ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., Suppl. 5, 2014: 61-73

Grassland Vegetation of Ponor Special Protection Area (Natura 2000), Western Bulgaria

Kiril Vassilev, Hristo Pedashenko, Nikolay Velev, Iva Apostolova

Department of Plant and Fungal Diversity and Resources, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. Georgi Bonchev Street, Bl. 23, 1113 Sofia, Bulgaria, e-mail: kiril5914@abv.bg

Abstract: The vegetation of Ponor Mt. has not been studied systematically. Being a part of the national Natura 2000 network, this region deserves special attention regarding the knowledge of biodiversity. The recent study was conducted during 2007-2010. Herbaceous vegetation was sampled and a total of 214 relevés were collected. They were analysed by divisive classification methods. Six classes, 11 alliances, 13 associations and 4 subassociations were distinguished within Ponor Special Protection Area. Dry grasslands of the *Festuco-Brometea* class are widespread. Restricted areas mostly in the pot-holes are occupied by communities of *Scheuchzerio-Caricetea fuscae.* Hay meadows classified within *Arrhenatheretalia* are situated close to the villages. Decreased grazing and mowing intensity appears to be the main threat for biodiversity in grasslands. Over the last decade, due to the significant reduction in grazing intensity, large areas covered by grasslands were converted into scrublands.

Keywords: Bulgaria, meadows, Natura 2000, pastures, syntaxonomy

Introduction

Vegetation studies in Bulgaria are nowadays in the focus of scientific interest. The reason is the topicality of the issues related to environmental protection. Development of Natura 2000 network is particularly strong driver in this respect because the habitats, primarily determined on the basis of vegetation, are subject of protection. The development of strategy for preservation lands with high conservation value is also linked to knowledge of diversity and specifics of grassland vegetation in meadows and pastures (Veen *et al.* 2009).

Ponor Special Protection Area (further referred to as Ponor SPA) occupies 31,376.99 ha and includes great variety of vegetation types including forests and grasslands. Grasslands in this area have not been systematically studied so far. Limited data on the composition and structure of herbaceous vegetation in Ponor Mt. have been published by Jordanov (1924), Stoyanov (1947), Meshinev *et al*. (2005), Hájek *et al*. (2008), Pedashenko *et al*. (2010), Velev *et al*. (2010, 2011a, b) and Vassilev *et al*. (2012). Processes of shrub invasion as a result of land abandonment are observed by Vassilev *et al*. (2011). On the other hand, floristic diversity of Ponor SPA is represented by 869 vascular plants belonging to 84 families and 364 genera and 60 bryophyte species of 2 classes, 25 families and 39 genera (Pedashenko, Vassilev 2014). The state and trends of contemporary vegetation cover in this zone is important starting point for further conservation measures and raising awareness of stakeholders about the natural resources.

Data about vegetation classification and species composition of plants are very important for zoology. According to Horsák *et al*. (2011), species composition of plants is the best predictor for all categories of mollusc species richness and abundance. Furthermore, the vegetation is an important structural feature of the lanscape and is of primary significance for insect species (Söderström *et al.* 2001; Nikolov 2010).

The main objective of this study is to reveal the syntaxonomical diversity of grassland vegetation in Ponor SPA (BG0002005) and to outline the main threats to this vegetation. The collected data will contribute also to building the national vegetation classification.

Matherial and Methods

2.2. Study area location and Field Sampling

The study area is situated at N43"06'E23"14'. Elevation ranges between 380 and 1550 m. A total of 214 relevés were sampled in grassland communities during 2007-2010 following the Braun-Blanquet approach (Braun-Blanquet 1965; Westhoff, van der Maarel 1973). They were taken from central, homogenous part of communities thus excluding ecotone effect. Plot size was set at 16 m^2, which is recommended for grassland communities (Chytrý, Otýpková 2003).

A total of 159 soil samples were collected from relevé stands and were analyzed for electrical conductivity (EC), pH and humus. Mixed soil samples were taken from all corners and the centre of the plot at a depth of 0-10 cm. Samples were air-dried before further analyses (ISO 11464:1994). EC and pH were measured in water solution with 1:5 soil/water ratio and pH-meter Jenway 3310 (ISO 10390:2005). Humus was determined according to the modified Turin method (Kononova 1966). All analyses were performed at the Analytical Laboratory of Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences.

Altitude and location were measured by Garmin eTrex Vista, aspect was determined by a compass, and slope inclination was assessed visually. Soils were classified as (1) shallow (<10 cm depth), (2) moderately deep (10–20 cm) or (3) deep (>20 cm). Special attention was paid on grazing as a prevailing management for sampled vegetation. It was marked as presence/absence.

2.3. Data Analysis

Original relevés, as well as those published to date from the study area, were used in the analyses. All samples are part of Bulgarian Phytosociological database (Apostolova *et al*. 2012). Modified TWINSPAN (Roleček *et al*. 2009) was applied as divisive classification method within JUICE 7.0 software (Tichý 2002). Diagnostic species were defined by Phi-coefficient (Chytrý *et al*. 2002). Species in synoptic tables were presented by two indicators: Fidelity measure expressed by the Phi-coefficient and Constancy expressed in percentages. The Phi-coefficient depends on the size of syntaxa. All relevé groups were standardized to equal size (Chytrý *et al*. 2006). The Phi-coefficient calculated under the standardized database is independent by the volume of any cluster (Tichý, Holt 2006). Only statistically significant values of Phi-coefficients evaluated with Fisher's exact test ($P<0.05$) are given in synoptic table and the species were sorted by decreasing fidelity value. We accepted as diagnostic the species with Phi-coefficient ≥ 0.3 (multiplied by 100 in the tables). Species with Phi-coefficient ≥ 0.5 were considered highly diagnostic.

