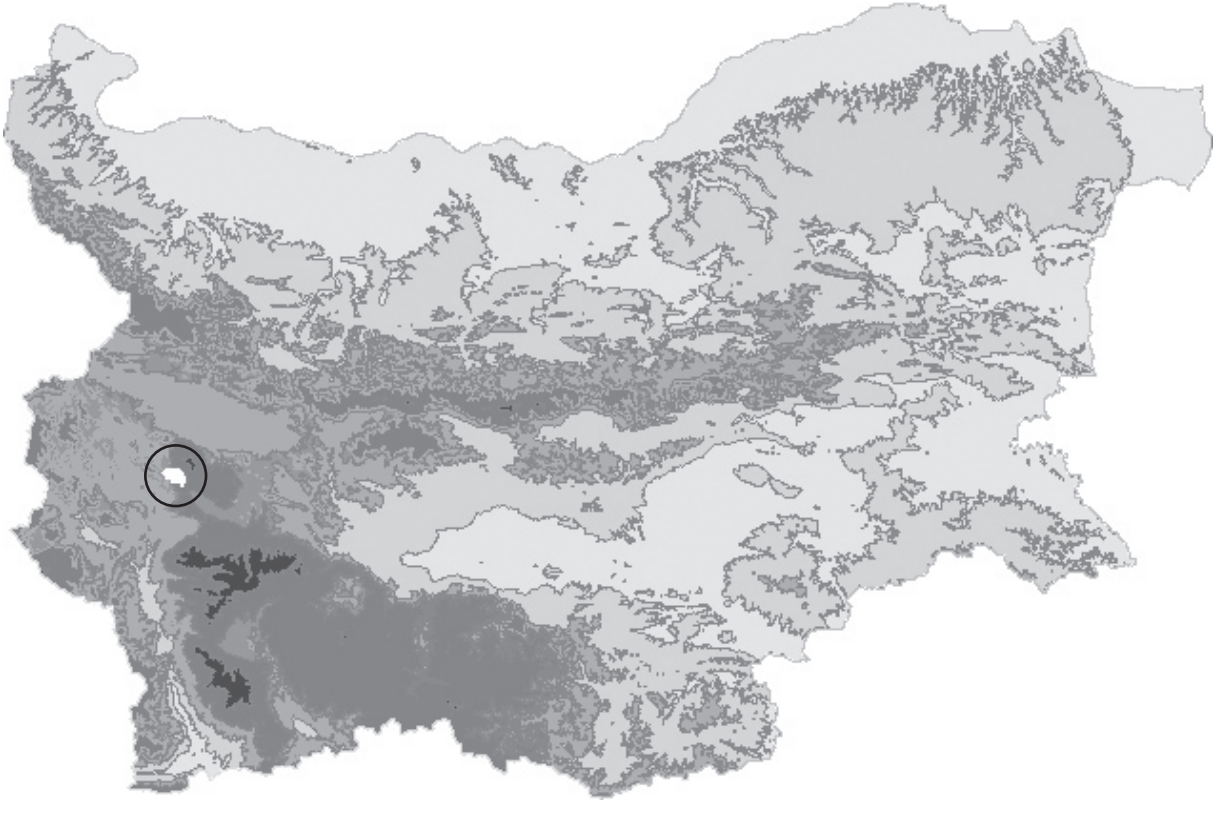

Figure 1: Location of the studied area on the map of Bulgaria.
Slika 1: Lokacija obravnevanega območja na zemljevidu Bolgarije.

the plant taxa are given according to Delipavlov & Cheshmedzhiev (2003). The floristic elements of the taxa are given according to Asyov et al. (2005), except for the subspecies (those for which there is no data available in Asyov et al. 2005), which are given according to Meusel et al. (1965). The life form of the species is given according to Raunkiaer (1934).

The object of the present study – dry grasslands – covers approximately 20 % of the Bosnek karst region. The region lies within the southwestern foothills of Mt Vitosha, SW Bulgaria, and includes a branchy flattish mountainous area (approximately 23 sq. km). The altitude varies between 830 and 1500 metres a. s. l. (see Figure 1). The bedrock consists of limestone and dolomite (Zagorchev et al. 1994). The karst rocks cover approximately 80 % of the entire territory. The type of climate is temperately continental (Velev 2002), i.e. winters are cold and humid, and summers hot and dry, but the limestone bedrock and the shallow soils mitigate the local weather conditions in the winter and intensify them in the summer.

From a geobotanical point of view, the territory of the Bosnek karst region belongs to the Vitosha floristic region – part of the Illyric (Balkanic) province of the European deciduous forest region (Bondev 2002). Its borders lie within the belts of xerophilous oak and hornbeam forests and that of mesophilous beech forests.

3. RESULTS & DISCUSSION

The analysis of the sampled phytosociological material manifests the existence of one single association which covers the entire territory of the Bosnek karst region. 38 relevés have been made, from which 3 were dropped out as a result of the cluster analysis made in SYN-TAX (Figure 2).

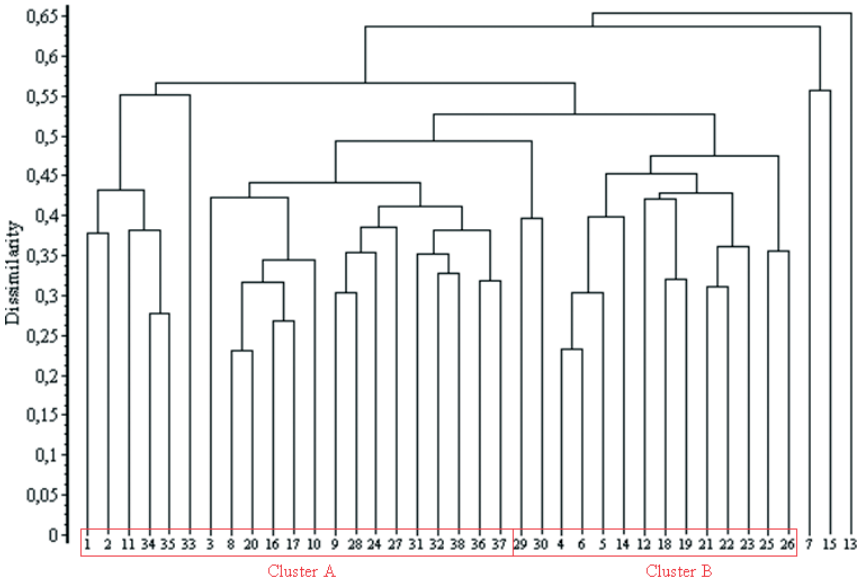

Figure 2: The result of the cluster analys of the relevés from Bosnek karstic region made in the computer program SYN-TAX (Podani 2002): A + B – *Bromo moesiacae-Stipetum epilosae* ass. nov.; A – var. *typicum*; B – var. *siderites montana.*

Slika 2: Rezultat klastrske analize popisov s kraškega območja Bosnek s programom SYN-TAX (Podani 2002): A + B – *Bromo moesiacae-Stipetum epilosae* ass. nova; A – var. *typicum*; B – var. *sideritis montana.*

Characteristics of the studied phytocoenoses

In Bosnek karst region the studied vegetation is to be found on open, rocky places with poor soils (Figure 3). The structure of the phytocoenoses varies from an open to an almost closed one, as the total vegetation cover varies from 20 % to 95 % per plot. The mean cover is 75 %. The studied vegetation grows most frequently on slopes with southern exposition. The slope varies between 0° and 65°, mean – 17°. The soils are mostly rendzinas – shallow, more or less eroded (Ninov 2002). The base rock is to be seen at the surface in many places as large fragments in different sizes or as gravel. In some sites the bare rock covers more than 60 % of the sample plot (see Table 1).

Figure 3: The studied vegetation is to be found on open, rocky places with poor soils. The bedrock is dolomite and carbonate.
Slika 3: Proučevano vegetacijo najdemo na odprtih, kamnitih rastiščih na slabo razvitih tleh. Matična podlaga je dolomit in apnenec.

The studied phytocoenoses are characterized by the little presence of trees and shrubs. There are only solitary shrubs and low trees such as *Juniperus communis, Rosa myriacantha, Rosa agrestis, Rosa dumalis, Rosa canina, Corylus avellana*, etc. They are bounded by remains of open xerothermic forests frequently dominated by *Quercus pubescens* and by other xerothermic species such as *Fraxinus ornus*, *Carpinus orientalis*, *Cornus sanguinea*, etc. In the highest parts of the region they are surrounded by mesothermic forests with *Fagus sylvatica* (Figure 4).

Figure 4: A general view to Bosnek karst region – the dry grasslands are bordered by mesothermic forests with *Fagus sylvatica* or remains of light xerothermic oak forests in the lower parts.
Slika 4: Pogled na območje Bosnek – suhi travniki so omejeni z mezotermnim bukovim gozdom ali ostanki kserotermnih hrastovih gozdov v spodnjem delu.

Figure 5: In the vegetation of Bosnek karst region there are a lot of aromatic chamaephytes such as *Hyssopus officinalis* spp. *aristatus.*
Slika 5: V vegetaciji kraške regije Bosnek je mnogo aromatičnih hamefitov kot *Hyssopus officinalis* spp. *aristatus.*

The studied phytocoenoses are rich in species. The mean number of species is 46 but their number varies from 34 to 62 per relevé (see Table 1). The main dominants are grasses (*Poaceae*) and sedges (*Cyperaceae*) but frequent are also the aromatic chamaephytes from *Lamiaceae* (Figure 5). Typical for the phytocoenoses is the seasonality in flowering time, i.e. change in the color aspect of the community. In spring (March-April) *Carex humilis* (IV) and *Potentilla cinerea* (III) represent the yellow aspect and *Hyacinthella leucophaea* (II) and *Muscari neglectum* (II) represent the blue one. In the beginning of the summer (May-June) start to blossom most of the dominating species such as *Stipa epilosa* (V), *Bromus moesiacus* (V), *Thymus striatus* (V), *Hypericum rumeliacum* (V) (Figure 6).

