Herbaceous vegetation on carbonate terrains in Mt Lozenska

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Abstract. Mt Lozenska is situated close to Sofia city. Its string of peaks and the ridges connecting them rest on limestone and dolomite limestone baserock, with shallow, dry and eroded hummus-carbonate soils. The diversity of the secondary grassland communities on carbonate terrains has been studied comparatively with some close in nature communities from East Serbia. The *Hyperico rochelii-Stipetum epilosae* **assoc. nov.** has been described as distributed on limited areas in the most xerothermic habitats of the mountain. A part of the studied communities is considered a transitional successive phase and has not been classified. The high conservation value of the habitats is mentioned too.

Key words: calcareous grasslands, *Hyperico rochelii-Stipetum epilosae, Saturejon montanae*

Introduction

Carbonate baserocks offer a set of specific conditions for vegetation different from those of silicate terrains. With their high content of $CaC0_3$ in the limestones, supplemented by considerable amounts of $MgC0_3$ in the dolomites, carbonate rocks influence the flora and vegetation not only by the composition of their chemical elements but also with the formation of a specific abiotic environment. The soil cover of the carbonate rocks is often shallow, strongly susceptible to surface erosion, with neutral or alkaline pH. The high albedo of the reflecting surface makes these terrains warmer. The shallow, eroded soils and the presence of karst formations render them dry (Ellenberg 1996).

Calcareous vegetation is marked with high diversity, a rich species composition and frequently present rare and specific floristic elements (Velchev 1998), owing to which it is of great scientific interest.

In a number of cases the carbonate terrains are represented locally, on limited areas, with xerothermic type of vegetation on them, and emerge in patches among the prevalent mesophyllous plant cover (Poschold & WallisDeVries 2002). Similar pattern might be seen on Mt Lozenska, the study area selected by the authors.

The main interest in the diversity of plant communities and their classification on such terrains has been supplemented by some unclarified issues about their status under the conditions of discontinued grazing, issues pertaining to their economic and environmental importance at national and international level.

Material and methods

Mt Lozenska lies 15 km southeast of the city of Sofia (Fig. 1). A string of peaks at an altitude of 985–1190 m forms the main ridge with an east-west orientation. The baserock on the southern slopes is represented mainly by archaic crystalline schists and Palaeozoic phyllitoids, while on the northern slopes red sandstones of Buntsandstein obtain. Part of the mountain ridge is formed of Middle Triassic limestones and dolomite limestones (Dimitrov 1923).

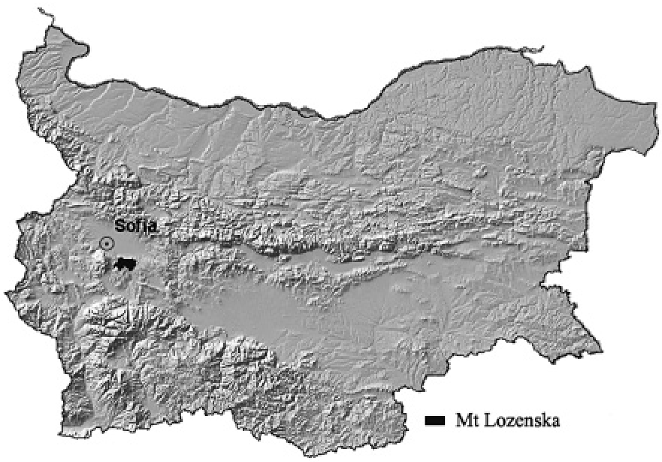

Fig. 1. Location of the studied area.

Mt Lozenska falls into the mild continental climatic zone, remarkable for its warm summer and cold winter, broad annual amplitude of air temperatures, spring-summer maximum and winter minimum of precipitations, and durable snow cover. The annual amount of precipitations varies within the 560-628 mm range (Velev 2002).

According to Ganchev (1961), Mt Lozenska is occupied mostly by broadleaved deciduous tree and shrub communities. On its northern slopes coppice forests of *Fagus sylvatica* L. and *Carpinus orientalis* Mill. prevail. The southern slopes are covered chiefly by xeromesophyllous forests of *Quercus dalechampii* Ten., and to a more limited extent by *Q. frainetto* Ten. and *Q. pubescens* Willd. forests. Secondary shrub vegetation with prevalence of *Corylus avellana* L. and *Carpinus orientalis* Mill. covers those parts of the mountain which have deeper and moister soils. According to Ganchev (1961), the herbaceous communities are of secondary origin and have come to replace the forests that were cut in the past. Ecologically they vary from hydrophytes to xerotherms.

