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Armerio rumelicae-Potentillion Micevski 1978 in South-Central Balkan with emphasis on Galičica Mountain vegetation

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***Abstract*:**

Ćušterevska, R.: ***Armerio rumelicae-Potentillion Micevski 1978 in South-Central Balkan with emphasis on Galičica Mountain vegetation. Biologica Nyssana, 8 (1), September 2017: 61-72.***

The article provides an overview of current knowledge about distribution of perennial grasslands supported by nutrient-poor soils on siliceous bedrocks at elevations characterized by the submediterranean climate of South-Central Balkan Peninsula (*Armerio rumelicae-Potentillion*). We used our own field data from Galičica Mountain and literature sources to compile a set of vegetation plots that have been stored in a vegetation database, data-mined and analyzed using numerical-analytical tools such as cluster analysis and ordination. Five already known associations, were confirmed as well-defined floristic complexes, while the floristic composition of our data enabled recognition of ass. *Euphrasio-Plantaginetum holostei* Micevski 1994 subass. *festucetosum hirtovaginatae* subass. nova.

Key words: Balkan Peninsula, silicicolous perennial grasslands, syntaxonomy, vegetation classification

***Apstrakt*:**

Ćušterevska, R.: ***Armerio rumelicae-Potentillion Micevski 1978 u južnom delu centralnog Balkana sa posebnim osvrtom na vegetaciju planine Galičice. Biologica Nyssana, 8 (1), Septembar 2017: 61-72.***

Članak obezbeđuje pregled postojećeg znanja o distribuciji višegodišnjih travnjaka na silikatnim zemljištima siromašnim nutrijentima i nadmorskim visinama okarakterisanim submediteranskom klimom južnocentralnog dela Balkanskog poluostrva (*Armerio rumelicae-Potentillion*). Korišćeni su autorski terenski podaci sa planine Galičice i literaturni izvori kako bi se sastavio skup vegetacijskih plotova, koji su zatim sačuvani u vegetacijskoj bazi podataka i analizirani korišćenjem numeričko-analitičkih alata poput klaster analize i ordinacije. Pet poznatih asocijacija potvrđene su kao dobro definisani floristički kompleksi, dok je iz florističkog sadržaja naših podataka prepoznata ass. *Euphrasio-Plantaginetum holostei* Micevski 1994 subass. *festucetosum hirtovaginatae* subass. nova.

Ključne reči: Balkansko poluostrvo, višegodišnji travnjaci na silikatima, sintaksonomija, klasifikacija vegetacije

Introduction

In the framework of a broader research of the grassland vegetation on Galičica Mountain, among other it was investigated the vegetation which is developing to deep decalcified soil on carbonate substrate distributed in the area between 1000-1500 m a.s.l.. Whereby there was a need to define its affiliation to higher sintaxonomic categories. Communities that develop on silicate surface up to 1000 m a.s.l. in South-Central Balkan belong to the alliance *Trifolion cherleri* Micevski 1970 (*Festuco-Brometea*), while communities that develop over this belt belong to the alliance *Armerio-Potentillion* Micevski 1978. According to the original concept (Micevski, 1970, 1971, 1978), *Armerio-Potentillion* was subordinated to the order *Astragalo-Potentilletalia*. In the classification scheme, as adopted by the EuroVegChecklist (Mucina et al., 2016), the *Astragalo-Potentilletalia* (*Festuco-Brometea*) comprises only open calcicolous grasslands of the *Saturejo-Thymion*. The *Trifolion cherleri* represents submediterranean therophyte communities in the Southern Balkans, classified in the *Helianthemetalia guttati* Br.-Bl. in Br.-Bl. & al. 1940 (*Helianthemetea guttati* Rivas Goday et Rivas-Mart. 1963). The *Armerio-Potentillon* cannot be classified into either the *Astragalo-Potentilletalia* or in the *Helianthemetalia guttati*. This vegetation is perennial grassland supported by nutrient-poor soils on siliceous bedrocks at elevations characterized by the submediterranean climate of Macedonia, Southern Serbia and Bulgaria. The following associations have so far been classified in the *Armerion-Potentillon*: *Genisto-Agrostietum byzanthinae* Micevski 1978, *Koelerio-Festucetum stojanovii* Micevski 1978, *Diantho-Armerietum rumeliacae* N. Ranđelović 1978, *Euphrasio-Plantaginetum holostei* Micevski 1994 and *Plantagini subulatae-Agrostietum capillaris* Pedashenko et al. 2013. Similar vegetation was described or reported from southeastern Serbia by N. Ranđelović (1978), where ass. *Diantho-Armerietum rumelicae* N. Ranđelović 1978 in describing is arranged in alliance *Chrysopogono-Danthonion* Kojić 1957 (order *Brometalia erecti* Br.-Bl. 1936 class *Festuco-Brometea* Br.-Bl. et Tx. Ex Klika et Hadac (1944). Later, Milosavljevic et al. (2008), Ranđelović et al. (2008) and V. Ranđelović & Zlatković (2010) classified this vegetation in the *Armerio-Potentillon*. V. Ranđelović & Zlatković (2010) proposed classification of the *Armerio-Potentillon* into a new order – the *Armerietalia rumelicae*, however since they failed to designate the *holotypus* in *expressis verbis* (as required by the ICPN after 01.01.2002), the order name remained invalid. Mucina et Čarni (Di Pietro et al. 2015) agreed with the syntaxonomic concept of the new order suggested by Ranđelović & Zlatković (2010) and therefore formally validated the *Armerietalia rumelicae* V. Randelovic et N. Randelovic in V. Randelovic et Zlatkovic ex Mucina et Čarni in Di Pietro et al. 2015.