Figure 6: Stipa *epilosa* gives a characteristic spectrum of the studied phytocenoeses in spring time.
Slika 6: *Stipa epilosa* daje značilen videz proučevani združbi v spomladanskem času.

The new syntaxon

As a result of the numerical classification and the comparison with similar associations from Bulgaria and Serbia, we designated a new association *Bromo moesiacae-Stipetum epilosae* ass. nova, hoc. loco, **holotypus nom. rel. 17,** with the following diagnostic species *Stipa epilosa* (V), *Bromus moesiacus* (IV), *Tragopogon balcanicus* (III), *Pimpinella tragium* subsp. *lithophila* (V), *Asphodeline taurica* (IV), *Thymus striatus* (V), *Hypericum rumeliacum* (V) (Table 1). We consider this association to be a part of the relict petrophyte steppes, which centre of floristic differentiation and endemic plant species origin lies in the foot-hills of low karst mountains in West Bulgaria and East Serbia. Such steppic phytocoenoses are distinguished by the presence of vicariant species, especially among the grasses, by the degree of Mediterranean and Ponto-continental phytogeographical influences (which decrease to the north and to the west respectively) and by the number of endemics. Regarding the endemism, the newly established association is richer than those of Suva and Rtnaj Mts (see Jovanović-Dunjić 1955, 1956; Diklić 1962).

From a syntaxonomical point of view, we distinguish two variants regarding the extent of grazing effect and ruderalization. Phytocoenoses of variant *typicum* are dominated by hemicryptophytes and occupy sites where there is no grazing, or else the grazing is very limited. For example, the territory of the fenced Vitoshko-Stoudena game breeding station or on rocky steep slopes which are difficult to be accessed and have a low percent of total vegetation cover (Figure 7). The phytocoenoses of variant *Sideritis montana* include many therophytes and are distributed in more open and disturbed sites – usually close to dirt roads (Figure 8). In the phytocoenoses of that variant, ruderals and weeds such as *Sideritis montana* (V), *Alyssum alyssoides* (IV), *Filago lutescens* (IV), *Xeranthemum annuum* (II) are widely spread. *Dorycnium herbaceum* and *Melica ciliata* are differential species for variant *Sideritis montana* and variant *typicum* respectively.

Figure 7: For variant *typicum* are characteristic species such as *Globularia aphyllanthes*, *Scabiosa triniifolia*, *Jurinea consanguinea.*
Slika 7: Za tipično varianto so značilne vrste *Globularia aphyllanthes*, *Scabiosa triniifolia*, *Jurinea consanguinea.*

Figure 8: In variant *Sideritis montana* dominate therophytes such as *Sideritis montana*.
Slika 8: V sestojih variante *sideritis montana* prevladujejo terofiti kot je *Sideritis montana*.

Syntaxonomical position

These communities are of continental-steppe origin and belong to the typical steppes characteristic for East and Central Europe – *Festuco-Brometea* Br.-Bl. & Tüxen 1943 and *Festucetalia valesiacae* Br.-Bl. & Tüxen 1943. We consider that it belongs to the alliance *Saturejon montanae* Horvat 1962, since many of the diagnostic species given for the alliance are presented with high constancy also in the newly established association (e.g. *Satureja montana* subsp. *kitaibelii, Carex humilis, Potentilla cinerea, Festuca dalmatica, Rhodax canus, Artemisia alba, Teucrium montanum, Onobrychis alba, Asperula purpurea*).

On the one hand, *Saturejon montanae* is described as a geographically and floristically autonomous syntaxon by Royer (1991) in his work on *Festuco-Brometea* in Europe. On the other hand, according to the synopsis that generalizes the vegetation in Serbia (Kojić et al. 1998), the steppe associations from Mts Suva and Rtanj are included in the more widely distributed *Festucion valesiacae*. Probably this is the reason why it was excluded from the list of the European syntaxa (Rodwell et al. 2002), as well as from SynBioSys Europe (http://www.synbiosys.alterra.nl/eu). We consider that the present study confirms the presence of such an alliance distributed within the range of West Bulgaria and partially in former Yugoslavia. Publications from other Bulgarian authors also confirm the presence of *Saturejon montanae* in SW, SE and N Bulgaria (Tzonev 2002, Apostolova-Stoyanova et al. 2005, Sopotlieva 2009, Pedaschenko et al. 2009).The diagnostic species of the alliance (Horvat et al. 1974) are adequate as characteristic ones and define its appearance, thus distinguishing it from *Festucion valesiacae*. In contrast to the latter alliance, in which phytocoenoses dominate perennial grasses on rich soils, phytocoenoses of *Saturejon montanae* are relatively open petrophyte steppes where grasses are co-dominants with tufted chamaephytes rich in aromatic oils, mainly from *Lamiacaeae* (*Satureja* spp., *Thymus* spp., *Hyssopus* spp., *Teucrium* spp.). These petrophyte steppes are to be found in the transitional zone between the continental and the mediterranean climate and their range coincides with that of the endemic for the Balkans species *Satureja montana* subsp. *kitaibelii*.

Comparison with similar syntaxa from SW Bulgaria and E Serbia

There are several publications dealing with steppe vegetation in the karst low-hilly mountains in SW Bulgaria and E Serbia. Velchev (1962) describes similar associations from the region of Dragoman – Belediye Han, but using the dominant method for classification. Three provisional associations were described from Mt Golo bardo (West Bulgaria) by Apostolova-Stoyanova et al. (2005) using the Blaun-Blanquet floristic approach. These associations belong to *Satureion montanae* Horvat 1962. Out of the three, *Bromo moesiacae-Festucetum valesiacae* nom. prov. should be considered as most similar to *Bromo moesiacae-Stipetum epilosae* ass. nova. *Bromus moesiacus*, *Astragalus angustifolius, Bupleurum falcatum* and *Centaurea chrysolepis* are given as diagnostic species; *Festuca valesiaca*, *Artemisia campestris* (more probably *Artemisia alba*), *Satureja montana* – as dominants. Despite the similarity in floristic composition and dominating species, most of the diagnostic species in the provisional syntaxon from Mt Golo bardo are not present in the new association. Actually, the syntaxon from Mt Golo bardo is closer to *Astragalo-Silenetum supinae* N. Ranđ. & V. Milos. 2005 from Mt Rudina in Serbia. In the latter association a significant role is played by *Astragalus angustifolius* (Milosavljević & Ranđelović 2006) – a species absent from *Bromo moesiacae-Stipetum epilosae*. Despite the presence of many common

species (*Allium cupani, Convolvulus cantabrica, Satureja montana, Thymus striatus*), most of the species characteristic for *Carici-Festucetum stojanovii* N. Ranđ. & V. Milos, 2005; *Fritillario-Seslerietum rigidae* N. Ranđ. & V. Milos. 2004; *Edraiantho-Anthylletum aureae* N. Ranđ. & V. Milos. 2005 do not have a diagnostic role or are not present at all in *Bromo moesiacae-Stipetum epilosae*. These are *Sesleria rigida, Silene supina, Astragalus wilmottianus, Aster linosyris, Edraianthus serbicus, Achillea serbica*, etc (see Milosavljević & Ranđelović 2006).

Very close to *Bromo moesiacae-Stipetum epilosae* remain several associations described from East Serbia – mainly in Mt Suva and Rtanj (Jovanović-Dunjić 1955, 1956, Diklić 1962) and one from West Bulgaria – Lozenska planina (Pedashenko et al. 2009). There is a main core of species common to the Serbian syntaxa and the phytocoenoses from Mt Golo bardo, Mt Lozenska and the Dragoman karst region (West Bulgaria) (Velchev 1962, Apostolova-Stoyanova et al. 2005, Pedashenko et al. 2009). These are *Satureja montana* subsp. *kitaibelii, Artemisia alba, Carex humilis, Potentilla cinerea, Asperula purpurea, Teucrium montanum, Melica ciliata, Teucrium chamaedrys, Euphorbia cyparissias*. Future studies would possibly confirm the presence of that main core in other low karst mountains in West Bulgaria and East Serbia. Most of the listed species are specific for the climatic and edaphic conditions of that geographic region. Other species are widespread in many places in Bulgaria.

Since the phytosociological relevance of *Bromo moesiacae-Stipetum epilosae* and of the published syntaxa from East Serbia is quite obvious, we assume that it is expedient to look at the syntaxonomical similarities and differences between each of the above-mentioned associations and *Bromo moesiacae-Stipetum epilosae* (Table 2).

Myrsiniteto-Ischaemetum R. Jov. 1955 from Mt Suva has several essential similarities with *Bromo moesiacae-Stipetum epilosae* ass. nova, the main one being the high constancy of species such as *Fumana procumbens* (IV), *Satureja montana* (IV), *Melica ciliata* (V). On the other hand, most of the diagnostic species of that association are either not present or occur with low constancies in *Bromo moesiacae-Stipetum epilosae*. Among the latter are *Botriochloa ischaemum* and *Euphorbia myrsinites* (giving the name of the Serbian association), *Allium moschatum, Chamaecytisus jankae, Adonis vernalis, Haplophyllum suaveolens*. Many species frequent in *Bromo moesiacae-Stipetum epilosae* are fully absent in phytocoenoses of *Myrsiniteto-Ischaemetum*.