Xerothermic communities, which are the object of this study, thrive on the ridges and higher parts of the slopes of the peaks Polovrak, Lalina Mogila and Mala Rakovichka Mogila, on carbonate baserock (limestones and dolomites). The soils are Rendzic Leptosols, shallow, dry, with rock outcrops.

During the vegetation seasons in 2005-2008, the herbaceous vegetation was studied and 90 relevés have been collected following the Braun-Blanquet method (Braun-Blanquet 1965; Westhoff & van der Maarel 1980). All relevés have been set in a representative homogeneous area of the communities, where the experimental plots cover 16 m^2, in accordance with the criteria set in literature (van der Maarel 2005; Chytrý & Otýpková 2003). All data is stored in the TURBOVEG programme (Hennekens & Schaminee 2001) and via its export functions were transferred to the JUICE programme (Tichý 2002). The division cluster procedure of TWINSPAN (Hill 1979) was used for classification of the communities. Diagnostic species have been determined using phi-coefficient (Sokal & Rolf 1995; Chytrý & al. 2002). Phi-coefficient values higher than 0.30 have been considered significant. The results were submitted to analysis on the basis of literary sources from Bulgaria, as well as of materials published in Serbia, Macedonia and Central Europe.

Kindred relevés of Mt Lozenska and relevés from neighbouring East Serbia (Jovanović-Dunjić 1955, 1956) have been subjected in a general block to Correspondence Analysis in the CANOCO 4.5 package (ter Braak & Šmilauer 2002).

Plant taxonomy follows Jordanov (1963-1979), Velchev (1982), Kozhuharov (1992, 1995), and Delipavlov & Cheshmedzhiev (2003).

Results and discussion

After the processing and analysis of all 90 relevés from different parts of Mt Lozenska, a group of 28 relevés show relation specifically to carbonate terrains. Not a single relevé on these terrains did fall into another cluster group and, respectively, not a single relevé outside the carbonate terrains fell into the cluster of these 28 relevés. Thus a convincing differentiation of the calcareous and dolomite calcareous grasslands emerged, as compared to the xeromesophyllous, mesophyllous and hygrophyllous grasslands from the adjacent areas.

Analysis of literature data has shown that in 1961 Ganchev referred the grasslands from the studied area to several associations, with dominance of *Festuca pseudovina* Beck and *Dichantium ischaemum* (L.) Roberty. Determining them on the dominance principle, he found out that they were distributed in very broad limits, including outside the carbonate terrains. Data published on the dolomite grasslands in neighbouring Serbia were used for comparison. Ranđelović & Růžić (1986) have published the associations *Sedo-Potentilletum arenariae* Růžić 1978 and *Diantho-Centauretum diffusae* Randjel. & Růžić 1982 from Southeast Serbia. These associations were referred to the class *Festuco-Brometea* Braun-Blanq. & Tüxen 1943, order *Astragalo-Potentilletalia* Micevski 1970, and alliance *Koelerio-Festucion dalmaticae* Randjel. & Růžić 1982. Under the influence of a stronger sub-Mediterranean climate, the communities described from that part of Serbia have shown some considerable differences from the materials from Mt Lozenska. The main differences appeared in the diagnostic species of the associations, alliance and order.

Close ecological conditions and considerable similarity with the species composition of the communities were found in the investigations of Jovanović-Dunjić (1955, 1956). On the territory of Suva and Rtanj mountains in East Serbia, the associations *Humileto-Stipetum grafianae* Jovan.-Dunj. 1955 and *Potentilleto-Caricetum humilis* Jovan.-Dunj. 1955 showed significant resemblance with the materials from Mt Lozenska. Owing to this, the 37 relevés from both mountains, along with the relevés from Mt Lozenska were subjected to cluster and ordination analyses. TWINSPAN cluster procedure differentiated convincingly two groups of relevés from Mt Lozenska, different from those from Suva and Rtanj Mts in Serbia. These differences could be seen in Table 1, which in the last constancy columns compares the two groups differentiated in Mt Lozenska with the two associations from Serbia. Similarity was observed at alliance level and there were considerable differences at association level. The comparative analysis is better illustrated by the ordination diagram (Fig. 2). In the right-side part of this diagram two groups of relevés from Mt Lozenska are differentiated, and in the left-side part are the well differentiated associations *Humileto-Stipetum grafianae* Jovan.-Dunj. 1955 and *Potentilleto-Caricetum humilis* Jovan.-Dunj. 1955. The comparison made gives grounds to maintain that, irrespective of the ostensible closeness in composition and ecological conditions, the plant communities from Mt Lozenska cannot be referred to the associations from the Suva and Rtanj Mts. The species common for the two regions are manifested chiefly at alliance level (*Saturejon montanae* Horvat 1962).