Species with cover ≥ 50 % in minimum 5 % of relevés for any cluster were considered as dominants. In addition, species recorded in minimum 50 % of relevés for any cluster were considered as constant.

Results

The study region includes diverse landforms and all spectra of exposures. Variety of geographic features determines the vegetation diversity. Within the Ponor SPA, we found 6 classes, 11 alliances, 13 associations and 4 subassociations, included in the following syntaxonomical synopsis:

Class: *Scheuchzerio-Caricetea fuscae* Tüxen 1937
Order: *Scheuchzerietalia palustris* Nordhagen 1937
Alliance: *Sphagno recurvi–Caricion canescentis* Passarge (1964) 1978
Association: *Carici echinatae – Sphagnetum* Soó 1944
Alliance: *Caricion canescenti-nigrae* Nordhagen 1937
Association: *Caricetum nigrae* Braun 1915
Order: *Caricetalia fuscae* Koch 1926
Alliance: *Sphagno warnstorfii – Tomenthypnion nitentis* Dahl 1956
Association: *Geo coccinei – Sphagnetum contorti* Hájek *et al*. 2008
Subassociation *typicum*
Subassociation *caricetosum lasiocarpae* Hájek *et al*. 2008
Alliance: *Caricion davallianae* Klika 1934
Association: *Dactylorhizo cordigerae-Eriophoretum latifolii* Hájek *et al*. 2008
Association: *Carici flavae-Cratoneuretum filicini* Kovács et Felföldy 1960
Class: *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941
Order: *Phragmitetalia* Koch 1926
Alliance: *Phragmition australis* Koch 1926

Association: *Typhetum latifoliae* Lang 1973
Class: *Calluno-Ulicetea* Br.-Bl. et Tüxen ex Klika et Hadač 1944
Order: *Nardetalia strictae* Oberdorfer ex Preising 1949
Alliance: *Nardion strictae* Br.-Bl. 1926
Association: *Nardetum strictae* sensu lato
Class: *Galio-Urticetea* Passarge ex Kopecký 1969
Class: *Molinio-Arrhenatheratea* Tüxen 1937
Order: *Arrhenatheretalia* Tüxen 1931
Alliance: *Arrhenatherion elatioris* Luquet 1926
Association: *Ranunculo bulbosi-Arrhenatheretum elatioris* Ellmauer in Mucina *et al*. 1993
Association: *Tanaceto vulgaris-Arrhenatheretum elatioris* Fischer ex Ellmauer in Mucina *et al*. 1993
Alliance: *Cynosurion* Tüxen 1947
Association: *Cirsio cani-Festucetum pratensis* Májovský ex Růžičková 1971
Association: *Festuco rubrae-Agrostidetum capillaris* Horvat 1951
Class: *Festuco-Brometea* Br.-Bl. et Tüxen 1943 ex Soó 1947
Alliance: *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951
Association: *Galio lovcense-Artemisietum chamaemelifoliae* Pedashenko *et al*. 2010
Subassociation: *typicum*
Subassociation: *centauretosum* Vassilev *et al*. 2012
Association: *Hieracio pilosellae-Festucetum dalmaticae* Vassilev *et al*. 2012
Order *Festucetalia valesiacae* Br.-Bl. et Tüxen 1943
Alliance: *Festucion valesiacae* Klika 1931
Alliance: *Saturejion montanae* Horvat *et al*. 1974

Discussion

Cl. *Scheuchzerio-Caricetea fuscae* Tüxen 1937
The class includes waterlogged grasslands which are widespread on the European continent (Rodwell *et al*. 2002). Its center of distribution covers Northern and Central Europe. The region of Southeast Europe, including Ponor Mt. is considered as refugial (Hájek *et al*. 2009), where during the dry phases of Pleistocene fens survived, and where they persisted throughout entire Holocene.

Species composition of contemporary communities is dominated by sedges and many mosses, including species of the genus *Sphagnum*. Composition of herbs is rich of hygrophytes like *Eriophorum latifolium*, *Dactylorhiza cordigera*, *Drosera rotundifolia*, *Succisa pratensis* and others.

Soils are acidic to alkaline rich in nutrients and with high water level. Organic matter is accumulated in peat sediments due to the low oxygen and microbial activity.

The class is represented by 2 orders, 4 alliances and 5 associations in the study area (Hájek *et al*. 2008). This vegetation type is relatively rare in the region because the communities occupy small patches located in places with high ground waters.

All. *Sphagno recurvi–Caricion canescentis* Passarge (1964) 1978 comprises poor fens that develop in areas with high rainfall and calcium-poor bedrock in the study area. The vegetation covers bottom of pot-holes in the central and western part of Ponor Mt. near the Petrohan Pass. Peat mosses from sections *Cuspidata* and *Sphagnum* are dominant in the moss layer. Herb layer has low coverage and contains species of minerotrophic wetlands like *Carex rostrata*, *C. panicea*, *C. echinata* as well as species typical for acidic mires, such as *Eriophorum vaginatum* and *Drosera rotundifolia* (Hájek *et al*. 2008).

Ass. *Carici echinatae – Sphagnetum* Soó 1944 has been established in Bulgaria for the first time by Hájek *et al*. (2008). It is distributed in the pot-holes and on slightly inclined slopes of Ponor Mt, where conditions are suitable for retaining water and its poor drainage.