Potentilleto-Caricetum humilis R. Jov. 1955 and *Potentilleto-Caricetum humilis* R. Jov. 1955 subass. *artemisieosum camphoratae* Diklić 1962 are even closely related to *Bromo moesiacae-Stipetum epilosae* ass. nov (Jovanović-Dunjić 1955, 1956, Diklić 1962). Common species (with high constancy for both) are presented by species from the previously mentioned main core as well as others such as *Veronica austriaca, Galium album*, etc. However, the differences are greater because both Serbian associations miss the gramineous species that dominate in *Bromo moesiacae-Stipetum epilosae*, in particular genus *Stipa*. Gramineous species from the Serbian associations with relatively high constancy are *Festuca pančičiana* (IV, IV) and *Sesleria rigida* (II, III); both absent from *Bromo moesiacae-Stipetum epilosae*. On top of that, on Mt Suva, which is a relatively high mountain (up to 1810 a.s.l.), there are some subalpine species such as *Veratrum lobelianum, Arctostaphyllos uva-ursi, Juniperus nana*; that is to show that its grassland communities are quite mesophytic. Completely absent are many Mediterranean species, in particular some hemicryptophytes and therophytes such as *Hypericum rumeliacum, Hippocrepis comosa*, *Coronilla scorpioides, Odontites glutinosa,* etc. Absent are also many Balkan endemics and Pontic-east-sub-Mediterranean species (*Bromus moesiacus, Tragopogon balcanicus, Asyneuma limonifolium, Asphodeline taurica, Hyacinthella leucophaea*, *Pimpinella tragium* subsp. *lithophila*, *Onosma visiani, Stipa epilosa*) which are well presented (some with high constancy) in *Bromo moesiacae-Stipetum epilosae* (Figure 9).

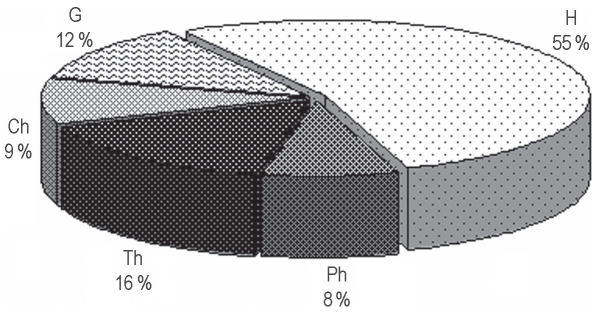

Figure 9: Life forms (Ch – chamaephytes, G – geophytes, H – hemicryptophytes, Ph – phanerophytes, Th – therophytes).
Slika 9: Življenske oblike (Ch – hamefiti, G – geofiti, H – hemikriptofiti, Ph – fanerofiti, Th – terofiti).

The most similar Serbian association is *Humileto-Stipetum pulcherrimae* (synonym of *Humileto-Stipetum grafianae* R. Jov. 1955) from Mt Suva, but the above-mentioned group of endemics and Pontic-east-sub-Mediterranean species are absent from that association too – a proof of the strong effect that the continental climate has on its floristic composition. *Humileto-Stipetum pulcherrimae*, having *Stipa pulcherrima* as a dominant (*Stipa pulcherrima* belong to the same aggregate as *Stipa epilosa*, i.e. *Stipa pennata*,), can be regarded as a vicariant of *Bromo moesiacae-Stipetum epilosae*.

Undoubtedly, the greatest similarity is with *Hyperico rochelii-Stipetum epilosae* from Mt Lozenska (Pedashenko et al. 2009). Beside the above-mentioned main core of common species there many of others that have high constancies both in *Hyperico rochelii-Stipetum epilosae* and in *Bromo moesiacae-Stipetum epilosae*. Moreover, two of the diagnostic species for *Bromo moesiacae-Stipetum epilosae* are present with high constancy in *Hyperico rochelii-Stipetum epilosae*. However, the above-mentioned group of endemics and Ponto-east-sub-Mediterranean species is missing from *Hyperico rochelii-Stipetum epilosae*, and only one of its six diagnostic species is to be found in *Bromo moesiacae-Stipetum epilosae*.

From the stated facts we can infer that *Bromo moesiacae-Stipetum epilosae* although in some terms very similar to some Serbian and Bulgarian associations- in particular *Stipetum pulcherrimae* and *Hyperico rochelii-Stipetum epilosae*- should be considered as an independent one. The main reason for its autonomy is the specific complex of endemic and Ponto-Mediterranean species such as *Bromus moesiacus* (IV), *Tragopogon balcanicus* (III), *Hypericum rumeliacum* (V), *Pimpinella tragium* subsp. *lithophila* (V), *Asphodeline taurica* (IV), *Scabiosa triniifolia* (IV), *Jurinea consaguinea* (II), *Thymus striatus* (V).

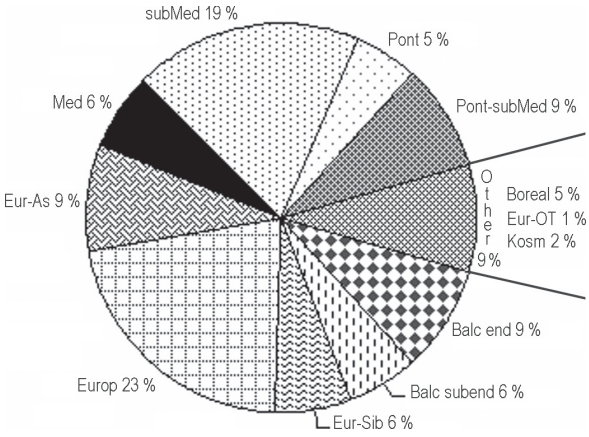

Figure 10: Geoelements (Note: Balc endemic = Balc + Bul; Balc subendemic = Alp-Carp-Bal + Ap-Bal + Bal-Anat + Balc-Dac; Boreal = Boreal + subBoreal, Europ = CSEur + Eur + Euro-Med + Eur-subMed; Eur-Sib = Eur-Sib + SSib + subMed-Sib; Eur-As = Eur-As + Med-CAs + subMed-As; Eur-OT = Eur-OT + Med-OT + Eur-Med-OT; Kosm = Kosm; Med = Med + OMed; subMed = subMed; Pont = Pont + Pont-Bal + Pont-Sib + Pont-CAs + Pont-Sib + SPont; Pont-subMed = Pont-Med + Pont-subMed).

Slika 10: Geoelementi (Okrajšava: Balc endemic = Balc + Bul; Balc subendemic = Alp-Carp-Bal + Ap-Bal + Bal-Anat + Balc-Dac; Boreal = Boreal + subBoreal, Europ = CSEur + Eur + Euro-Med + Eur-subMed; Eur-Sib = Eur-Sib + SSib + subMed-Sib; Eur-As = Eur-As + Med-CAs + subMed-As; Eur-OT = Eur-OT + Med-OT + Eur-Med-OT; Kosm = Kosm; Med = Med + OMed; subMed = subMed; Pont = Pont + Pont-Bal + Pont-Sib + Pont-CAs + Pont-Sib + SPont; Pont-subMed = Pont-Med + Pont-subMed).

Hypotheses about the origin of the studied vegetation

The analysis of the biological spectrum (Figure 9) gives an apportionment of life forms that is characteristic for grasslands with steppe origin (Steffanov 1943), while the apportionment of the geoelements shows a strong Mediterranean influence (Figure 10). The specificity of the studied phytocoenoses is underlined by the high percent of Balkan endemic species such as *Tragopogon balcanicus* (III), *Achillea clypeolata* (II), *Minuartia bosniaca* (I), *Genista subcapitata* (I), *Anthyllis aurea* (I); and two regional Bulgarian endemics – *Bromus moesiacus* (IV), *Verbascum urumovii* (I). Most of these endemics, as well as others which are not present in the Bosnek karst region (e.g. *Edrajanthus serbicum, Astragalus wilmottianus, Jurinea tzarferdinandii, Tulipa urumovii, Erysimum comatum, Malcomia serbica, Verbascum eriophorum*), are distributed also in other low calcareous mountains in W Bulgaria and E Serbia, respectively Golo Bardo, Chepan, Ruy, Konyavska, Lyubash in Bulgaria; and Suva and Rtanj in Serbia. According to Steffanov (1943), this group of endemic species originates from the Serbo-Illyrian endemic centre of species origin and serves as a proof for the relict origin of some grasslands in that region (W Bulgaria and E Serbia).

The floristic composition of grasslands on karst terrains in W Bulgaria includes also numer-

ous thermophytes from the northern continental centre (Steffanov 1943) with mostly Pontho-steppic origin: *Agropyron cristatum, Paeonia tenuifolia, Amygdalus nana, Astragalus pubiflorus, Inula ensifolia, Anemone sylvestris*. Stoyanoff (1941) uses this complex of species to prove the primary grassland character of plant communities. The author considers both the continental climate and the edaphic peculiarities of limestone bedrock as a reason for the absence of forests in some parts of the karst mountains. In addition to that, Yordanoff (1936) considers only edaphic conditions (the eroded, poor soils are too dry to support forests) as the main factor for the existence of primary grassland vegetation in some parts of these mountains because the climate in the region, even though having continental amplitudes, is characterized by sufficient annual rainfalls. The author gives as a proof of his thesis a research on Mt Vitosha (Georgieff 1929) that lists plant species from the vicinity of Krapetz village, i.e. the Bosnek karst region.