The class *Festuco-Brometea* is well represented in the relevés from Mt Lozenska (Table 1). The alliance *Saturejon montanae* Horvat 1962 is not unambiguously accepted in the literature sources. Horvat & al. (1974) had confirmed this alliance for Southeast Europe, adding in support the descriptions of Jovanović (1955) from the Suva and Rtanj Mts. Jovanović herself referred the associations *Humileto-Stipetum grafianae* and *Potentilleto-Caricetum humilis* to the alliance *Festucion valesiacae*, but in this year the alliance *Saturejon montanae* had not been described yet. Subsequently, Jovanović-Dunjić (1983) approved the reference of the two associations to the alliance *Saturejon montanae*. This alliance was accepted by Royer (1991) and placed by him in the group of xerophyllous alliances of *Festucetalia valesiacae*. Rodwell & al. (2002) did not mention in his work the alliance *Saturejon montanae*.

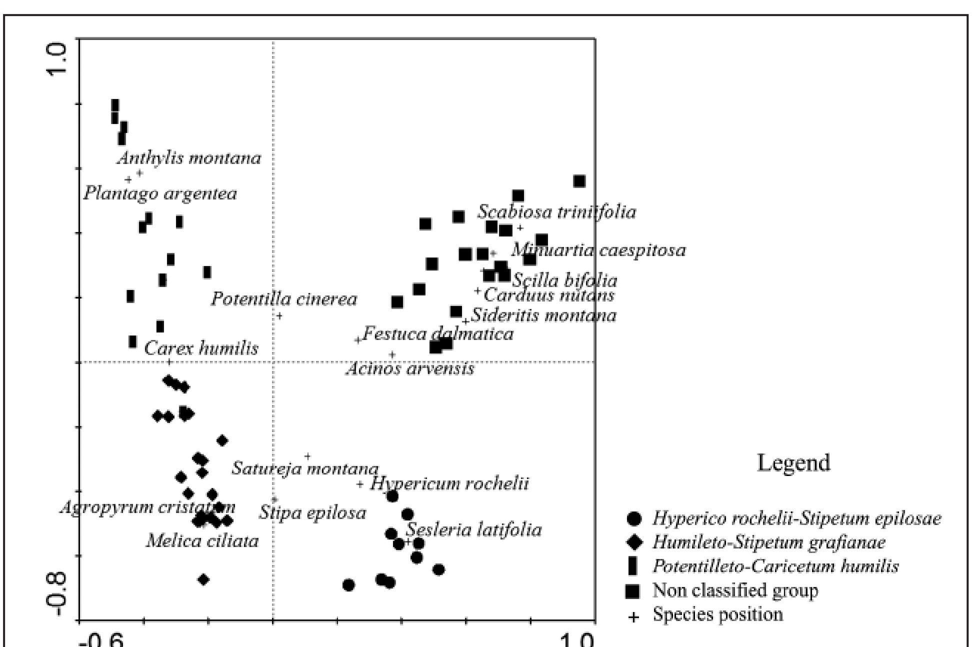

Fig. 2. Correspondence analysis ordination diagram of the samples. Axis 1 – horizontal, axis 2 – vertical.