High presence of peat mosses and sedges is specific feature of these communities. Two layers are clearly present – moss and grass. Cover of mosses ranges between 50 and 90% whereas herbaceous cover ranges between 60 and 85%. *Molinia caerulea* and *Sphagnum flexuosum* are dominants.

All. *Caricion canescenti-nigrae* Nordhagen 1937 covers mires and fens with shallow peat deposition on waterlogged soils dominated by sedges and rushes (Hájek, Háberová 2001). Species composition of these communities in Bulgaria is similar to those in Central Europe.

Ass. *Caricetum nigrae* Braun 1915 has very local distribution in Ponor Mt. It occurs on altitudes between 1274 and 1336 m on flat or slightly inclined slopes (up to 5°). Habitats are characterized by high air and soil moisture. However, unlike *Carici echinatae-Sphagnetum*, this association is developed in the periphery of pot-holes or edges of rivers and streams, where drought is observed during the hottest summer months.

Communities are characterized by closed horizontal structure, clearly stratified into 2 layers – moss- and herb, with total projective cover between 95 and 100%. Constant species group is represented by *Agrostis stolonifera*, *Molinia caerulea*, *Potentilla*

erecta, *Succisa pratensis*, *Aulacomnium palustre*, whereas dominant species are *Molinia caerulea* and *Sphagnum auriculatum*.

All. *Sphagno warnstorfii – Tomenthypnion nitentis* Dahl 1956 comprises fen meadows dominated by sedges, rushes and mosses, growing on calcareous terrains in the hilly and mountainous areas of the country. Presence of calcium-tolerant peat-mosses and great number of rare species are typical for these communities.

In Bulgaria, the alliance is represented by ***Geo coccinei – Sphagnetum contorti* Hájek *et al.* 2008** association described from the study region (Hájek *et al*. 2008). It is localized in the beech zone near concave forms of relief in the western and central part of the Ponor Mt. The plant communities are found in a narrow range of altitude (1230-1368 m), on flat or slightly inclined terrains with slopes up to 5°. Soils are deep, moderately moist to waterlogged. Accumulation of significant amounts of dead biomass (i.e., peat) is typical for this association.

The vegetation has high coverage (85 – 100 %). Unlike the two previous associations *Geo coccinei – Sphagnetum contorti* not always has clearly distinguished vertical structure.

Geo coccinei – Sphagnetum contorti is known only for Bulgaria so far. Boreal and Euro-Asian floristic elements are presented in its composition equally sharing about 60% of total species number. This proves the transitional nature of the association between other communities of the class, dominated by Boreal species on one hand and surrounding xero-mesophytic and xerophytic grasslands, dominated by Euro-Asian and Euro-Mediterranean species on the other hand.

The group of constant species includes *Festuca rubra, Geum coccineum*, *Luzula campestris, Nardus stricta, Potentilla erecta* and *Succisa pratensis*. *Geum coccineum* and *Sphagnum centrale* are dominants.

Two sub-associations are described within Geo *coccinei – Sphagnetum contorti* association – *typicum* and *caricetosum lasiocarpae* (Hájek *et al*. 2008), the latter occupying single small locality in the area.

All. *Caricion davallianae* Klika 1934 represents calcareous fens. Ecologically its localities fall into the most calcareous part of the pH/calcium gradient. Sampled communities occupy a restricted area and species composition resembles Central European calcareous fens (Hájek *et al*. 2008).

Although ***Dactylorhizo cordigerae-Eriophoretum latifolii* Hájek *et al.* 2008** association is well represented in Bulgaria, it was found in single locality in the study region situated in the westernmost part of the region, close to the Serbian border (Hájek *et al*. 2008). Terrains are slightly inclined to the south. A small river passes nearby and provides water supply. Total vegetation cover is 90%, while moss layer shares 60%.

Ass. *Carici flavae-Cratoneuretum filicini* Kovács et Felföldy 1960 is registered also in a single locality close to Shuma village (Hájek *et al*. 2008). It is developed on plane terrace along the river bed. Soils are deep, with high water supply. The area more remote from the river becomes drier and many *Molinio-Arrenatheretea* species are abundant. Some grassland species such as *Briza media* and *Cirsium creticum* penetrate in the community. Species composition is similar to this for Western and Central Europe (Háberová, Hájek 2001).

Cl. *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941 includes waterlogged grasslands dominated by species of the genus *Typha*, *Phragmites*, *Schoenoplectus* and *Carex*. Communities often occur in standing and running water bodies, temporary streams, along rivers and canals. The most important environmental conditions determining development of this vegetation type are related to the period of inundation, water depth and soil conditions occurring after water level decrease.

Due to very limited number of water bodies in the area of Ponor SPA, this vegetation was found only near Zasele village. The class is presented by *Typhetum latifoliae* Lang 1973, which has poor species composition, closed structure and is dominated by *Typha latifolia*.

The class ***Calluno-Ulicetea* Br.-Bl. et Tüxen ex Klika et Hadač 1944** includes vegetation of acidophilous grasslands dominated by *Nardus stricta*, widespread in western and northern Europe (Schubert *et al*. 2001, Krahulec *et al*. 2007). Eastwards where continentality of climate increases, these communities become limited to higher mountain zones.

In Bulgaria *Nardus stricta* is distributed between 800 to 2400 m altitude and its communities occupy about 50,000 ha (Velchev *et al*. 1989, Velev, Apostolova 2009). Usually its communities are maintained as a result of long time intensive grazing. In the study region some of the Mat-Grass communities are developed primarily in the wet places of pot-holes. Nowadays *Nardus stricta* communities occupy more or less flat terrains on the edge of pot-holes and plateaus in the central and western part of Ponor Mt. and westwards of Petrohan pass.