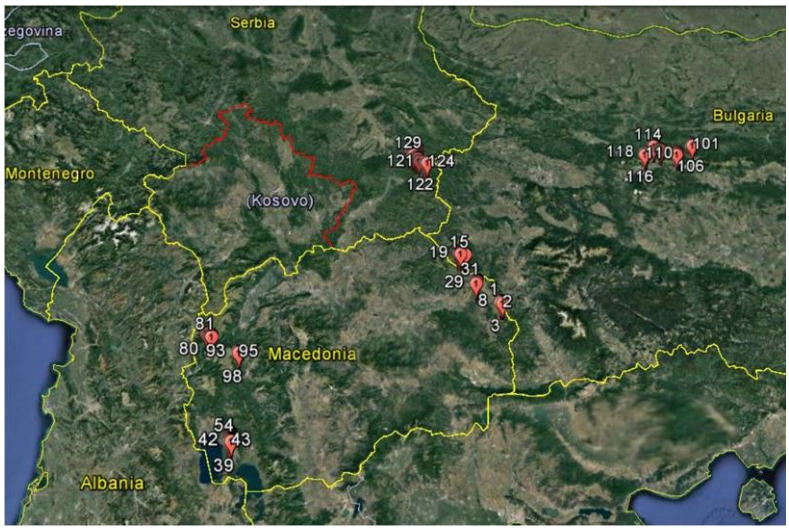

Fig. 1. Locations (relevés numbered with ordinal numbers) of the studied area

Material and methods

The studied area comprised the central and southern regions of the Balkan Peninsula, namely territory of southeastern Serbia, eastern and western Macedonia and central Bulgaria (**Fig. 1**). We focused on the collection of vegetation plot data of supratemperate and submediterranean, silicicolous perennial grasslands.

Original vegetation plot data were collected according to the standard Braun-Blanquet method of field-plot sampling (Braun-Blanquet, 1964). The sampling was done in optimal phenological period of the year – from the second half of June to mid-July during 2009 and 2010 on the Galičica Mountain, were investigated perennial grasslands supported by nutrient-poor soils which usually occur on silicate substrate and into this case on deep soil where carbonates are washed. The size of the sampled plots was 100 m². The choice of this sample size was motivated by the relatively homogenous vegetation at this scale and the preponderance of vegetation plot data collected at that scale in the past.

Table 1. Association *Euphrasio-Plantaginetum holostei* Micevski 1994 subass. *festucetosum hirtovaginatae* subass. nova (**E-Ph-fh) (G-Ab -** *Genisto-Agrostidetum byzanthinae;* **K-Fs** - *Koelerio-Festucetum stojanovii*; **E-Ph** - *Euphrasio-Plantaginetum holostei* (Bistra Mt.); **Ps-Ac** - *Plantagini subulatae-Agrostietum capillaris*; **D-Ar** - *Diantho-Armerietum rumelicae*)