Table 1. ***Saturejon montanae*** **in Mt Lozenska.**

Floristic elements																														Constancy		
	Elevation (m)	1180	950	1140	950	850	950	1095	900	950	950	1160	1132	1077	1085	1065	1085	1057	1105	1012	1158	1180	1151	1146	1105	1181	1148	1181	1180	*Hyperico rochelii-Stipetum epilosae*	Assoc. *Humileto-Stipetum Grafianae*	Assoc. *Potentilleto-Caricetum humilis*
	Slope (°)	20	40	25	40	20	40	10	25	40	40	5	20	10	20	20	20	20	20	20	25	35	20	15	20	10	35	0	5			
	Exposition	SW	W	W	SW	S	SW	S	W	W	SW	SW	SE	S	SW	SW	SW	S	E	SW	N	SE	SW	NW	E	SW	SW	SW	N			
	Cover (%)	85	96	90	95	95	90	80	96	95	95	90	98	80	95	95	98	90	90	95	90	90	80	90	90	90	65	95	95			
	Relevé number	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			
	Hyperico rochelii–Stipetum epilosae **Pedashenko, Meshinev et Apostolova, assoc. nov.**																															
Alp-Med	*Helianthemum nummularium*	.	+	.	+	1	1	1	2	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**	**II**	**V**
Med	*Muscari botryoides*	.	1	.	+	+	+	1	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**	.	.
med-OT	*Seseli peucedanoides*	.	.	.	+	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**	.	**III**
Ap-Bal	*Stipa epilosa*	3	5	3	4	3	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**	**V**	.
Bal	*Sesleria latifolia*	.	.	.	.	.	.	3	4	4	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**III**	.	.
Eur-Med	*Thesium divaricatum*	.	+	.	+	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**III**	.	.
Bal-Dac	*Hypericum rochelii*	+	.	.	+	+	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	**III**	.	.
subMed	*Hippocrepis comosa*	.	.	+	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**III**	.	.
Eur-Sib	*Genista tinctoria*	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**	.	.
	Saturejon montanae																															
subMed	*Festuca dalmatica*	2	.	2	+	1	.	1	2	1	2	2	3	.	3	1	2	1	3	4	1	1	1	4	2	3	.	2	2	**V**	**II**	**IV**
Eur	*Potentilla cinerea*	1	+	+	.	.	+	1	1	+	+	2	.	1	1	+	.	3	3	1	2	1	1	2	2	2	.	+	+	**V**	**V**	**V**
Eur-As	*Carex humilis*	1	.	1	1	2	.	1	2	2	+	1	.	.	1	.	1	.	1	.	1	+	+	+	1	.	1	1	+	**IV**	**V**	**V**
Pont-Med	*Leontodon crispus*	.	.	+	.	+	+	+	.	.	.	+	+	1	+	+	+	+	+	1	+	+	+	+	+	.	r	.	.	**IV**	**IV**	**I**
Pont-Med	*Satureja montana*	1	1	1	1	1	1	+	+	1	.	.	+	.	.	.	.	.	.	1	1	.	.	.	.	1	1	.	.	**III**	**IV**	.
Eur-Med	*Anthylis vulneraria*	.	.	+	.	.	.	+	.	.	.	2	2	.	1	.	.	1	1	.	2	3	.	.	2	1	.	+	+	**III**	.	**II**
Pont-Bal	*Asyneuma canescens*	+	+	.	.	.	+	1	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	**II**	**I**	**III**
subMed	*Trinia glauca*	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	r	.	+	+	.	.	+	.	.	+	**II**	.	.
subMed	*Teucrium montanum*	+	.	.	.	.	1	.	.	.	.	+	.	1	.	.	.	1	.	1	.	.	.	.	+	.	.	.	.	**II**	**IV**	**I**

Table 1. Continuation.