Ass. *Nardetum strictae* sensu lato (Table 1) has closed horizontal structure with an average of 26 species per relevé. Species composition is poor-

Table 1. Ass. *Nardetum strictae* sensu lato

Life form	Floristic elements	Number of releve	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Constansy
		Altitude (m)	1278	1244	1262	1275	1260	1275	1319	1367	1321	1244	1306	1203	1425	1337	1371	1241	
		Exposure	SE	E	0	E	0	0	0	SW	0	SE	E	SW	SW	0	N	0	
		Slope (%)	5	5	0	4	0	0	0	10	0	4	8	15	7	0	10	0	
		Total cover (%)	100	100	100	100	100	100	100	100	70	100	100	100	100	100	100	95	
Diagnostic species of *Nardetum strictae* sensu lato																			
H	Boreal	*Agrostis capillaris*	+	2	2	3	3	2	2	1	1	3	1	1	2	2	3	-	V
H	Arct-Alp	*Nardus stricta*	1	3	3	2	3	+	2	-	-	1	-	1	-	1	-	1	III
H	Boreal	*Festuca rubra*	1	1	+	1	1	2	1	2	-	1	1	-	1	1	-	-	III
H	Eur-Med	*Verbascum longifolium*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	I
Diagnostic species of *Calluno-Ulicetea*																			
H	Boreal	*Lerchenfeldia flexuosa*	3	2	1	2	1	3	2	3	3	1	5	1	2	+	1	2	V
H	subBoreal	*Luzula campestris*	+	+	+	+	-	+	+	-	+	+	-	+	+	+	+	+	IV
Ch	Eur	*Chamaespartium sagittale*	1	+	+	+	-	+	+	1	-	-	1	+	+	+	-	+	IV
H	subBoreal	*Potentilla erecta*	+	+	+	+	+	+	+	+	1	-	+	+	+	-	-	-	IV
H	Boreal	*Viola canina*	+	+	+	+	+	+	+	-	-	-	-	1	+	+	-	-	III
H	Pont-Med	*Viola dacica*	+	-	-	+	-	+	+	+	1	-	-	-	1	1	-	+	III
H	Boreal	*Hypericum maculatum*	+	-	+	-	+	-	1	-	-	-	-	-	-	-	1	-	III
H	Boreal	*Carex pallescens*	-	+	+	-	-	-	+	-	-	+	-	-	-	-	-	-	I
Other species																			
H	Eur-As	*Stellaria graminea*	+	+	+	+	+	+	+	+	+	+	-	-	-	1	+	+	IV
H	Eur-Sib	*Achillea millefolium*	+	+	+	+	+	+	+	-	+	+	-	-	+	+	-	+	IV
H	Eur-As	*Anthoxanthum odoratum*	+	-	+	1	+	+	1	+	+	+	-	1	+	+	+	-	IV
H	Eur-As	*Veronica chamaedrys*	+	-	-	+	+	+	+	+	1	+	+	-	-	+	+	+	IV
H	Eur-As	*Galium verum*	-	-	-	-	+	+	+	1	+	-	+	+	+	1	+	1	IV
H	Kos	*Hypericum perforatum*	-	+	-	-	-	-	-	1	+	+	+	-	-	+	-	+	II
H	Eur-Med	*Veronica austriaca* ssp. *jacquinii*	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	+	II
H	subBoreal	*Filipendula vulgaris*	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-	II
H	Eur-Med	*Festuca pseudodalmatica*	-	-	-	-	-	-	-	-	1	-	-	3	-	-	+	3	II
H	Eur	*Briza media*	-	-	-	-	-	-	1	-	-	-	-	+	2	1	-	-	I
H	Eur-subMed	*Rumex acetosella*	+	+	+	-	+	+	-	-	-	+	-	-	+	-	+	+	III
H	subMed	*Cerastium banaticum*	+	-	-	+	+	+	+	-	+	+	-	-	+	+	-	+	IV

Table 1. Continued

Life form	Floristic elements	Number of releve	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Constansy
		Altitude (m)	1278	1244	1262	1275	1260	1275	1319	1367	1321	1244	1306	1203	1425	1337	1371	1241	
		Exposure	SE	E	0	E	0	0	0	SW	0	SE	E	SW	SW	0	N	0	
		Slope (%)	5	5	0	4	0	0	0	10	0	4	8	15	7	0	10	0	
		Total cover (%)	100	100	100	100	100	100	100	100	70	100	100	100	100	100	100	95	
H	subMed-Anat	*Bellardiochloa violacea*	-	-	-	-	+	-	2	1	-	-	-	-	-	1	+	-	II
H	sMed-CAs	*Cruciata glabra*	-	-	-	-	-	+	+	+	-	-	+	+	+	+	+	+	III
H	Pont	*Alchemilla erythropoda*	-	-	-	+	+	+	-	-	-	+	+	1	-	-	-	-	II
H	Eur-Med	*Scabiosa columbaria*	-	-	-	-	+	-	+	-	-	-	-	+	+	-	-	-	II
H	Med	*Thymus longicaulis*	1	1	1	1	1	2	1	+	-	2	+	1	+	-	-	1	IV
Ch	Eur-Sib	*Genista tinctoria*	-	+	-	-	-	-	-	-	2	-	-	-	1	1	-	-	II
H	Pann-Pont	*Potentilla alba*	-	-	-	-	-	+	-	-	-	-	1	-	+	-	+	+	II
BI	Pont-Med	*Thlaspi kovatsii*	-	-	-	-	-	-	1	+	+	-	-	-	-	-	-	+	I
Ch	Boreal	*Juniperus sibirica*	+	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-	I
H	Eur-Med	*Hieracium pilosella*	1	+	2	1	+	+	-	-	-	+	-	+	-	-	-	-	III
H	Bal-Anat	*Galium lovcense*	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	-	II
Ch	Bal	*Chamaecytisus calcareus*	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	I