We assume that part of the calcareous grasslands in W Bulgaria has a relict origin and dates back to the time of maximum distribution of steppes on Bulgarian territory. That time coincides with the Boreal phase of the Holocene (Bozhilova 1986, Palamarev 2002 etc.). During the Holocene the preservation of grasslands in the mountains of W Bulgaria was aided by the specific edaphic and thermic conditions of the karst, which hindered the forest invasion (Yordanoff 1936). This does not exclude the presence of forests there, which grow in the present time on the northern and eastern slopes of the low karst mountains – Chepan, Mt Koyavska, Golo Bardo. The development of forests on Mt Vitosha has been established from some palynological investigations. For example, Filipovich (1988) found a great participation of *Quercus, Coryllus, Betula* spp., which extended up to 1900 m. a. s. l. on Mt Vitosha during the Atlantic period of the Holocene (6000 BP). Some authors consider some of these tree and shrub species as indicators for the presence of more open (mixture forest-grassland) landscapes (Poshlod & Baumann 2010). The secondary expansion of grasslands on calcareous terrains has happened after the increase of human activities. This assumption has been made for the calcareous grasslands in Central Europe (see Poschlod & WallisDeVries 2002). The open structure of the calcareous grasslands allowed the penetration of many thermophilous Mediterranean species during the favourable climate changes of the Holocene. To this group of Mediterranean species belong some dominant grasses such as *Chrysopogon gryllus* and *Botriochloa ischaemum* (see Jordanoff 1936). At the same time, the long-term preservation of intrazonal grassland vegetation within the zonal thermophilous forests in the isolated low karst mountains in West Bulgaria has led to the origin of endemic forms. These species together with the newly penetrated Mediterranean species and the relict steppe taxa make up the diverse and rich floristic complex that defines the specificity of grassland vegetation in that part of the country.

4. CONCLUSIONS

a) We established a new association designated as *Bromo moesiacae-Stipetum epilosae* ass. nova, hoc. loco, with diagnostic species *Stipa epilosa* (V), *Bromus moesiacus* (IV), *Tragopogon balcanicus* (III), *Asphodeline taurica* (IV), *Pimpinella tragium* subsp. *lithophila* (V), *Thymus striatus* (V), *Hypericum rumeliacum* (V), b) Its phytocoenoses are distinguishable from the other associations in SW Bulgaria and SE Serbia by the presence of vicariant species, by the extent of Mediterranean and Pontocontinental phytogeographical influence and by the number of endemic taxa, c) We consider that this association is part of the relict petrophyte steppes with endemic centre in the low karst mountains of West Bulgaria and East Serbia, d) *Bromo moesiacae-Stipetum epilosae* ass. nova, hoc. loco confirms the presence of the alliance *Saturejon montanae*. A more precise profile of *Saturejon montanae* and its ecological and geographical characteristics could be gained through a future revision and gathering of additional information about the steppe plant communities in West Bulgaria and East Serbia.

5. ACKNOWLEDGEMENTS

The authors would like to express their thanks to BBF – Bulgarian Biodiversity Foundation and Vitosha Nature Park Directorate for the financial support for the field investigations. We would also like to thank "Sylvica" Foundation (BSFP) for giving permission to use the programme SYNTAX, and Assoc. Prof. Dr. Marius Dimitrov for the technical support.

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Received 25.3.2010
Revision received 30.6.2010
Accepted 4.7.2010

Table 1 (Tabela 1): Ass. *Bromo moesiacae-Stipetum epilosae* ass. nova

Geolement	Life form	**Cluster, №**	**A**													
		Number of relevés:	21													
		Relevé №	**3**	**11**	**2**	**10**	**1**	**20**	**16**	**17**	**24**	**37**	**27**	**38**	**36**	**31**
		altitude (m x10)	105	97,3	105	119	102	111	119	120	121	140	145	133	139	130
		slope (°)	5	60	26	7	27	17	0	7	1	20	1	3	20	8
		exposition	SE	S	SE	N-NW	SE	W-SW	-	S-SW	E	SE	N	S-SW	E-SE	W-SW
		total vegetation cover, %	90	35	70	70	70	70	95	85	80	40	95	80	40	60
		Bare stones (%)	0	60	5	20	15	20	0	5	0	50	2	0	60	40
		Ass. *Bromo moesiacae-Stipetum epilosae* ass. nov. holotypus nom. releve 17 hoc loco														
SSEur	G	*Stipa epilosa*	**4**	**2a**	**2b**	**2b**	**2b**	**3**	**2b**	**2a**	**1**	**1**	.	**2a**	.	**2a**
subMed	Ch	*Thymus striatus*	**1**	.	**1**	+	**2a**	+	**1**	**1**	**1**	+	**1**	**1**	**1**	.
Bal	H	*Hypericum rumeliacum*	**2m**	+	.	+	+	+	**2m**	+	**1**	+	.	.	+	+
Pont-subMed	H	*Pimpinella tragium* ssp. *lithophila*	.	+	**1**	**1**	+	+	**1**	+	+	+	**1**	.	+	+
Bul	G	*Bromus moesiacus*	**2a**	**2a**	.	**2a**	.	.	**2b**	**2a**	**3**	**1**	**2b**	**2a**	**2a**	**1**
Pont-Med	G	*Asphodeline taurica*	**1**	+	+	+	.	+	**1**	**1**	+	.	.	.	.	+
Bal	H	*Tragopogon balcanicus*	.	.	.	.	+	+	.	+	.	+	.	.	.	.
		var. *typicum*														
Bal	H	*Scabiosa triniifolia*	+	+	**1**	**1**	+	+	+	+	+	+	**1**	+	+	+
Eur	H	*Globularia aphyllanthes*	+	**1**	+	+	**1**	.	**1**	+	+	+	**1**	+	+	**1**
Eur-Med	Ch	*Carlina acanthifolia*	+	.	.	.	+	+	**1**	+	.	+	+	+	**1**	+
Eur	H	*Dorycnium herbaceum*	.	**1**	**2b**	.	**2a**	.	.	.	**2a**	**1**	**1**	**1**	**1**	**1**
subMed-Sib	H	*Jurinea consaguinea*	+	**r**	.	.	+	+	+	+	.	+	.	+	.	.
Eur-Med	H	*Hieracium pilosella*	.	+	**1**	.	**1**	.	+	+	+	+	**1**	+	.	.
SSib	G	*Brachypodium pinnatum*	.	+	**1**	.	**1**	.	.	.	.	+	**1**	+	+	+
		var. *Sideritis montana*														
subMed	Th	*Sideritis montana*	.	.	.	+	.	+	.	+	.	.	.	+	1	+
Eur-Med	H	*Sedum acre*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-subMed	G	*Melica ciliata*	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Boreal	Th	*Filago lutescens*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Eur-Med	Th	*Alyssum alyssoides*	.	.	.	.	.	.	.	.	.	.	+	.	.	.
subMed	Th	*Coronilla scorpioides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	Th	*Xeranthemum annuum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-OT	G	*Allium rotundum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-Med	Th	*Euphorbia exigua*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		All. *Saturejon montanae* Horvat 1962														
Pont	G	*Festuca dalmatica*	3	.	.	1	1	2a	2b	1	3	1	2a	1	1	2a
Bal	Ch	*Satureja montana* ssp. *kitaibelii*	1	1	.	.	2a	1	.	.	1	1	.	1	1	1
Pont	Ch	*Rhodax canus*	1	+	.	+	+	+	1	+	+	+	1	+	+	+
subMed	H	*Asperula purpurea*	1	+	+	1	+	+	.	+	.	+	+	+	+	+
Eur-As	G	*Carex humilis*	1	2a	2b	3	.	2a	3	3	1	2a	2b	3	2b	2b
Eur-Med	H	*Anthyllis vulneraria* ssp. *pulchella*	+	.	1	+	+	+	r	.	+	+	1	1	1	1
Eur	G	*Potentilla cinerea*	2a	.	.	+	.	+	1	.	1	.	1	+	.	.
Pont-Med	Ch	*Fumana procumbens*	1	+	1	+	+	+	.	+	.	.	.	.	.	+
subMed	Ch	*Teucrium montanum*	.	.	.	1	.	+	1	+	+	+	1	+	1	1
subMed	Ch	*Artemisia alba*	2a	2a	2b	.	3	.	.	.	2a	.	.	.	.	.
Bal	H	*Achillea clypeolata*	.	+	.	.	.	.	.	.	.	+	.	.	.	.
Bal	H	*Onobrychis alba* ssp. *calcarea*	.	.	.	.	+	.	.	+	.	.	.	.		.
subMed	Ph	*Rosa myriacantha*	.	.	.	.	.	.	.	.	+	.	.	.	r	.
Eur-Sib	G	*Vincetoxicum hirundinaria*	+	.	.	.	.	.	.	.	.	.	.	.	.	.