		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			
Med	*Allium flavum*	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	**I**	**III**	.
Festuco–Brometea, Festucetalia valesliacae																																
subMed	*Euphrasia pectinata*	+	.	+	.	.	.	.	+	.	.	+	.	.	2	+	+	.	+	+	+	+	1	+	+	2	+	.	+	**IV**	.	**III**
Eur-Med	*Asperula cynanchica*	+	.	+	.	.	.	+	+	.	+	.	.	.	+	+	+	+	.	+	.	+	+	+	+	+	+	.	1	**IV**	**IV**	**V**
Eur	*Euphorbia cyparissias*	+	.	+	.	.	.	+	+	1	+	.	+	+	+	+	+	+	.	+	+	+	+	+	+	1	.	.	+	**IV**	**IV**	**III**
subMed	*Thymus striatus*	.	+	.	+	+	+	1	1	+	1	1	.	.	.	2	+	1	.	.	.	.	2	1	.	.	.	.	.	**III**	.	.
subMed	*Asperula purpurea*	.	+	+	+	+	+	+	.	+	+	+	.	.	.	.	+	1	+	+	.	.	.	.	+	.	.	.	.	**III**	**V**	.
subMed	*Sideritis montana*	1	.	+	.	.	1	1	.	.	.	.	.	.	1	1	+	1	.	+	1	2	1	1	+	+	.	.	+	**III**	.	.
Eur-As	*Medicago falcata*	.	.	.	.	.	+	r	.	.	.	.	.	+	+	+	1	.	+	1	.	1	.	.	+	+	.	+	+	**III**	.	.
PontMed	*Eryngium campestre*	.	.	+	.	+	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	.	.	.	+	.	.	.	.	**III**	.	.
Pont	*Koeleria nitidula*	.	.	.	1	.	1	1	1	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**	.	.
subMed	*Teucrium chamaedrys*	+	.	+	1	1	.	.	.	.	.	+	+	.	.	.	1	.	.	.	.	.	.	1	.	.	+	+	1	**II**	**V**	.
sumBoreal	*Linum catharicum*	.	.	.	.	+	+	+	.	+	.	+	+	.	.	.	.	.	.	.	+	1	.	+	.	.	.	.	.	**II**	.	.
PontMed	*L. tenuifolium*	.	.	.	+	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	+	+	.	.	+	.	.	**II**	.	.
PontMed	*Fumana procumbens*	+	.	.	.	.	.	.	.	.	.	.	.	2	2	3	1	2	.	.	.	.	+	.	.	.	1	.	.	**II**	.	.
Med	*Thesium arvense*	.	.	+	.	.	.	.	.	.	.	.	+	+	.	+	.	+	+	.	.	.	.	.	+	.	+	.	.	**II**	.	.
Med-As	*Dichantium ischaemum*	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	+	.	+	.	.	**I**	.	.
	Others																non-classified relevés on association level															
Eur-Med	*Minuartia caespitosa*	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	+	+	+	+	+	.	+	.	1	+	**III**	.	.
Bal	*Scabiosa triniifolia*	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	r	.	.	+	+	+	.	.	+	+	+	.	**III**	.	.
Pont-Med	*Teucrium polium*	1	1	1	2	1	.	.	.	.	+	.	.	+	1	+	.	+	.	.	1	2	1	+	.	.	.	.	.	**III**	.	.
Eur-Med	*Acinos arvensis*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	r	+	+	1	.	+	+	+	.	.	**II**	.	.
Pont-subMed	*Scilla bifolia*	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	.	**II**	.	.
Eur-Med	*Carduus nutans*	+	.	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	+	+	+	.	.	.	.	.	**II**	.	.
Eur-Med	*Sedum acre*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	.	.	.	+	.	**II**	.	.
Bal	*Asyneuma anthericoides*	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	**II**	.	.
Pont	*Rhodax canus*	.	+	1	.	.	.	+	.	.	.	.	.	.	1	.	1	.	.	+	1	.	.	.	.	+	.	.	.	**II**	**I**	**II**
Kos	*Hypericum perforatum*	1	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	1	.	.	.	1	**II**	.	.
subMed	*Rosa canina*	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	r	.	.	.	.	**I**	.	.
subBoreal	*Sanguisorba minor*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	+	1	.	.	.	**I**	**II**	**I**
Bal-Dac	*Melica transsilvanica*	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	**I**	.	.
Med	*Linum corymbulosum*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	**I**	.	.

Table 1. Continuation.