Number of releve	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	***E-Ph-fh***	*G-Ab*	*K-Fs*	*E-Ph*	*Ps-Ac*	*D-Ar*
Euphrasia pectinata	+	+	+	+	1	.	1	1	1	1	1	1	+	1	1	1	1	+	+	1	+	1	1	+	.	+	+	+	1	1	1	+	V			V	II	V
Plantago holosteum	.	.	.	.	1	.	.	1	1	.	1	4	3	4	3	3	3	+	1	1	+	1	.	.	.	.	.	1	1	1	1	+	IV	V		V	V	
Arenaria serpyllifolia	.	.	+	.	.	1	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I			IV	I	
subass. *festucetosum hirtovaginatae*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.					
Achillea seidlii	1	+	+	1	+	+	1	2	1	+	1	+	1	+	+	+	+	1	+	1	+	1	+	+	+	1	1	.	.	.	.	.	V					
Centaurea deusta	.	.	.	.	.	+	+	2	1	1	1	1	2	1	+	+	+	+	1	1	1	1	1	+	+	+	.	1	1	1	.	+	IV					
Hypericum barbatum	1	1	+	1	1	+	+	1	+	+	+	.	+	+	.	.	.	1	+	1	+	.	+	.	+	+	1	+	.	+	+	+	IV		I			
Verbascum speciosum	.	.	.	.	.	.	.	+	+	1	1	+	+	+	1	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	IV					
Festuca hirtovaginata	.	.	.	.	1	.	.	.	.	1	2	+	2	2	1	2	+	4	5	4	3	4	4	4	4	4	1	.	.	.	.	.	III					
Bupleurum falcatum subsp. *cernuum*	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	1	+	1	+	1	+	+	1	2	2	1	1	III					
Armerio-Potentillion																																						
Agrostis castellana	.	.	.	.	.	.	.	2	1	4	3	.	+	+	+	+	+	+	+	1	+	.	1	.	.	+	1	1	1	+	+	+	IV	V	I			
Leontodon hispidus	+	+	+	+	.	.	+	1	1	1	+	+	+	.	.	.	.	+	.	+	+	.	.	.	.	.	1	1	1	1	1	+	IV		IV		I	
Festuca valesiaca	3	4	4	3	4	4	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	+	.	II			III	IV	
Helianthemum nummularium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	I	III	V		I	III
Veronica austriaca subsp. *austriaca*	.	+	.	.	.	+	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I		III		I	
Armerietalia rumelicae , Stipo giganteae-Agrostietea castellanae																																						
Anthoxanthum odoratum	2	1	+	+	1	+	1	1	1	1	+	1	+	1	+	1	+	+	+	1	+	+	+	+	+	+	1	1	1	1	+	.	V	IV	III	IV	III	I
Plantago lanceolata	1	1	+	+	+	+	+	1	1	+	+	.	+	+	+	+	+	1	.	+	.	+	+	+	.	.	+	+	+	+	+	.	V	V	V	V	II	V
Cruciata pedemontana	1	1	+	+	+	1	+	.	+	.	.	.	.	.	.	.	.	1	+	1	+	+	1	1	+	1	1	.	.	.	.	.	III		I	I	I	
Poa bulbosa	.	.	.	.	.	.	.	+	1	1	1	1	1	1	1	1	+	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	III	V	III	V	II	
Trifolium campestre	.	.	+	.	2	2	+	+	1	1	1	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	III	V	I	III	III	I
Dianthus deltoides	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	1	1	1	+	.	.	II					I
Trifolium repens	+	2	+	+	2	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	II	IV	V	IV	II	IV
Veronica arvensis	+	.	+	.	2	+	+	.	.	.	.	.	.	+	+	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	II		III	II	I	I
Cynosurus echinatus	+	+	+	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II				II	
Anthemis cretica subsp. *carpatica*	.	.	.	.	.	.	.	1	+	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Arabidopsis thaliana	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Erodium cicutarium	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Filago arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I					
Filago minima	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Myosotis stricta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I		I			I
Potentilla pedata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	+	+	I					