							A																	B		
							21																	14		35
28	**8**	**9**	**33**	**34**	**35**	**32**		**22**	**14**	**12**	**18**	**21**	**23**	**4**	**26**	**30**	**6**	**5**	**25**	**19**	**29**			
109	110	120	100	100	103	128		102	110	97,7	97,8	105	104	110	116	136	123	110	119	110	139			
3	30	15	60	60	65	8		8	25	26	6	8	10	1	5	8	15	15	2	7	5			
N	S-SW	SE	S	S	S-SE	N	**Constancy**	S	S-SW	S-SW	S-SW	SW	SE	S	S	SW	S	S	SE	SW	W-SW	**Constancy**	**Constancy**	
90	75	85	50	40	40	95		85	60	60	95	85	90	75	90	95	80	60	70	70	95			
5	15	3	45	60	50	0		1	30	15	0	7	5	2	5	0	10	5	10	5	1			
2a	**2a**	**2b**	+	**1**	**1**		**V**	**3**	**2a**	**2a**	**2b**	**2a**	**2b**	**1**	**2a**	.	**1**	**1**	**2a**	**2a**	.	**V**	**V**
2a	**2a**	**1**	**1**	+	+	**1**	**V**	**1**	**1**	**1**	**1**	+	+	**1**	**2a**	**1**	**1**	**1**	**1**	**1**	+	**V**	**V**
2m	+	+	+	+	+	**2m**	**V**	+	+	+	**1**	+	**2m**	+	**1**	**2m**	**1**	+	+	**1**	**2m**	**V**	**V**
1	+	+	+	+	+	**1**	**V**	.	+	+	.	+	**1**	+	**1**	+	+	+	+	+	**1**	**V**	**V**
.	.	**2a**	.	**2a**	**1**	**2b**	**IV**	.	**2a**	**2a**	**2b**	**2a**	**2a**	**2b**	**2b**	**2a**	**2a**	.	**1**	**2a**	**2a**	**V**	**IV**
1	+	**1**	+	**r**	**r**	+	**IV**	+	.	+	+	+	**1**	**r**	.	.	**r**	+	**1**	+	.	**IV**	**IV**
1	**1**	.	.	+	+	.	**II**	**1**	**1**	+	**1**	+	**1**	+	**1**	.	+	**r**	.	**1**	.	**IV**	**III**
1	+	+	.	+	.	+	**V**	.	.	+	+	.	1	+	.	+	.	.	.	+	.	**III**	**IV**
.	.	**1**	+	+	**1**	**1**	**V**	.	+	+	.	.	1	.	.	.	.	.	.	+	1	**II**	**IV**
.	.	**1**	.	**r**	**r**	**1**	**IV**	.	+	.	+	.	+	.	.	.	.	r	.	+	.	**II**	**III**
.	.	**1**	.	**1**	**1**	**1**	**IV**	.	.	.	1	.	.	.	.	.	.	.	.	.	.	**I**	**II**
+	+	.	.	+	+	**1**	**IV**	.	.	.	.	.	.	.	.	.	.	.	.	.	.		**II**
.	.	**1**	.	**1**	.	+	**III**	.	.	.	.	.	.	.	.	.	.	.	.	.	.		**II**
.	.	.	.	.	.	+	**III**	.	.	.	.	.	.	.	.	.	.	.	.	.	.		**II**
.	.	.	.	.	.	.	**II**	**1**	**1**	.	**1**	+	**1**	**1**	**1**	**1**	**2a**	+	**1**	+	**1**	**V**	**III**
.	.	+	.	.	.	.	**I**	.	+	+	**1**	+	.	+	**1**	**1**	+	+	+	+	**1**	**V**	**II**
.	.	.	.	1	.	.	**I**	**2a**	**2a**	**1**	**2a**	**2a**	**1**	**1**	**2b**	.	**1**	**1**	**1**	**2a**	.	**V**	**II**
.	.	.	.	.	.	.	**I**	**1**	.	+	**1**	+	+	.	.	+	**r**	.	+	+	.	**IV**	**II**
.	.	.	.	.	.	.	**I**	+	.	.	+	+	+	+	.	+	+	+	.	+	+	**IV**	**II**
.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	+	.	**III**	**I**
.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	+	.	.	.	+	.	.	**II**	**I**
.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	+	.	.	**II**	**I**
.	.	.	.	.	.	.	.	.	.	+	+	.	.	**r**	.	.	+	+	.	.	.	**II**	**I**
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
2b	2b	2a	1	1	1	3	**V**	2a	2a	2a	2b	3	3	3	3	3	3	2b	2a	2b	2a	**V**	**V**
3	3	2a	.	1	1	2a	**IV**	1	2a	2b	.	1	1	2b	1	2a	2b	2b	1	.	2b	**V**	**IV**
1	1	1	.	+	1	1	**V**	+	.	1	1	+	1	+	.	.	.	+	+	+	.	**IV**	**IV**
+	+	+	.	+	+	+	**V**	+	.	+	+	+	+	.	.	+	.	+	+	+	+	**IV**	**IV**
2a	2b	1	.	2a	2a	2a	**V**	.	.	.	.	2a	2b	1	.	2a	.	2a	2a	.	.	**III**	**IV**
.	.	1	+	+	1	1	**V**	.	.	.	1	1	1	.	.		r		1	1	.	**III**	**IV**
1	1	1	.	.	.	1	**III**	1	.	.	.	+	1	1	.	1	1	+	1	.	1	**IV**	**III**
1	+	.	+	+	+	.	**IV**	1	+	+	+	+	1	.	.	.	.	+	.	+	.	**III**	**III**
+	+	1	+		1	1	**IV**	.	.	+	1	.	.	.	.	.	.	+	.	1	1	**II**	**III**
2b	2a	.	.	2b	2a	.	**II**	.	2b	2a	.	.	.	2a	.	.	2a	2b	.	.	.	**II**	**II**
.	.	.	.	.	.	.	**I**	.	1	.	1	1	+	+	1	.	.	.	1	1	2a	**IV**	**II**
+	+	.	.	.	.	.	**I**	.	+	.	.	+	.	+	1	.	+	+	.	+	.	**III**	**II**
.	.	.	.	.	.	.	**I**	.	.	.	.	.	.	.	+	.	.	.	.	.	.	**I**	**I**
.	.	.	+	.	.	.	**I**	.	.	.	.	+	.	.	.	.	.	+	.	.	.	**I**	**I**

		Relevé №	**3**	**11**	**2**	**10**	**1**	**20**	**16**	**17**	**24**	**37**	**27**	**38**	**36**	**31**
Eur-Med	H	*Cephalaria flava*	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Alp-Carp-Bal	Th	*Acinos alpinus*	.	+	.	+	+	.	.	+	.	.	.	.	.	.
Bal-Anat	Ch	*Micromeria cristata*	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Eur-As	H	*Herniaria hirsuta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		All. *Festucion valesiacae* Klika 1931 (*F. rupicolae* Soó 1940)														
Pont-Med	H	*Eryngium campestre*	.	.	.	.	.	+	1	+	+	.	1	.	.	.
Pont-Med	Ch	*Teucrium polium*	.	+	+	+	+	+	1	+	+	.	.	.	.	.
Eur-As	H	*Medicago falcata* ssp. *falcata*	.	+	.	+	.	.	+	+	+	+	1	+	1	+
subMed	H	*Trinia glauca* ssp. *glauca*	+	.	.	+	.	r	1	1	+	.	1	+	.	+
Eur-As	H	*Galium album* ssp. *album*	.	+	+	.	+	.	.	+	.	.	+	.	.	.
Eur-Med	H	*Veronica austriaca*	.	+	.	.	.	+	.	.	+	+	1	+	.	+
Pont-Med	G	*Stipa capillata*	.	.	.	.	.	+	.	1	.	.	.	+	+	.
SPont	H	*Onobrychis arenaria*	.	.	.	.	.	.	.	+	+	.	+	+	.	+
Med	H	*Scorzonera hispanica*	+	.	1	.	+	.	.	.	.	.	.	.	.	+
Med	G	*Allium flavum*	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Pont-Med	G	*Chrysopogon gryllus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed-As	G	*Botriochloa ischaemum*	.	.	.	.	2a	.	.	.	.	.	.	.	.	.
Pont-subMed	H	*Petrorhagia illyrica* ssp. *haynaldiana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	H	*Potentilla laciniosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-As	G	*Poa badensis*	.	.	.	+	.	.	.	.	+	.	.	+	.	.
subMed	H	*Plantago argentea*	.	.	.	.	.	.	.	.	.	+	.	+	.	.
		Ord. *Festucetalia valesiacae* Br.-Bl. et Tüxen 1943 and Cl. *Festuco-Brometea* Br.-Bl. et Tüxen 1943														
subBoreal	H	*Sanguisorba minor*	+	+	+	.	+	+	1	+	+	+	1	+	+	+
subMed	Ch	*Teucrium chamaedrys*	.	+	2m	+	+	.	+	3	1	+	.	+	+	+
Eur	H	*Euphorbia cyparissias*	.	+	+	+	.	+	+	+	+	+	1	+	.	+
Pont-Med	H	*Leontodon crispus*	1	+	+	1	+	+	1	1	.	+	1	+	.	1
Eur-subMed	H	*Asperula cynanchica*	.	+	.	+	.	+	+	+	+	.	+	+	+	+
Eur-As	H	*Astragalus onobrychis* ssp. *chlorocarpus*	.	.	.	.	+	+	+	.	.	.	.	.	.	+
Pont	G	*Koeleria nitidula*	1	+	.	.	1	.	.	1	1	.	.	1	+	.
Eur	Th	*Cuscuta epithymum*	.	r	.	r	.	+	.	+	+	+	.	.	+	.
Eur-Sib	G	*Fragaria viridis*	.	.	.	.	.	.	.	.	.	+	1	+	+	.
Pont-Med	H	*Linum tenuifolium*	+	+	+	.	+	.	.	.	.	+	.	+	+	+
subMed	Th	*Euphrasia pectinata*	+	.	.	+	+	.	+	+	+	+	+	+	.	+
Pont-Med	Ch	*Onosma visianii*	+	+	.	+	+	.	.	.	.	.	.	.	.	.
Pont-Med	G	*Stipa capillata*	.	.	.	.	.	+	.	+	.	.	.	+	+	.
Pont-Med	G	*Hyacintella leucophaea*	1	.	.	+	.	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Inula oculus-christi*	.	.	.	.	.	+	+	+	.	+	.	.	1	.
Med-OT	G	*Muscari neglectum*	.	.	.	.	.	+	.	+	+	.	.	.	.	.
subMed	H	*Hippocrepis comosa* ssp. *comosa*	.	.	+	.	.	+	.	.	.	.	.	.	.	+
Eur-Med	H	*Filipendula vulgaris*	.	.	.	1	.	.	.	.	+	.	+	.	+	.
subMed	Ch	*Ononis pusilla* ssp. *orientalis*	.	+	+	.	+	.	.	.	.	.	.	+	.	.
Eur-Sib	H	*Inula hirta*	.	+	.	.	.	.	+	.	.	.	.	.	+	+
subMed	Ch	*Hyssopus officinalis* ssp. *aristatus*	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Kos	H	*Plantago lanceolata*	.	.	.	.	.	.	+	.	.	.	+	.	+	.
Eur-Med	Th	*Carduus nutans*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	Th	*Crupina vulgaris*	.	+	+	.	.	.	.	.	.	.	.	.	.	.
subBoreal	H	*Minuartia verna*	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Pont-Med	Th	*Thesium dollineri*	+	+	.	.	.	.	.	.	+	.	.	.	.	.
Kos	G	*Poa pratensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Ssib	H	*Ajuga laxmannii*	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Eur-As	H	*Galium verum*	.	.	.	.	.	.	.	+	.	.	.	+	.	.
subMed	H	*Digitalis lanata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Inula ensifolia*	1	.	.	.	+	.	.	.	.	.	.	1	.	+
Eur-Med	H	*Hieracium bauhinii*	.	+	1	.	.	.	.	.	.	.	+	.	.	.
Eur	G	*Briza media*	.	.	.	.	.	.	.	.	.	+	+	+	+	+