Verbascum longifolium 5: +; *Anthennaria dioica* 14: +; *Dianthus deltoides* 15: +; *Crepis conyzifolia* 7: +; 9: 1; 14: +; *Stachys officinalis* 13: 1; 15:+; *Ranunculus acris* 8: +; 14: +; 16: +; *Phleum pratense* 6: +; 13: +; *Trifolium repens* 12: +; 16: +; *Leucanthemum vulgare* 13: +; *Ranunculus repens* 1: +; 3: +; 4: +; *Leontodon autumnalis* 1: +; 3: +; *Sanguisorba officinalis* 12:+; 15: 2; *Knautia arvensis* 14: +; 15: +; *Cynosurus cristatus* 4:1; 10: 1; *Deschampsia caespetosa* 14: 1; *Carex hirta* 14: 1; *Poa pratensis* 10: +; *Festuca pratensis* 15: 1; *Prunella vulgaris* 13: +; *Valerianella officinalis* 16: +; *Asperula cynanchica* 11: +; 12: +; *Trifolium alpestre* 12: +; 13: +; *Leotodon hispidus* 12: 1; *Lotus corniculatus* 5:+; *Pastinaca hirsuta* 14:+; *Danthonia alpina* 3:+; 12:+; *Linum catharticum* 12:+; *Plantago lanceolata* 5:+; *Brachypodium pinnatum* 13:1; *Primula veris* 12:+; 13:+; *Hypericum linarioides* 6:+; 7:+; 13:+; *Carlina acanthifolia* 11:+; 12:+; *Inula salicina* 13:+; *Koeleria macrantha* 14:+; *Plantago media* 4:+; 12:+; *Achillea setacea* 12:+; 14:+; *Muscari neglectum* 13:+; *Corothamnus procumbens* 16:1; *Carex humilis* 12:+; *Potentilla cinerea* 12:+; *Leontodon crispus* 4:+; *Euphorbia cyparisias* 12:+; 15:+; *Chamaecytisus jankae* 3:+; *Seseli peucedanoides* 12:+; *Ornithogalum kochii* 1:+; 16:+; *Onopordum acanthium* 8:+; *Carex montana* 5:+; 8:1; 13:+; *Cruciata laevipues* 4:+; *Mercurialis ovata* 15:+; *Veronica officinalis* 5:+; *Silene roemerii* 8:+; 13:+; *Campanula sparsa* 3:+; 7:+; 8:+; *Rhinanthus angustifolius* 12:+; *Bryum* sp. 3:+; *Dianthus moesiacus* 15:+; *Thalictrum minus* 12:+; *Euphrasia pectinata* 12:+; *Hypochaeris maculata* 3:+; 12:+; *Geranium sanguineum* 13:2; *Vicia villosa* 14:+; *Cirsium ligulare* 6:+; 12:+; *Thesium linophyllon* 13:+; 15:+; *Plagiomnium affine* 12:+; *Pedicularis grisebachii* 13:+; 15:+; *Carlina vulgaris* 1:+; 2:+; 12:+; *Galium rotundifolium* 12:+; *Hypnum cupressiforme* 2:+; 12:+; *Ranunculus bulbosus* 5:+; 9:+; *Carex tricolor* 16:1; *Polytrichum piliferum* 1:+; *Fragaria viridis* 4:+; 12:+; *Festuca heterophylla* 14:3; *Pimpinella tragium* 13:+; 14:+; *Taraxacum* sp. 11:+; *Scleranthus perennis* 1:+; 3:+; *Avenulla pubescens* 14:1; *Rhizamnum punctatum* 7:+; *Hypericum barbatum* 13:+; *Bistorta major* 6:+; 15:1; 16:+; *Luzula sylvatica* 1:+; 15:+; *Bruckenthalia spiculifolia* 1:+; 2:1; 3:1; *Pleurozium schreberi* 7:+; *Carex caryophyllea* 4:+; 5:1; *Sanguisorba minor* 12:+; *Rosa* sp. 4:r; *Potentilla argentea* 11:+; *Rorripa pyrenaica* 10:+; *Ceratodon purpureus* 1:+; 5:+; *Juniperus communis* 7:r; *Abietienella abietina* 12:+; *Cerastium fontanum* 4:+; 10:+; 14:+; *Thuidium assimile* 12:+; *Ranunculus polyanthemos* 7:+; *Chamaecytisus calcareus* 13:+; 14:+.