Potentilla recta subsp. *recta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I		I			
Scleranthus annuus subsp. *annuus*	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I					
Sedum urvillei	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I			I		
Trifolium arvense	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	I			III	III	
Vicia lathyroides	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Rumex acetosella	+	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I		IV	II	V	III
Scabiosa triniifolia	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	I		IV	
Viola tricolor subsp. *macedonica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I					IV
other species																																						
Dianthus cruentus	1	+	+	1	1	2	2	1	2	1	1	+	2	1	1	1	1	+	1	+	1	+	+	+	+	+	1	+	+	1	+	+	V		II			IV
Galium verum	1	2	1	1	+	+	1	1	1	+	+	+	+	1	+	1	+	1	1	1	1	1	+	+	+	+	1	1	+	+	1	1	V	II	IV		II	III
Pilosella officinarum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+	1	+	+	1	1	1	1	1	1	V	V	V			
Thymus sibthorpii	2	.	1	+	1	1	1	1	2	1	1	+	+	+	2	2	2	1	1	1	1	1	1	1	1	+	1	1	1	1	1	1	V	V				
Campanula patula subsp. *patula*	1	1	+	1	.	.	1	1	1	1	1	+	1	1	+	+	+	+	+	+	+	+	1	1	1	1	1	1	+	1	+	+	V		III			V
Rhinanthus minor	1	+	+	1	+	.	+	.	.	.	1	+	.	+	+	+	+	+	.	1	1	+	1	+	.	+	+	1	.	1	+	+	IV					V
Potentilla detommasii	1	1	1	+	1	1	1	1	+	.	1	+	+	+	.	1	+	1	1	+	1	+	+	+	+	+	+	1	.	.	.	.	V		II			
Stellaria graminea	+	+	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	1	1	1	+	+	+	III		III			V
Trifolium pratense	.	+	.	.	+	.	+	.	+	.	+	+	.	.	.	.	.	+	+	+	+	.	.	.	.	.	+	+	+	+	+	.	III		II	I	I	V
Cerastium brachypetalum subsp. *roeseri*	1	+	1	+	+	1	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	+	+	.	.	.	III					
Silene sendtneri subsp. *balcanica*	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	+	+	.	+	+	+	+	+	.	1	+	.	.	+	+	.	III					
Potentilla arenaria	+	+	+	+	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	+	1	+	.	+	.	.	.	.	.	.	II					
Achillea chrysocoma	.	.	+	+	+	.	+	.	+	.	+	+	1	2	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II					
Koeleria splendens	.	.	.	.	1	1	+	1	1	.	1	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II					
Genista tinctoria	.	.	.	.	.	.	.	1	+	.	1	1	+	.	.	.	1	+	.	.	.	.	+	.	.	.	1	1	.	+	.	+	II				I	
Stipa balcanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	+	+	.	+	1	4	4	3	4	4	4	II					
Dichoropetalum oligophyllum	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	1	.	.	.	.	.	+	1	+	+	1	1	+	.	+	II			II		I
Lotus tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	+	+	.	+	+	.	.	+	.	.	.	1	+	+	.	.	II	V	II			
Asphodelus albus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	+	+	1	+	+	+	+	.	II					
Cirsium eriophorum	+	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	+	.	.	.	.	II					
Primulla veris subsp. *columnae*	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	II			I		
Noccaea praecox	.	+	+	+	.	.	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	II					I
Euphorbia verrucosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	1	2	1	1	1	1	+	II					
Secale strictum	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	+	1	.	.	.	.	.	.	II					
Scorzoneroides cichoriacea	.	+	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	II					
Silene viscaria	.	.	.	.	+	.	.	.	.	2	1	.	.	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	II					I
Achillea setacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	1	+	+	1	+	II		V			V
Carduus tmoleus	.	.	.	.	.	.	.	1	+	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	1	II			II		
Galium verticillatum	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II					
Knautia arvensis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	+	.	.	+	1	II	II				III
Verbascum longifolium subsp. *pannosum*	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	I					II
Euphorbia myrsinites	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I				I	

Carex halleriana	.	.	.	.	.	.	.	.	.	.	.	+	1	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Seseli peucedanoides	+	+	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I		II			
Trifolium phleoides	.	+	+	+	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Muscari racemosum	.	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I					
Ranunculus psilostachys	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Pimpinella tragium subsp. *lithophila*	.	.	.	.	.	.	.	1	1	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Trisetum flavescens	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	.	.	.	.	I		I	IV	I	
Thesium arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	+	1	+	I			I		
Alyssum strigosum	.	.	+	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Festuca rubra subsp. *rubra*	+	+	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Erysimum kummerlei	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I			I		
Cruciata laevipes	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I					
Malva moschata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	I					I
Poa angustifolia	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.	.	.	.	.	I				I	
Sanguisorba minor	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	IV	I	II	II	III
Galium divaricatum	.	.	+	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	IV	II	III		
Bromus squarrosus	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Trifolium alpestre	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	I	II	III		II	II
Trifolium velenovskyi	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	1	.	.	.	.	.	.	.	.	.	I		III	I		V
Briza minor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	I					
Juniperus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	I			IV		
Veronica chamaedrys	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I		I		I	I
Clinopodium alpinum subsp. *meridionale*	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I			I		
Teucrium chamaedrys	.	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	II	I		I	
Phleum montanum	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Eryngium amethistinum	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I			I		
Ranunculus oreophilus	.	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Asperula aristata subsp. *scabra*	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I			III		
Ornithogalum orthophyllum subsp. *kochii*	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					I
Stachys germanica subsp. *heldreichi*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	I					
Polygala nicaeensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	I	II				
Polygala vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	I		I	II		IV
Helleborus odorus	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				I	
Schedonorus pratensis	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I					
Medicago lupulina	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					
Geum montanum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I					
Carthamus lanatus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I					
Thymus longicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	I		V	IV	II	V
Elytrigia intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	I					
Digitalis ferruginea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	I					
Dactylis glomerata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I					

Bromopsis cappadocica	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Orlaya daucorlaya	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Xeranthemum annuum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Scandix australis subsp. *australis*	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Alyssum repens subsp. *trychostachyum*	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I			I	
Orlaya daucoides	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Prunella laciniata	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I		II	
Odontites luteus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Silene nemoralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Cytisus austriacus subsp. *heuffelii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I				
Clinopodium alpinum subsp. *hungaricum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I				
Trifolium tenuifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I				
Delphinium fissum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I				
Silene bupleuroides subsp. *staticifolia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I				
Gentiana cruciata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I				
Allium rotundum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I				
Eryngium campestre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	V		I	II
Lathyrus nissolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I				
Rumex alpestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I				I
Brachypodium pinnatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	I				
Stachys officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	I				
Veronica orbelica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I				

The plots were located within targeted remnant patches of dry grasslands in such a way that edge effects (close forest edge, roads and settlements) were excluded.