		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			
Bal	*Koeleria penzesii*	2	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	I	.	.
Eur	*Globularia aphyllanthes*	.	.	.	+	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.
subMed	*Genista januensis*	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	I	.	.
subMed	*Centaurea stoebe*	.	+	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Bal	*Chamaecytisus calcareus*	.	.	.	+	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-As	*Anthoxanthum odoratum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	1	3	+	.	.	.	.	.	I	.	.
Kos	*Plantago lanceolata*	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-Sib	*Achillea millefolium*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	I	.	.
Alp-Karp	*Acinos alpinus*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	I	III	III
Eur-As	*Astragalus onobrychis*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-As	*Bromus barcensis*	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	I	.	.
subMed	*B. erectus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	3	I	IV	I
Pont-Med	*Chrysopogon gryllus*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	3	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-As	*Galium verum*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	I	.	.
subMed	*Hypericum richerii*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	r	1	.	.	I	.	.
Eur-As	*Medicago minima*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	I	.	.
Eur-As	*Moenchia mantica*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	I	.	.
Eur-Sib	*Polygala major*	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	I
Bal	*Sesleria comosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	4	.	I	.	.
Pont	*Thymus callieri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	+	I	.	.
Bal	*Tragopogon pterodes*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	I	.	.
Pann-Bal	*Verbascum chaixii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	I	.	.
subBoreal	*Sanguisorba officinalis*	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-Med	*Melica ciliata*	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	III	.
	Mentha sp.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
subMed	*Inula germanica*	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Kos	*Anagalis arvensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur	*Carlina acanthifolia*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Eur-Med	*Chamaecytisus supinus*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.
Karp-Bal	*Cirsium candelabrum*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I	.	.
Eur-Med	*C. vulgare*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.
Eur-Med	*Coronilla varia*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I	.	.
Eur-Med	*Filipendula vulgaris*	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I	.	II
subBoreal	*Fragaria vesca*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	I	.	.
subMed	*Fritillaria orientalis*	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.

Table 1. Continuation.

		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			
Eur-Med	*Inula ensifolia*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.
Eur-Sib	*I. hirta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	I	.	II
subBoreal	*Juniperus communis*	.	.	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Bal	*Knautia ambigua*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	I	.	.
Eur-Med	*Tragopogon pratensis*	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	.	.
subBoreal	*Trifolium pratense*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	.	IV

Species occurring in one relevé only: *Stachys recta* 4:1, *Alyssum species* 6:+, *Arabis hirsuta* 4:+, *Veratrum species* 6:+, *Centaurea apiculata s. spinulosa* 5:+, *Inula salicina* 4:+, *Caucalis platicarpos* 5:r, *Erodium cicutarium* 5:+, *Avenula compressa* 12:+, *Jurinea consanguinea* 18:+, *Anthericum liliago* 26:2, *Tragopogon orientalis* 19:+, *Odontites glutinosa* 18:+, *Lotus corniculatus* 16:+, *Taraxacum species* 16:+, *Tragopogon dubius* 12:r, *Bromus intermedius* 15:1, *Cuscuta approximata* 19:+, *Digitalis lanata* 16:+, *Avenula pubescens* 27:+, *Trifolium alpestre* 18:+, *Primula veris* 27:+, *Verbascum species* 6:r, *Poa pratensis* 12:1, *Ononis arvensis* 19:1, *Arabis sagittata* 12:r, *Carex caryophyllea* 12:+, *Bromus riparius* 13:+, *Crepis foetida* 15:+, *Asperula tenella* 13:+, *Veronica chamaedrys* 16:+, *Medicago lupulina* 19:+, *Cichorium intybus* 16:+, *Helleborus odorus* 12:r, *Pyrus pyraster* 16:r, *Thymus vandasii* 12:+, *Anthemis tinctoria* 12:+, *Onobrychis alba* 25:+, *Achillea collina* 12:+, *Hyacintella leucophaea* 1:+, *Iris pumila* 1:+, *Thalictrum minus* 3:+, *Orobanche species 1:+, Amygdalus nana 1:1, Geranium dissectum 1:+, Verbascum lichnitis 7:+, Trachystemon orientalis* 10:+, *Silene species* 10:+, *Scabiosa columbaria* 10:+, *Plantago coronopus* 8:+, *Malva alcea* 11:+, *Leontodon hispidus* 8:r, *Festuca valesiaca* 13:3, *Chondrilla juncea* 7:+, *Asphodelus albus* 10:+, *Allium saxatile* 7:+.

Within the framework of Bulgarian researches, this alliance was identified in the Central Danubian Plain (Tzonev 2002) and in Southeast Bulgaria (Sopotlieva 2008). The diagnostic species for the alliance from Mt Lozenska were selected on the basis of reports of Horvat (1962), Horvat & al. (1974), Royer (1991). The same diagnostic group for the alliance was very well presented in the mountains of Serbia (Table 1).