Localities: 1. Ponor Mt., 1.07.2009, N43.09350, E23.24776; 2. Ponor Mt., 1.07.2009, N43.08606, E23.23668; 3. Ponor Mt., 1.07.2009, N43.08878, E23.23510; 4. Ponor Mt., 1.07.2009, N43.09486, E23.25745; 5. Ponor Mt., 1.07.2009, N43.07995, E23.22367; 6. Ponor Mt., 1.07.2009, N43.08355, E23.24212; 7. Ponor Mt., 26.06.2009, N43.09341, E23.17394; 8. Ponor Mt., 25.06.2009, N43.10393, E23.12598; 9. Ponor Mt., 26.06.2009, N43.08938, E23.19302; 10. Ponor Mt., 1.07.2009, N43.09205, E23.26321; 11. Ponor Mt., 14. 04. 2009, N43.05565, E23.22003; 12. Ponor Mt., 15.07.2009, N43.070610, E23.25616; 13. Ponor Mt., 30.06.2009, N43.09386, E23.21808; 14. Ponor Mt., 26.06.2009, N43.09336, E23.19830; 15. Ponor Mt., 4.07.2009, N43.03232, E23.26846; 16. Ponor Mt., 24.06.2009, N43.09510, E23.12856.

er as compared with dry grasslands in the region. Bedrock type is limestone and dolomite. Soils are deep, moderately moist, with acidic soil reaction (pH is betwen 3.77 and 5.59). Conductivity is in the range from 33 mS/cm to 114 mS/cm and humus content is high.

Euro-Asiatic and Euro-Mediterranean floristic elements prevail in the species composition (38%). European, Balkan and Boreal elements are also well presented respectively with 13%, 7% and 15%. Hemicryptophytes are most abundant (85%), followed by chamephytes – 8% whereas therophytes, geophytes and biennial plants are represented only by 4%, 2% and 1% respectively.

Group of constant species includes *Thymus longicaulis*, *Achillea millefolium*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Cerastium banaticum*, *Chamaespartium sagittale*, *Festuca rubra*, *Galium verum*, *Lerchenfeldia flexuosa*, *Luzula campestris*, *Nardus stricta*, *Potentilla erecta*, *Stellaria graminea*, *Veronica chamaedrys*. Dominants are *Lerchenfeldia flexuosa* and *Agrostis capillaris*.

Nardetum strictae communities have been extensively used as pastures in the past, which has favoured the spread of Mat-Grass. During the last 20 years, after the political changes in the country, the number of grazing animals in the area has significantly decreased. Nowadays the average sheep density in Ponor Mt. is about 0.03 animals per hectare (Nikolov 2010). This has resulted in increasing abundance of other grasses (*Agrostis capillaris*, *Festuca rubra*, *Briza media)* and forbs (*Chamaespartium sagittale, Hypericum perforatum*), whereas coverage of *Nardus strica* has decreased.

Cl. *Galio-Urticetea* Passarge ex Kopecký 1969

The class represents ruderal vegetation developed near settlements and barns around villages Zanoge and Zasele. Only 4 releves were assigned to this class. Sampled vegetation has restricted distribution and is dominated by nitrophilous species as *Urtica dioica*, *Chaerophyllum bulbosum* and *Galium aparine*.

Cl. *Molinio-Arrhenatheratea* Tüxen 1937

This class combines mesic pastures and hay meadows in the Temperate region of Europe and adjacent regions of Asia, reaching the South Urals and southern Siberia, north-western Turkey and Iran (Chytrý, Blažková 2007). The communities are mostly of secondary origin, developed on the territory of cleared deciduous forests.

The main gradient which determines variation in species composition of mid-European meadows classified to *Molinio-Arrhenatheratea* is moisture. Other factors that determine differences between plant communities are altitude, nutrient availability, pH of soil and groundwater fluctuation (Škodová 2007, Cachovanová *et al*. 2012).

Syntaxonomical diversity of mesic grasslands in the regon has been studied by Velev *et al*. (2010, 2011b). It is represented by alliances *Cynosurion cristati* (Velev *et al*. 2010, 2011a), *Arrhenatherion elatioris* (Velev *et al*. 2010, 2011b) and *Trifolion medii* of class *Trifolio-Geranietea* (Velev *et al*. 2010). This vegetation is distributed in the periphery of potholes of Ponor Mt. and near villages Zanoge, Zasele, Ravna and Gintsi.

All. *Arrhenatherion elatioris* Luquet 1926

Majority of mesic vegetation in Central Europe, which is mainly used as hay meadows, falls within this alliance. Soils are predominantly alluvial and cambisols, moderately moist, deep, nutrient rich, neutral to slightly acidic (Chytrý, Blažková 2007).

The alliance, which was first referred to the country by Meshinev *et al*. (2005), is widespread in lower-mountain belt in Bulgaria. In the western part of the country it occurs at low altitudes near settlements and arable land (Velev *et al*. 2010). Basic rock type is mostly silicate and rarely limestone. Communities are rich in European and Euro-Asian species, whereas presence of Balkan elements is negligible. Floristic composition of low mountain hay meadows in Ponor Mt. is similar to those in Central Europe.

Arrhenatherion grasslands are to be found mostly below 1000 m a.s.l. They differ from the vegetation of alliance *Rumicion thyrsiflori* Micevski 1994, which includes mountain to subalpine grasslands settled in the altitudinal range 1000-1400 m a.s.l. Alliance *Rumicion thyrsiflori* is not found in Bulgaria so far. It has been described from the Republic of Macedonia and classified within *Trifolio-Hordeetalia* Horvatić 1963 order (Micevski 1994; Melovski, Matevski 2008).

Ass. *Ranunculo bulbosi-Arrhenatheretum elatioris* Ellmauer in Mucina *et al*. 1993

Vegetation of this association is mesic to xeric. *Coronilla varia*, *Festuca rubra* agg., *Filipendula vulgaris*, *Knautia arvensis* and *Potentilla argentea* are diagnostic species (Velev *et al*. 2010). The communities are dominated by *Arrhenatherum elatius*. Total vegetation cover varies between 60 and 100%. This association is characterized by the lowest levels of moisture and nutrients of the substrate and by the highest levels of light and heat within *Arrhenatherion* alliance. Presence of many diagnostic species for *Festuco-Brometea* is also characteristic. Communities are managed mainly for haymaking.