The sampled 32 relevés and the rest 108 from literature sources were entered into TURBOVEG (Hennekens & Schaminée, 2001). Classification was made using the PC-ORD 4 package (McCune & Mefford, 1999) integrated in JUICE software, using Flexible Beta (clustering) and Relative Euclidean Distance (known also as Chord Distance) as the measure of resemblance among relevés. The table sorting based on this clustering was then performed in JUICE 7.0 (Tichý & Holt, 2006). Diagnostic species of each cluster (interpreted as associations) were defined in JUICE by calculating the fidelity of each species to each group using the *phi* coefficient as the fidelity measure (Chytrý et al., 2002). The threshold of the *phi* value was selected at level 0.55. Diagnostic species were identified by JUICE using the *phi* coefficient greater than 0.6. In order to assist ecological interpretation of the ordinated patterns, average bioindicator values (Pignatti, 2005) for the relevés were calculated based on presence-absence data and overlaid as supplementary environmental data. We used Raunkiaer's (1934) system of life forms and we determined the chorological spectra using data of Gajić (1980) and Pignatti (2005). The chorological spectrum is presented as percentages of each group of species within the entire species composition.

In the analytic table (**Tab. 1**) are presented the results of the cluster analysis and subsequent JUICE tabular sorting. The syntaxonomic affiliation of taxa other than diagnostic ones was decided upon using expert knowledge and the database of the European Vegetation Checklist (Mucina et al., 2016). The nomenclature follows in principle the Flora Europaea (Tutin et al., 1964-1993) however it was adjusted using the Med-Check List (Greuter et al., 1984-1989; Greuter et al., 2008) and new taxonomic and nomenclatural findings as featured in the Euro+Med Database (www.emplantbase.org). Some taxonomic concepts follow regional floras (Hayek, 1927, 1931, 1933; Jordanov, 1963-1979; Josifović, 1970-1986; Velchev, 1982-1989; Micevski, 1985-2005; Kozuharov, 1995; Matevski, 2010). Formation of the names of the new syntaxa follows the International Code of Phytosociological Nomenclature (Weber et al., 2000).

Results and discussion

The optimal level of the clustering was determined by the Optimclass 1 method. The cluster analysis suggested six well separated clusters (**Fig. 2**). Since they show a high degree of floristic (and geographic) integrity, five already described associations were confirmed. While, after the made extensive comparative analysis, relevés of cluster 5, showed the greatest syntaxonomic affinity with ass. *Euphrasio-Plantaginetum holostei* because of the presence of its characteristic species.