28	8	9	33	34	35	32		22	14	12	18	21	23	4	26	30	6	5	25	19	29		
.	.	.	.	.	+	.	**I**	.	+	.	.	.	.	.	.	.	.	.	.	.	.	**I**	**I**
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.	.	.	.	.	.	.		.	.	.	.	.	.	r	+	.	.	.	.	.	.	**I**	**I**
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.	.	.	+	1	1	.	**III**	1	1	1	1	1	1	+	1	.	+	+	1	1	.	**V**	**IV**
1	+	.	.	.	.	.	**III**	1	.	+	+	.	.	.	+	+	.	+	+	.	+	**III**	**III**
1	+	+	.	.	.	1	**IV**	.	.	.	.	+	.	r	.	+	+	+	+	.	+	**III**	**III**
.	.	.	.	+	.	.	**II**	.	+	.	+	+	+	r	.	.	1	.	.	+	.	**III**	**II**
.	.	+	.	.	.	1	**III**	.	.	.	1	.	.	.	.	+	.	.	1	.	.	**II**	**II**
.	.	.	.	+	.	.	**II**	1	+	+	.	+	+	.	.	.	.	.	.	1	.	**II**	**II**
.	.	1	.	.	.	+	**II**	.	.	.	.	.	.	.	.	+	.	.	.	.	+	**I**	**II**
.	.	.	+	.	.	.	**II**	.	.	+	.	.	.	.	.	.	.	.	.	.	.	**I**	**I**
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.	.	.	2a	.	.	.	**I**	+	.	1	.	+	+	.	.	.	.	.	.	.	.	**II**	**I**
.	.	.	.	.	+	.	**I**	+	+	1	+	.	+	.	.	.	.	.	.	.	.	**II**	**I**
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+	1	+	.	+	+	2m	**V**	+	+	+	+	+	1	1	+	+	2m	+	+	+	+	**V**	**V**
2a	2m	2m	.	+	+	1	**V**	+	+	+	1	2m	.	+	1	1	+	+	1	1	2m	**V**	**V**
+	+	+	+	+	+	1	**V**	1	+	+	+	+	1	+	.	+	1	+	.	.	.	**IV**	**IV**
1	+	1	+	+	+	.	**V**	.	+	1	1	+	+	+	.	.	r	+	1	1	1	**IV**	**V**
+	+	+	+	+	+	+	**V**	+	+	+	.	+	+	+	+	+	.	.	+	+	+	**IV**	**IV**
+	+	+	.	.	+	.	**II**	1	+	+	+	.	.	1	2a	1	2a	+	+	+	1	**V**	**III**
.	.	.	.	+	+	1	**III**	.	1	1	1	.	1	+	1	1	.	.	1	1	.	**IV**	**III**
+	+	.	+	+	+	.	**III**	+	+	.	.	+	.	.	+	.	.	+	+	+	.	**III**	**III**
.	.	1	.	.	.	.	**II**	1	1	+	+	+	.	+	.	1	2a	.	.	1	.	**IV**	**II**
.	.	+	.	.	r	.	**III**	+	.	.	.	+	+	+	.	.	.	+	.	.	.	**II**	**III**
.	.	.	.	.	.	+	**III**	.	.	.	+	+	.	.	.	+	.	.	.	.	.	**II**	**II**
+	+	r	.	.	+	.	**II**	.	+	.	+	.	+	.	.	.	r	r	.	.	.	**II**	**II**
.	.	.	.	+	.	.	**II**	+	+	+	.	+	+	.	.	.	.	.	.	1	.	**III**	**II**
+	+	.	.	.	.	.	**I**	.	r	.	.	.	+	r	+	.	r	+	+	.	.	**III**	**II**
1	+	.	.	.	.	.	**II**	.	.	+	1	.	.	.	.	.	.	.	+	.	.	**II**	**II**
+	+	.	.	.	.	.	**II**	.	.	.	.	.	+	+	.	.	+	+	.	.	.	**II**	**II**
1	1	+	+	+	.	.	**II**	.	.	.	.	+	+	.	.	.	.	r	.	.	.	**II**	**II**
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.	.	.	+	+	.	.	**II**	.	.	+	.	.	r	.	.	.	.	.	.	.	.	**I**	**II**
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.	.	.	.	.	.	+	**I**	.	.	+	+	.	.	r	.	+	.	r	.	.	.	**II**	**II**
r	r	.	.	.	.	+	**I**	.	.	.	.	.	.	.	.	.	.	r	+	.	+	**II**	**I**
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.	.	.	.	.	.	.	**I**	.	+	.	.	.	+	+	.	+	+	+	.	.	.	**III**	**I**
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		Relevé №	**3**	**11**	**2**	**10**	**1**	**20**	**16**	**17**	**24**	**37**	**27**	**38**	**36**	**31**
Eur-subMed	H	*Achillea collina*	.	.	.	.	.	.	.	.	.	.	+	+	+	.
SEEur	H	*Stachys recta* ssp. *subcrenata*	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Kos	H	*Hypericum perforatum*	.	.	.	.	+	.	.	.	.	.	.	+	.	.
Boreal	H	*Plantago media*	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Boreal	G	*Carex caryophyllea*	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Carp-Bal	H	*Silene flavescens* ssp. *flavescens*	.	r	+	.	.	.	.	.	.	.	.	.	.	.
Bal	H	*Anthyllis aurea*	1	.	.	.	.	.	.	+	.	.	.	.	.	.
Eur	G	*Pulsatilla montana*	.	.	.	.	.	.	.	.	.	r	.	.	.	.
Eur-As	H	*Origanum vulgare* ssp. *vulgare*	.	+	.	.	.	.	.	.	.	.	.	.	+	.
subMed	Ch	*Genista januensis*	.	.	1	.	1	.	.	.	.	.	.	.	.	.
Eur-Sib	H	*Centaurea scabiosa*	.	.	.	.	.	.	.	.	+	.	.	r	.	.
Med	H	*Polygala anatolica*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Bal	G	*Sesleria latifolia*	.	.	1	.	1	.	.	.	.	.	.	.	.	1
Eur-Med	H	*Lotus corniculatus*	.	.	.	.	.	.	.	+	.	+	+	.	.	.
Pont-subMed	G	*Allium moschatum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bal-Anat	Ch	*Thymus moesiacus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Trifolium campestre*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Coronilla varia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pont-subMed	H	*Orlaya grandiflora*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		Other species														
Bal-Anat	H	*Centaurea affinis* ssp. *affinis*	1	.	.	r	.	+	+	1	+	+	1	+	+	+
Med	H	*Plantago subulata*	1	.	.	1	.	1	+	2a	+	+	1	+	+	+
Eur	H	*Orobanche reticulata*	.	r	.	.	.	.	.	+	.	+	.	+	.	.
Omed	H	*Asyneuma limonifolium* ssp. *limonifolium*	+	.	.	.	.	.	.	.	.	.	.	.	.	+
Eur-Sib	H	*Trifolium alpestre*	.	.	.	+	.	.	.	.	.	.	.	.	+	+
subBoreal	Ph	*Crataegus monogyna*	.	+	+	.	+	.	.	.	+	.	.	+	.	+
Med	H	*Euphorbia barrelieri*	.	+	1	.	+	.	.	.	.	.	.	+	.	+
Bal	H	*Hieracium pannosum*	.	.	.	+	.	.	.	.	.	+	+	.	+	+
subMed	Ph	*Fraxinus ornus*	.	.	+	.	1	.	.	.	.	.	.	.	.	.
Eur-As	Th	*Arabis recta*	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Med	H	*Euphorbia niciciana*	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Bal	H	*Minuartia bosniaca*	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Pont-Cas	G	*Elymus hispidus* ssp. *hispidus*	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Eur-As	Th	*Medicago minima*	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Eur-As	Th	*Arenaria serpyllifolia*	.	.	.	.	.	.	.	.	.	.	.	+	.	.
subMed	Ph	*Rosa agrestis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	Ph	*Rosa canina*	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Eur-Sib	G	*Carex tomentosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	Th	*Bromus squarrosus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-As	Th	*Vicia angustifolia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pont-Med	Th	*Bupleurum commutatum* ssp. *commutatum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Trifolium dubium*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eur-subMed	G	*Ornithogalum kochii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kos	H	*Convolvulus arvensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bal-Dac	G	*Avenula compressa*	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Eur	G	*Anthericum ramosum*	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Eur	H	*Campanula bononiensis*	.	r	.	.	.	.	.	.	r	.	r	.	.	.
Eur-Sib	Ph	*Cotoneaster integerrimus*	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Pont-Med	Th	*Odontites glutinosa*	.	.	.	.	.	.	+	+	.	.	.	.	+	.
Eur-subMed	H	*Alyssum murale*	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Med	H	*Scorzonera cana*	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Bal	H	*Dianthus moesiacus* ssp. *moesiacus*	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Eur	G	*Carex michelii*	1	.	.	.	+	.	.	.	.	.	.	.	.	.
Eur-Med	H	*Primula veris*	.	.	.	.	.	.	.	.	.	r	+	.	.	.
Eur-Sib	Th	*Rhinanthus minor*	.	.	.	.	.	.	.	..	+	.	+	+	.	.