Ass. *Tanaceto vulgaris-Arrhenatheretum elatioris* Fischer ex Ellmauer in Mucina *et al*. 1993

The association includes mesic grasslands dominated by *Arrhenatherum elatius* and *Elymus repens*. Diagnostic species are *Artemisia vulgaris*, *Cirsium arvense*, *Convolvulus arvensis* and *Dactylis glomerata*. Total vegetation cover varies between 60 and 100%. *Tanaceto vulgaris-Arrhenatheretum elatioris* is characterized by low species diversity and high total cover due to the strong competitors such as *Arrhenatherum elatius* and *Elymus repens*. This vegetation type is characterized by presence of many diagnostic species for *Artemisietea vulgaris* class, as *Artemisia vulgaris*, *Cichorium intybus*, *Cirsium vulgare*, *Elymus repens*, *Lactuca serriola*, *Melilotus officinalis*, *Tanacetum vulgare*, etc. Fischer *et al*. (1985) consider this vegetation type as a transitional between *Arrhenatheretum elatioris* and *Tanaceto-Artemisietum* associations. Stands of *Tanaceto vulgaris-Arrhenatheretum elatioris* association are used mainly for haymaking.

All. *Cynosurion* Tüxen 1947

The alliance brings together mesic grasslands, which are developed on soils with a good water and nutrient supply and usually provide high primary production and acidic soil reaction (Velev *et al*. 2011). Up to now it was reported for Bulgaria by Dimitrov (2001), Meshinev *et al*. (2005) and Velev *et al*. (2010).

Ass. *Cirsio cani-Festucetum pratensis* Májovski et Růžičková 1971

This association is characterised by high species diversity. Diagnostic species for the association are *Cirsium canum*, *Festuca pratensis* and *Potentilla reptans*. Dominant species is *Festuca pratensis*. Total vegetation cover varies between 65 and 95%. It contains many diagnostic species for order *Molinietalia caeruleae* and in Central Europe it is classified within the *Deschampsion* alliance recently (e.g., Janišová 2007, Borhidi *et al*. 2012). In the studied area the association is relatively rare.

Cl. *Festuco-Brometea* Br.-Bl. et Tüxen 1943 ex Soó 1947

The class combines xero-mesophitic and xeric grasslands which are widespread in the country. In Ponor SPA, communities assigned to the class have secondary origin, developed at the place of former beech and oak forests. Soils are shallow to moderately deep, with a high content of skeletal material and slightly acid to slightly alkaline reaction. The vegetation is developed on slopes of different exposure and inclination. Bedrock type is pure limestone or dolomite. The communities are managed mostly as pastures and occasionally for mowing.

They are characterized by high species richness and high percentage of endemic plants (average 8-10% of all species). Their composition is dominated by Euro-Mediterranean, Euro-Asian and sub-Mediterranean floristic elements and stress-tolerant species as *Stipa pennata*, *Festuca pseudodalmatica*, *F. dalmatica* and *Brachypodium pinnatum*.

The class is represented by three alliances – *Cirsio-Brachypodion*, *Festucion valesiacae* and *Saturejion montanae* (Table 2). Transitional communities between *Festuco-Brometea* and *Molinio-Arrhenatheratea* were also observed in contact area of their stands.

All. *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951

The alliance comprises semi-dry (i.e., xero-mesophytic) grasslands, which are widespread in Central and Eastern Europe (Mucina, Kolbek 1993, Borhidi 2003, Berg *et al*. 2004, Sanda *et al*. 2008, Janiľová *et al*. 2010), but with limited distribution on the Balkan Peninsula (Vassilev *et al*. 2012). For the first time this vegetation type was established for Bulgaria by Pedashenko *et al*. (2010) from the region of Ponor Mt. Communities are restricted mainly to mountainous areas in western Bulgaria, which is related to high annual rainfall there (> 1000 mm, Mateeva 2002) which is creating favorable conditions for distribution of xero-mesophytic and mesophytic species. Soils are shallow to moderately deep, rich in nutrients, with acidic reaction (average pH is 5.83). Communities have been used as pastures in the past but nowadays they are rarely grazed. In some areas of western and central part of the mountain region the stands are also mown.

Cirsio-Brachypodion pinnati is the most widely distributed community type of *Festuco-Brometea* in the area under study and it is represented by 107 relevés in the synoptic table (Table 2). Species with southern distribution (Euro-Asian, Euro-Mediterranean and sub-Mediterranean) as well as central European affiliation are evenly presented in their composition. Stands are dominated by different species depending on the particular location: grasses (*Brachypodium pinnatum*, *Sesleria latifolia*, *Festuca dalmatica*, *F. pseudodalmatica*), legumes (*Trifolium alpestre*, *T. montanum*, *Chamaecytisus calcareous*) or other forbs (*Thymus longicaulis*, *Potentilla alba*, *Hieracium pilosella* and *Inula salicina*).

Two new endemic associations for Bulgaria were described within the alliance – *Galio lovcense-Artemisetum chamaemelifoliae* Pedashenko *et al*. 2010 and *Hieracio pilosellae-Festucetum dalmaticae* Vassilev *et al*. 2012.