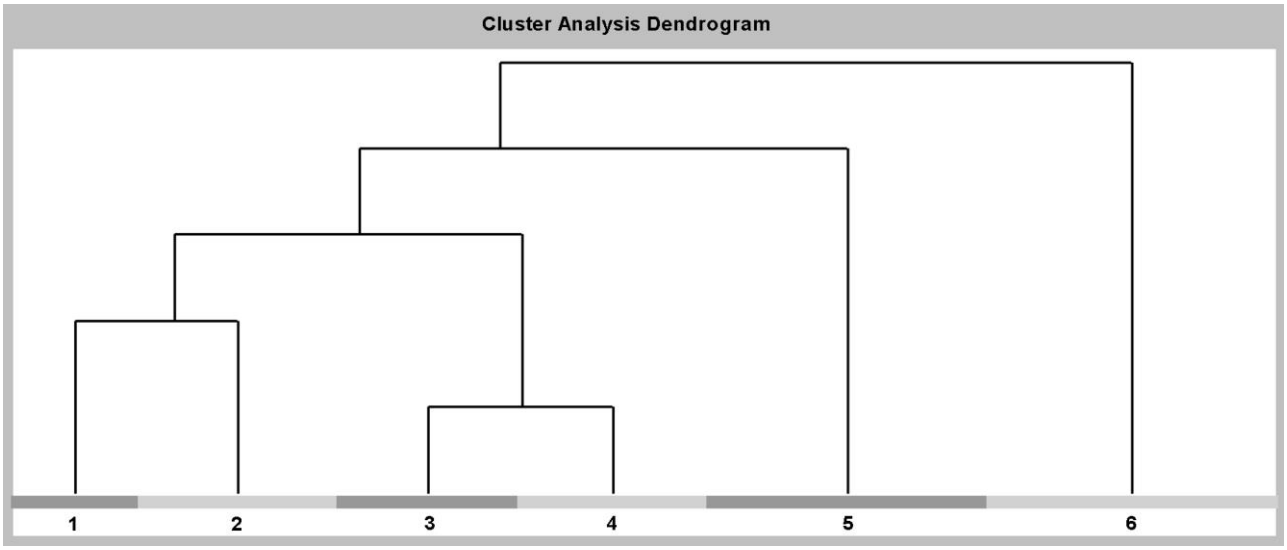

Fig. 2. Graphical representation of the classification results of the *Armerio rumelicae-Potentillion* vegetation (Flexible Beta clustering method, relative Euclidean distance). Legende: Cluster 1: *Genisto-Agrostietum byzanthinae*, Cluster 2: *Koelerio-Festucetum stojanovii*, Cluster 3: *Plantagini subulatae-Agrostietum capillaris*, Cluster 4: *Diantho-Armerietum rumeliacae*, Cluster 5: *Euphrasio-Plantaginetum holostei* subass. *festucetosum hirtovaginatae* subass. nova., Cluster 6: *Euphrasio-Plantaginetum holostei*

Fig. 3. Ass. *Euphrasio-Plantaginetum holostei* Micevski 1994 subass. *festucetosum hirtovaginatae* subass. nova – Asan Gjura (Galičica Mt.)

The association *Euphrasio-Plantaginetum holostei* has been described and for the first time registered on Bistra mountain, developing exclusively on silicate substrate with a thin layer of soil, so that in some places subsoil breaks out on the surface. This association on Bistra mountain is differentiated into 3 subassociations - subass. *typicum*, subass. *festucetosum nigrescentis* (over the village Galičnik) and subass. *agrostidetosum capilaris* (from Kičevo side of the mountain Bistra, above Knežino). In the floristic composition of the vegetation relevés (cluster 5, **Fig. 2**) made in our research on the move Asan Gjura-Dofa, all three characteristic species of the association were registered: *Euphrasia pectinata*, *Arenaria serpyllifolia* and *Plantago holosteum*. None of diagnostic taxa of existing subassociations of the ass.

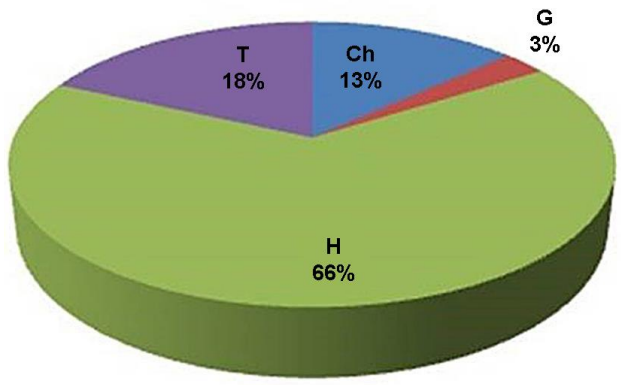

Fig. 4. Ass. *Euphrasio-Plantaginetum holostei* Micevski 1994. subass. *festucetosum hirtovaginatae* subass. nova. – spectrum of life forms

Euphrasio-Plantaginetum holostei, was registered. But therefore, with analysis "analysis of constancy columns in synoptic table" of the program package Juice, were separated taxa over which the community that is developing on the Galičica Mountain, differs from existing community *Euphrasio-Plantaginetum holostei.*

Diagnostic species: *Achillea seidlii, Bupleurum falcatum* subsp. *cernuum, Centaurea deusta, Festuca hirtovaginata, Hypericum barbatum, Rhinanthus minor, Verbascum speciosum*

Constant species: *Anthoxanthum odoratum, Euphrasia pectinata, Galium verum, Pilosella officinarum, Plantago lanceolata, Thymus sibthorpii*

Dominant species: *Agrostis castellana, Festuca hirtovaginata, Festuca valesiaca, Plantago holosteum, Stipa balcanica*

Because of this, the need for extraction of new subassociation *festucetosum hirtovaginatae* subass. nova was imposed (Holotypus hoc loco: Tab. 1/23) (**Tab. 1**). Subassociation is named by the species *Festuca hirtovaginata,* which has a dominant presence and define its physiognomy. Subass. *festucetosum hirtovaginatae*, unlike the other subassociations of ass. *Euphrasio-Plantaginetum holostei* develope on a limestone substrate, on deep soil, at the move Asan Gjura-Dofa (**Fig. 3**). Diagnostic species of subassociation are: *Achillea seidlii, Centaurea deusta, Hypericum barbatum, Rhinanthus minor, Verbascum speciosum, Festuca hirtovaginata* and *Bupleurum falcatum* subsp. *cernuum.*

As far as the ecological characteristics of this community, subass. *festucetosum hirtovaginatae*, develops at an altitude of 1455-1500 m, in habitats with very low inclination (most vegetation relevés are made on a completely flat surface, almost without inclination) (App. 1). From the spectrum of life forms (**Fig. 4**), it may be noted that the percentage of hemicryptophytes is 66%, which is due to the dominant presence of representatives of fam. *Poaceae*: *Agrostis castellana, Festuca hirtovaginata, Festuca valesiaca, Stipa balcanica* and others.