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subBoreal	Ph	*Juniperus communis*	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Eur-Med	Th	*Arabis sagittata*	.	.	.	.	.	.	.	.	.	.	.	+	.	.
subMed	Th	*Bupleurum sibthorpianum*	.	+	.	.	.	.	.	.	+	.	.	.	.	.
subMed	Ph	*Coronilla emerus* ssp. *emeroides*	.	r	1	.	.	.	.	.	.	.	.	.	.	.
Bal	Ch	*Genista subcapitata*	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Eur-As	Ph	*Rosa dumalis*	.	.	.	.	.	.	.	.	.	r	r	.	.	.
Med-cAs	Ph	*Corylus avellana*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pont-Bal	Th	*Trigonella striata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bal-Dac	H	*Salvia amplexicaulis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subMed	Th	*Trifolium pallidum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Med	G	*Allium cupani*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SPont	Ph	*Prunus spinosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Species that occur only in one relevé: *Campanula lingulata* 2:+, *Pteridium aquilinum* 2:2b, *Achillea ageratifolia* 3:+, *Potentilla neglecta* 4:r, *Medicago lupulina* 5:+, *Cornus sanguinea* 11:+, *Helleborus odorus* 14:r, *Thlaspi alliaceum* 14:+, *Anthemis ruthenica* 17:+, *Trigonella monspeliaca* 18:+, *Cichorium intybus* 19:+, *Scorzonera mollis* 21:+, *Verbascum urumovii* 21:r, *Bupleurum apiculatum* 22:+, *Medicago coronata* 22:+, *Euphrasia stricta* 23:+, *Thymelea passerina* 23:+, *Ajuga chia* 26:+, *Phleum montanum* 26:+, *Centaurea triumfetti* ssp. *adscendens* 27:+, *Dianthus cruentus* ssp. *cruentus* 29:+, *Prunella laciniata* 31:+, *Prunella grandiflora* 31:+, *Danthonia alpina* 32:+, *Onosma echiodes* 33:+, *Scabiosa argentea* 33:+, *Hieracium heterogynum* 34:+, *Pinus sylvestris* 34:r, *Paronychia cephalotes* 35:+, *Rosa elliptica* 35:+, *Erysimum diffusum* 38:+

GPS coordinates and date of the relevés:

1 – N42 29 45.5 E23 11 44.4 (18.6.2008); 2 – N42 29 46.6 E23 11 39.2 (18.6.2008); 3 – N42 29 47.1 E23 11 31.9 (18.6.2008); 4 – N42 29 52.4 E23 11 30.4 (21.6.2008); 5 – N42 29 50.5 E23 11 23.5 (23.6.2008); 6 – N42 29 58.4 E23 11 28.5 (23.6.2008); 8 – N42 30 06.2 E23 11 35.3 (01.7.2008); 9 – N42 30 12.1 E23 11 38.5 (01.7.2008); 10 – N42 30 16.2 E23 11 32.1 (01.7.2008); 11 – N42 29 31.6 E23 11 36.1 (01.7.2008); 12 – N42 29 36.1 E23 11 16.6 (04.7.2008); 14 – N42 29 45.3 E23 11 15.8 (04.7.2008); 16 – N42 30 26.6 E23 11 50.5 (05.7.2008); 17 – N42 30 28.1 E23 12 03.9 (05.7.2008); 18 – N42 29 58.0 E23 10 54.4 (06.7.2008); 19 – N42 30 01.1 E23 11 04.8 (06.7.2008); 20 – N42 30 08.9 E23 11 16.2 (06.7.2008); 21 – N42 30 15.3 E23 10 31.5 (07.7.2008); 22 – N42 30 10.6 E23 10 34.6 (07.7.2008); 23 – N42 30 17.6 E23 10 38.5 (07.7.2008); 24 – N42 31 16.7 E23 11 13.2 (09.7.2008); 25 – N42 31 01.8 E23 10 59.6 (08.7.2008); 26 – N42 30 58.4 E23 10 55.3 (09.7.2008); 27 – N42 30 58.0 E23 13 09.1 (09.7.2008); 28 – N42 30 45.1 E23 10 36.1 (10.7.2008); 29 – N42 30 55.3 E23 12 51.6 (10.7.2008); 30 – N42 30 55.8 E23 12 42.5 (11.7.2008); 31 – N42 30 49.2 E23 12 30.3 (11.7.2008); 32 – N42 30 51.1 E23 12 18.1 (11.7.2008); 33 – N42 29 49.2 E23 10 19.2 (12.7.2008); 34 – N42 29 33.5 E23 11 21.4 (12.7.2008); 35 – N42 29 53.4 E23 11 48.8 (12.7.2008); 36 – N42 30 44.5 E23 13 33.6 (13.7.2008); 37 – N42 30 37.9 E23 13 26.1 (13.7.2008); 38 – N42 30 12.7 E23 13 18.1 (13.7.2008);

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Table 2: Diagnostic species and species with high constancy in the associations of the steppe vegetation in E Serbia and SW Bulgaria.
Tabela 2: Diagnostične vrste in vrste z visoko prisotnostjo v asociacijah stepske vegetacije vzhodne Srbije in jugozahodne Bolgarije.

Cl. *Festuco-Brometea* Br.-Bl. et Tüxen 43
Ord. *Festucetalia valesiacae* Br.-Bl. et Tüxen 43
All. *Saturejon montanae* Horvat 62

BS – *Bromo moesiacae-Stipetum epilosae* ass. nova from Bosnek karstic region, SW Bulgaria
MIs – *Myrsiniteto-Ischaemetum* R. Jov. 55 from Suva Mt, Serbia
HSr – *Humileto-Stipetum pulcherrimae* (=*grafianae*) R. Jov. 55 from Rtanj Mt, Serbia
HSs – *Humileto-Stipetum pulcherrimae* (=*grafianae*) R. Jov. 55 from Suva Mt, Serbia
Sjr – *Stipetum joannis* (=*tirsae*) R.Jov. 56 from Rtanj Mt, Serbia
PCr – *Potentilleto-Caricetum humilis* R.Jov. 55 from Rtanj Mt, Serbia
PCs – *Potentilleto-Caricetum humilis* R.Jov. 55 from Suva Mt, Serbia
HS – *Hypericum rochelii-Stipetum epilosae* Ped. et al. 2009 from Lozenska Mt, SW Bulgaria

* – species that are locally characterstic for the associations (Jovanović-Dunjić 1955, 1956)
1–5 – Constancy classes

	BS	MIs	HSr	HSs	Sjr	PCr	PCs	HS
Hypericum rumeliacum	5	.	.	.	.	.	.	.
Pimpinella tragium ssp. *lithophila*	5	.	.	.	.	.	.	.
Thymus striatus	5	.	.	.	.	.	.	3
Stipa epilosa	5	.	.	.	.	.	.	4
Asphodeline taurica	4	.	.	.	.	.	.	.
Bromus moesiacus	4	.	.	.	.	.	.	.
Tragopogon balcanicus	3	.	.	.	.	.	.	.
Galium purpureum (=*Asperula purpurea*)	4	4	5	5	5	3	.	3
Artemisia alba	2	5	4*	4	2	1	.	.
Potentilla cinerea	3	4	2	5	.	5*	5*	5
Asperula cynanchica	4	4	2	4	.	2	5	4
Carex humilis	4	.	5	5	5	5*	5	4
Galium album ssp. *album*	2	.	3	4	3	4	4	.
Achillea clypeolata	2	3	2	4	.	4*	.	.
Stachys recta	1	3	4	4	.	4	1	.