Analysis of the two differentiated groups from the relevés in Mt Lozenska (Table 1; Fig. 2) shows that one of them, with 11 relevés, could be considered a new association: *Hyperico rochelii-Stipetum epilosae*. A group of nine diagnostic species was accepted as a characteristic combination, which distinctly differentiates this association from the other relevés on dolomite limestones. **Table 1, relevé 6 is designated as a nomenclatural type of the association (Holotype).**

In the association's name the main species, *Stipa epilosa* Martinovský, has been nuanced by *Hypericum rochelii* Griseb. & Schenk, selected as a Balkan-Dacian species related chiefly to carbonate terrains and with a comparatively limited distribution in the western parts of the country (Western Balkan Range, Mt Sredna Gora (*Western*), Znepole Region, Valley of Struma River, Mt Slavyanka, and Pirin Mts). Two separate facies were differentiated on the basis of domination of *Stipa epilosa* and *Sesleria latifolia* Degen.

The general floristic diversity of the association comprises 90 vascular plants (an average of 23 species per relevé). Floristic elements manifest considerable diversity: European and Eurasian elements prevail (42 %), followed by the sub-Mediterranean (39 %), Balkan-Dacian (1 %), etc.

The communities of the newly described association have been localized on the ridges and slopes with southern and western exposition of the peaks Lalina Mogila and Polovrak. Their area is limited and totals about 3 ha, without covering the entire area under carbonate terrains in the mountain (about 120 ha). The slopes are mostly very steep, with a gradient up to 40°. Baserock is composed of dolomite limestones, with the following chemical composition: $CaCO_3$ – 55,42 %; $MgCO_3$ – 40,87 %; $Fe_2O_3 + Al_2O_3$ – 1,26 %, insoluble substances – 2,1 % (Dimitrov 1923). The soils are Rendzic Leptosols, shallow, eroded and dry. On the average, rock outcrops constitute some 20–30 %. Considering the strong gradient of the slopes, the rock outcrops are an important factor for retaining some of the soil substrate and preventing its complete washing out during the erosion processes.

In summary, the association occupies one of the most xerothermic habitats in the mountain. A significant characteristic of the association is the presence of high percentage of sub-Mediterranean species in the floristic composition. Probably in the past these areas were occupied by the xerothermic oak forests of *Quercus pubescens* and *Q. frainetto*.

The second group of 17 relevés from Mt Lozenska (Table 1; Fig. 2) is chiefly defined by ecologically various species, including the chasmophytes *Minuartia caespitosa* (Ehrh.) Degen and *Sedum acre* L., widely distributed *Scabiosa triniifolia* Friv. and *Teucrium polium* L., forest species *Scilla bifolia* L., ruderal weeds *Carduus nutans* L. and *Acinos arvensis* (Lam.) Dandy, etc. Although in the cluster analysis these species have been associated to a high degree with the group of 17 relevés, we do not consider them suitable for supporting a single syntaxon. Within the scope of the class *Festuco-Brometea* and alliance *Saturejon montanae*, these relevés should remain unclassified at the lower syntaxonomic levels and should be considered representatives of a transitional succession phase. Attached to less steep slopes, the communities from this group were probably subjected to more intensive grazing in the past, which has led to the presence of ruderal elements.

In the ordination analysis (Fig. 2), the groups of relevés along the first axis are divided according to the soil moisture. The two associations from Serbia are related to more xerothermic ecological conditions, while in Mt Lozenska the unclassified group prefers relatively higher soil moisture. Along the second axis of the chart the influence of the anthropogenic impact is manifested, as well as the presence of more of less anthropophytic species related to it. The associations *Hyperico rochelii-Stipetum epilosae* from Mt Lozenska and *Humileto-Stipetum grafianae* from Serbia proved lesser influenced and more resistant in the succession processes.

In the last 10–15 years the grazing has been strongly reduced and virtually stopped across Mt Lozenska. The main succession processes are now aimed at restoring the shrub and tree vegetation. These processes are remarkably intensive in the case of mesophyllous grasslands on more deeper and moister soils. On the dry carbonate soils, single specimens of *Rosa canina* L. and *Juniperus communis* L. may occur accidentally, but they could be also viewed as indicators of the same trend.

Mt Lozenska is included in the NATURA 2000 network. The grasslands on carbonate terrains form the habitat type **6210 *Semi-natural dry grasslands and shrubland facies on calcareous substrates*** (*Festuco-Brometalia*) (*important orchid sites) and are subject to special protection care under Divective 92/43 EEC.

The resumption of a moderate grazing regime would be a good measure in the Management Plan for the SCI zone "Lozenska Planina" in order to provide sustainable protection of the habitat and of the biological diversity within its limits.

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