From the spectrum of floral elements it can be seen that the most common is the Eurasian floral element (46%) (**Fig. 5**), while the Balkan floral elements are second group by representation (19%),

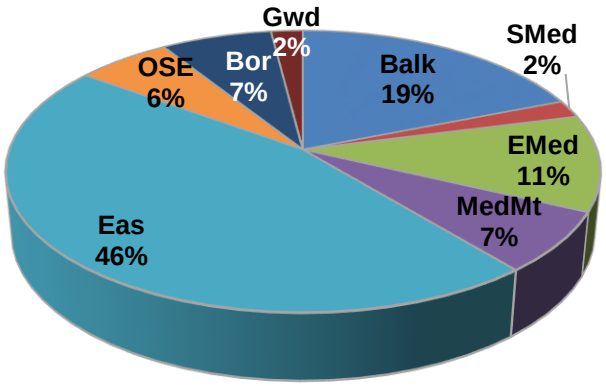

Fig. 5. Ass. *Euphrasio-Plantaginetum holostei* Micevski 1994. subass. *festucetosum hirtovaginatae* subass. nova. – spectrum of geo-elements (**Balk** - Balkan and sub Balkan; **SMed** - Steno Mediterranean; **EMed** - Eurimediterranean; **MedMt** – Mediterranean mountainous; **Eas** - Eurasian; **OSE** - Orophil-South European; **Bor** - Boreal; **Gwd** - Geo-elements with wider distribution)

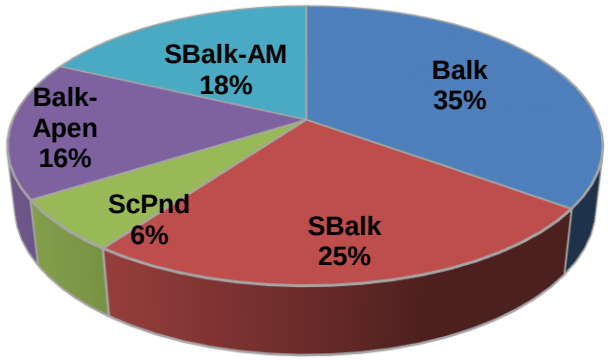

Fig. 6. Ass. *Euphrasio-Plantaginetum holostei* Micevski 1994. subass. *festucetosum hirtovaginatae* subass. nova. – percentage representation of Balkan geo-elements (phytogeographic spectrum) (**Balk** - Balkan (*sensu stricto*); **SBalk** - South Balkan; **ScPind** - Scardo-Pindus; **Balk-Apen** - Balkan-Apennine; **SBalk-AM** - South Balkan-Asia Minor)

with the most dominant Balkan-Apennine (35%) (**Fig. 6**).

Using the data from "WorldClim", we received the following bioclimatic variables for the researched community:

BIO1 = Annual mean temperature (6,6), BIO2 = Mean diurnal range (mean of monthly (max temp – min temp)) (9,8), BIO3 = Isothermality (BIO2/BIO7) (0,34), BIO4 = Temperature seasonality (standard deviation *100) (62,9), BIO5 = Max temperature of warmest month (22,1), BIO6 = Min temperature of coldest month (-6), BIO7 = Temperature annual range (BIO5–BIO6) (28.1), BIO8 = Mean temperature of wettest quarter (2.6), BIO9 = Mean temperature of driest quarter (14.7), BIO10 = Mean temperature of warmest quarter (14.7), BIO11 = Mean temperature of coldest quarter (-1.4)

BIO12 = Annual precipitation (930), BIO13 = Precipitation of wettest month (117), BIO14 = Precipitation the driest month (48), BIO15 = Precipitation seasonality (coefficient of variation) (27), BIO16 = Precipitation of wettest quarter (311), BIO17 = Precipitation of driest quarter (149), BIO18 = Precipitation of warmest quarter (149), BIO19 = Precipitation of coldest quarter (272);

Conclusion

This paper represents an oveview of the distribution and syntaxonomic position of the supratemperate and submediterranean, silicicolous perennial grasslands South-Central Balkan, which are covered by the alliances *Armerio-Potentillion* Micevski 1978. With numerical analyses it has also been shown that own unpublished data from Mountain Galičica sintaxonomically have proved that they are closest to the ass. *Euphrasio-Plantaginetum holostei* Micevski 1994. The fact that species *Festuca hirtovaginata* was significantly dominanted in the reaserched stands led us to distinguish a new subassociation *festucetosum hirtovaginatae* subass. nova which was confirmed with additional ecological analyses. This study complements the picture of South-Centarl Balkan supratemperate submediterranean silicicolous perennial grasslands with additional data from the Republic of Macedonia, but there are still areas that are not sufficietly researched.