	BS	MIs	HSr	HSs	Sjr	PCr	PCs	HS
Teucrium chamaedrys	5	3	5	5	5	4	.	2
Stipa pulcherrima	.	2	5*	5*	.	.	5	.
Leontodon crispus	5	2	5	4*	.	.	1	4
Teucrium montanum	3	.	4*	4*	1	1	1	2
Rosa pimpinellifolia(=Rosa myriacantha)	1	.	4	4	1	3	3	.
Cynanchum vincetoxicum (*=Vincetoxicum hirundinaria*)	1	5	4*	4*	1	3	.	.
Sedum ochroleucum	.	3	5	4	.	5	1	.
Bromus erectus	.	.	2	4	.	5	1	1
Chamaecytisus ciliatus	.	.	5	4	.	5	3	.
Euphorbia cyparissias	4	2	5	2	4	4	3	4
Agropyron cristatum	.	.	4*	2	.	.	.	.
Satureja montana ssp. *kitaibelii*	4	4	5*	4	1	2	.	3
Melica ciliata	2	5*	2	3	.	.	.	1
Botriochloa ischaemum (*=Dichantium ischaemum*)	1	5*	.	.	.	.	.	1
Allium flavum	1	5	.	2	.	1	.	1
Euphorbia myrsinites	.	5*	.	.	.	.	.	.
Teucrium polium	4	4	.	.	.	.	.	3
Fumana procumbens	3	4*	.	.	.	.	.	2
Sedum acre	2	4	.	.	.	.	.	2
Silene flavescens	1	4	.	.	.	.	.	.
Allium moschatum	1	4*	.	.	.	.	.	.
Siliene flavescens	1	4	.	.	.	.	.	.
Adonis vernalis	.	4	.	.	.	.	.	.
Chamaecytisus jankae	.	4*	.	.	.	.	.	.
Haplophyllum suaveolens	.	2*	.	.	.	.	.	.
Centaurea biebersteinii ssp. *australis*	.	2*	.	.	.	.	.	.
Cephalaria laevigata	.	.	.	.	.	4*	.	.
Iris reichenbachii	.	.	.	.	.	4*	.	.
Ferulago campestris	.	.	2	.	.	4*	.	.
Micromeria cristata	1	.	.	4*	.	.	.	.
Cotoneaster tomentosa	.	.	.	4	.	.	.	.
Amelanchier vulgaris	.	.	.	4	.	.	.	.
Rhamnus saxatilis	.	.	.	4	.	.	1	.
Achnatherum calamagrostis	.	.	.	5	.	.	.	.
Achillea ageratifolia	1	.	.	2	.	.	.	.
Aethionema saxatile	.	.	.	2*	.	.	.	.
Stipa joannis	.	.	5	.	5*	.	.	.
Scleranthus annuus	.	.	.	.	4*	.	.	.
Herniaria hirsuta	1	.	.	.	4*	.	.	.
Bromus mollis (*B. hordeaceus* ssp. *hordeaceus*)	.	.	.	.	4*	.	.	.
Alyssum alyssoides	2	.	4	.	4*	5	.	.
Koeleria gracilis	.	.	5	.	1	5	4	.
Thymus glabrescens	.	.	.	3	2	1	4	.
Centaurea triumfettii	.	.	5	.	.	1	5	.
Cotoneaster integerrimus	2	.	.	3	.	2	5	.
Geranium sanguineum	2	.	3	.	.	3	4	.
Festuca panciciana	.	.	5	2	4	4	4	.
Veronica jacquinii (*=Veronica austriaca* ssp. *austriaca*)	2	.	4	2	4	4	4	.
Scabiosa columbaria	.	.	2	2	4	4	4	.
Asyneuma canescens	.	.	2	1	.	2	3*	2
Poa badensis	1	.	2	2	.	2	2	.

	BS	MIs	HSr	HSs	Sjr	PCr	PCs	HS
Pulsatilla vulgaris ssp. *grandis*	.	.	.	.	.	2*	4*	.
Crocus biflorus	.	.	.	.	.	.	4*	.
Dianthus petraeus	.	.	.	3	.	.	4	.
Trifolium alpestre	2	.	.	.	.	.	4	.
Hypericum linaroides	.	.	.	1	.	.	4	.
Anthyllis montana ssp. *jaquinii*	.	.	.	.	.	.	4	.
Helianthemum nummularium	.	.	.	.	.	.	.	5
Muscari botryoides	.	.	.	.	.	.	.	5
Seseli peucedanoides	.	.	2	.	.	2	3	4
Sesleria latifolia	1	.	.	.	.	.	.	3
Thesium divaricatum	.	.	.	.	.	.	.	3
Hypericum rochelii	.	.	2	.	.	.	.	3
Hippocrepis comosa	2	.	.	.	.	.	.	3
Genista tinctoria	.	.	.	.	.	.	.	2
All. *Saturejon montanae* Horvat 1962	.	.	.	.	.	.	.	.
Anthyllis vulneraria	3	.	.	.	.	.	.	3
Festuca dalmatica	5	.	.	.	1	1	.	5
Rhodax canus	4	.	.	.	.	.	.	2
All. *Festucion valesiacae* Klika 1931 (*F. rupicolae* Soó 1940)								
Eryngium campestre	4	.	.	.	.	.	.	3
Medicago falcata	3	5	.	.	.	.	.	3
Trinia glauca	3	.	5	.	1	2	5	2
Plantago argentea	1	.	5	.	3	3	3	.
Ord. *Festucetalia valesiacae* Br.-Bl. et Tüxen 1943 and Cl. *Festuco-Brometea* Br.-Bl. et Tüxen 1943								
Sanguisorba minor	5	3	5	2	4	3	1	1
Plantago lanceolata	2	.	.	.	5	.	1	.
Minuartia verna ssp. *collina*	1	.	2	2	4	1	2	.
Lotus corniculatus	1	.	2	1	3	1	1	.
Achillea collina	1	.	5	.	4	.	.	.
Orlaya grandiflora	1	.	3	4	.	.	.	.
Koeleria nitidula	3	.	.	.	.	.	.	2
Sideritis montana	3	.	.	.	.	.	.	3
Astragalus onobrychis ssp. *chlorocarpus*	3	.	.	.	.	.	.	1
Cuscuta epithymum	3	.	.	.	.	.	.	.
Linum tenuifolium	3	.	.	.	.	.	.	2
Origanum vulgare ssp. *vulgare*	1	.	3	.	.	.	.	.
Other species	.	.	.	.	.	.	.	.
Calamintha alpina (=*Acinos alpinos*)	1	.	5	3	.	4	3	1
Erysimum diffusum	1	2	.	2	3	2	.	.
Achillea crithmifolia	1	2	3	.	.	.	.	.
Arenaria serpyllifolia	1	.	4	3	4	2	1	.
Minuartia caespitosa	.	.	.	.	.	.	.	3
Scabiosa triniifolia	4	.	.	.	.	.	.	3
Centaurea affinis ssp. *affinis*	5	.	.	.	.	.	.	.
Globularia aphyllanthes	4	.	.	.	.	.	.	1
Carlina acanthifolia	3	.	.	.	.	.	.	.
Plantago subulata	4	.	.	.	.	.	.	.
Dorycnium herbaceum	3	.	.	.	.	.	.	.
Corylus colurna	1	.	.	4	.	.	.	.
Primula veris	1	.	2	.	.	3	.	.
Corothamnus procumbens (*Cytisus procumbens*)	.	.	.	1	.	5	3	.

	BS	MIs	HSr	HSs	Sjr	PCr	PCs	HS
Cerastium banaticum	.	.	4	.	.	4	3	.
Senecio rupestris	.	.	2	.	5	3	3	.
Thymus jankae	.	.	5	.	.	1	2	.
Silene sendtneri	.	.	5	.	.	1	2	.
Arabis nova	.	.	4	.	4	.	1	.
Viola tricolor ssp. *macedonica*	.	.	2	.	3	4	5	.
Dorycnium germanicum	.	.	5	1	.	2	1	.
Dianthus pelviformis	.	.	2	.	.	4	.	.
Centaurea stoebe	.	4	.	.	.	.	.	1
Festuca valesiaca	.	.	2	2	5	.	.	.
Calamintha acinos (=*Acinos arvensis*)	.	2	4	.	4	.	.	.
Thymus humifusus (=*Thymus praecox*)	.	.	.	5	3	.	.	.
Thymus marschalianus (=*Thymus pannonicus*)	.	2	2	4	1	4	.	.
Jurinea mollis	.	.	5	.	.	2	.	.
Carpinus orientalis	.	3	.	.	.	.	.	.
Cotoneaster nebrodensis	.	.	.	4	.	.	1	.
Dianthus capitatus	.	.	.	.	.	.	3	.
Dianthus pelviformis	.	.	2	.	.	4	.	.
Hieracium hoppeanum	.	.	.	2	.	.	3	.
Marrubium peregrinum	.	3	.	.	.	.	.	.
Mercurialis ovata	.	.	.	1	.	4	.	.
Potentilla argentea	.	.	.	.	4	.	.	.
Pyrus amygdaliiformis	.	3	.	.	.	.	.	.
Ranunculus illyricus	.	.	.	.	2	3	.	.
Rumex acetosella	.	.	.	.	5	.	.	.
Sesleria rigida	.	.	.	1	.	2	3	.
Sorbus mougeotii	.	.	.	3	.	.	.	.
Stachys officinalis	.	.	.	.	.	1	3	.
Syringa vulgaris	.	.	3	3	.	.	.	.
Veratrum nigrum	.	.	3	.	4	1	.	.
Viola macedonica	.	.	2	.	3	4	.	.