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Appendix

Review of metadata. Running number, locality, latitude, longitude, sampling date, area, altitude (m), aspect, inclination (%) and cover for all relévés shown in the table 1.

1. From Asan Gjura to Krstec, 41,028498, 20,860192, 25.06.2009, 100, 1498, S, 5, 100; **2**. From Asan Gjura to Krstec, 41,028141, 20,863512, 25.06.2009, 100, 1480, NW, 3, 100; **3**. From Asan Gjura to Krstec, 41,027695, 20,860687, 25.06.2009, 100, 1480, N, 8, 96; **4.** From Asan Gjura to Krstec, 41,027817, 20,861515, 25.06.2009, 100, 1492, NW, 3, 100; **5**. From Asan Gjura to Krstec, 41,028471, 20,860517, 25.06.2009, 100, 1499, S, 10, 98; **6**. From Asan Gjura to Krstec, 41,025218, 20,866777, 25.06.2009, 100, 1483, SW, 5, 100; **7**. From Asan Gjura to Krstec, 41,024437, 20,866423, 25.06.2009, 100, 1467, NE, 3, 100; **8**. From sheepfold below Krstec to Asan Gjura, 41,068493, 20,859072, 25.07.2009, 100, 1468, W, 5, 100; **9**. From sheepfold below Krstec to Asan Gjura, 41,068493, 20,859072, 25.07.2009, 100, 1462, W, 5, 100; **10**. From sheepfold below Krstec to Asan Gjura, 41,067209, 20,858302, 25.07.2009, 100, 1460, 0, 0, 100; **11**. From sheepfold below Krstec to Asan Gjura, 41,065362, 20,857134, 25.07.2009, 100, 1455, 0, 0, 100; **12**. From sheepfold below Krstec to Asan Gjura, 41,064284, 20,856815, 25.07.2009, 100, 1461, 0, 0, 100; **13**. From sheepfold below Krstec to Asan Gjura, 41,062178, 20,856931, 25.07.2009, 100, 1457, 0, 0, 100; **14**. From sheepfold below Krstec to Asan Gjura, 41,056869, 20,856586, 25.07.2009, 100, 1455, 0, 0, 100; **15**. From sheepfold below Krstec to Asan Gjura, 41,056341, 20,856325, 25.07.2009, 100, 1451, 0, 0, 100; **16**. From sheepfold below Krstec to Asan Gjura, 41,053895, 20,855478, 25.07.2009, 100, 1458, 0, 0, 100; **17**. From sheepfold below Krstec to Asan Gjura, 41,051082, 20,855352, 25.07.2009, 100, 1460, 0, 0, 100; **18**. From Asan Gjura to Dofa, 41,031984, 20,863158, 26.07.2009, 100, 1483, SE, 5, 100; **19**. From Asan Gjura to Dofa, 41,032361, 20,854084, 26.07.2009, 100, 1480, 0, 0, 100; **20**. From Asan Gjura to Dofa, 41,032862, 20,859263, 26.07.2009, 100, 1481, SE, 2, 100; **21**. From Asan Gjura to Dofa, 41,032597, 20,855601, 26.07.2009, 100, 1481, 0, 0, 100; **22**. From Asan Gjura to Dofa, 41,032404, 20,851892, 26.07.2009, 100, 1475, 0, 0, 100; **23**. From Asan Gjura to Dofa, 41,033543, 20,848666, 26.07.2009, 100, 1495, 0, 0, 100; **24**. From Asan Gjura to Dofa, 41,0366, 20,847866, 26.07.2009, 100, 1481, 0, 0, 100; **25**. From Asan Gjura to Dofa, 41,041671, 20,854218, 26.07.2009, 100, 1473, 0, 0,

100; **26**. From Asan Gjura to Dofa, 41,041567, 20,855939, 26.07.2009, 100, 1468, 0, 0, 100; **27**. From Asan Gjura to Dofa, 41,039669, 20,860384, 26.07.2009, 100, 1484, E, 2, 100; **28**. From Asan Gjura to Dofa, 41,035231, 20,856573, 29.07.2009, 100, 1480, NE, 3, 100; **29**. From Asan Gjura to Dofa, 41,035491, 20,856483, 29.07.2009, 100, 1469, NE, 3, 100; **30**. From Asan Gjura to Dofa, 41,036381, 20,856884, 29.07.2009, 100, 1472, E, 8, 100; **31**. From Asan Gjura to Dofa, 41,037793, 20,857846, 29.07.2009, 100, 1467, NE, 5, 100; **32**. From Asan Gjura to Dofa, 41,038896, 20,856981, 29.07.2009, 100, 1462, NE, 3, 100;