Table 2. Synoptic table of class *Festuco-Brometea*. The species are represented by two indicators: Fidelity measure, expressed by the Phi-coefficient (Chytrý *et al*. 2002) and Constancy, expressed in percentages. Values of highly diagnostic species are mark in dark gray, whereas diagnostic species are gray. Species which are represented in less than 5 reléves are excluded from table

Syntaxa	**Cirsio-Brachy-podion**		**Festu-cion valesi-acae**		**Sature-jion mon-tanae**		**Syntaxa**	**Cirsio-Brachy-podion**		**Festu-cion valesi-acae**		**Sature-jion mon-tanae**	
Number of relevés	107		7		8		Number of relevés	107		7		8	
Fidelity/Constansy	Phi	%	Phi	%	Phi	%	Fidelity/Constansy	Phi	%	Phi	%	Phi	%
Diagnostic species of *Cirsio-Brachypodion*							*Centaurea triumfetti*	-	11	-	0	-	13
Briza media	57	57	-	0	-	13	*Agrimonia eupatoria*	-	3	-	14	-	13
Filipendula vulgaris	56	69	-	14	-	13	*Inula oculus-christi*	-	7	-	29	-	13
Primula veris	52	36	-	0	-	0	*Allium flavum*	-	6	-	14	-	25
Potentilla alba	41	23	-	0	-	0	*Poa angustifolia*	-	7	-	29	-	0
Trifolium montanum	41	23	-	0	-	0	*Dichantium ischaemum*	-	4	-	29	-	13
Veronica austriaca ssp. *jacquinii*	41	51	-	14	-	13	*Dorycnium herbaceum*	-	25	-	43	-	38
Polygala major	39	21	-	0	-	0	**Other species**						
Brachypodium pinnatum	38	66	-	29	-	25	*Avenula pubescens*	-	19	-	0	-	0
Asperula cynanchica	33	81	-	43	-	50	*Linum catharicum*	52	36	-	0	-	0
Trifolium alpestre	32	59	-	14	-	38	*Pimpinella tragium*	50	34	-	0	-	0
Plantago media	30	51	-	43	-	0	*Hypericum linarioides*	49	48	-	0	-	13
Diagnostic species of *Festucion valesiacae*							*Inula salicina*	49	32	-	0	-	0
Centaurea stoebe	-	29	62	86	-	13	*Acinos alpinus*	-	6	30	43	-	25
Astragalus onobrychis	-	0	58	43	-	0	*Sideritis montana*	-	21	40	71	-	38
Medicago falcata	-	25	38	71	-	38	*Chamaespartium sagittale*	60	46	-	0	-	0
Diagnostic species of *Saturejion montanae*							*Anthoxanthum odoratum*	52	36	-	0	-	0
Teucrium montanum	-	12	-	14	62	75	*Chamaecytisus calcareus*	47	30	-	0	-	0
Satureja montana ssp. *kitaibelii*	-	3	-	0	60	50	*Artemisia chamaemelifolia*	45	27	-	0	-	0
Silene flavescens	-	0	-	0	54	38	*Festuca rubra*	44	26	-	0	-	0
Melica ciliata	-	0	-	0	43	25	*Agrostis capillaris*	43	25	-	0	-	0
Rhodax canus	-	0	-	0	43	25	*Stachys officinalis*	39	21	-	0	-	0
Artemisia alba	-	1	-	0	41	25	*Rhinanthus angustifolius*	37	20	-	0	-	0
Iris reichenbachii	-	1	-	0	41	25	*Potentilla pedata*	-	9	-	0	-	0
Tragopogon pterodes	-	2	-	0	40	25	*Galium lovcense*	-	44	-	14	-	25
Diagnostic species of *Festuco-Brometea*							*Viola hirta*	-	23	-	0	-	13
Teucrium chamaedrys	-	70	-	86	-	50	*Cruciata glabra*	-	25	-	0	-	13
Thymus longicaulis	-	80	-	57	-	63	*Veratrum nigrum*	-	16	-	0	-	0
Festuca dalmatica	-	65	-	71	-	88	*Campanula glomerata*	-	7	-	0	-	0
Asperula purpurea	-	45	-	71	-	75	*Luzula campestris*	-	13	-	0	-	0
Carlina acanthifolia	-	57	-	71	-	63	*Rumex thyrsiflorus*	-	4	-	0	-	0
Sanguisorba minor	-	58	-	57	-	50	*Prunella grandiflora*	-	7	-	0	-	0
Hieracium pilosella	-	50	-	57	-	25	*Phleum pratense*	-	9	-	0	-	0
Leontodon crispus	-	47	-	71	-	50	*Potentilla cinerea*	-	65	-	86	-	75
Fragaria viridis	-	40	-	57	-	13	*Tortella tortuosa*	-	18	-	0	-	38
Euphorbia cyparissias	-	41	-	29	-	50	*Crupina vulgaris*	-	5	-	14	-	0
Scabiosa columbaria	-	56	-	29	-	38	*Muscari neglectum*	-	7	-	0	-	0
Achillea setacea	-	40	-	43	-	13	*Carlina vulgaris*	-	22	-	0	-	13
Seseli peucedanoides	-	30	-	29	-	0	*Minuartia viscosa*	-	35	-	14	-	25
Festuca valesiaca	-	12	-	14	-	0	*Hypericum rumeliacum*	-	1	-	0	-	13
Galium verum	57	59	-	14	-	0	*Euphrasia pectinata*	-	21	-	29	-	13
Medicago lupulina	-	21	-	14	-	25	*Geranium sanguineum*	-	11	-	0	-	0
Helleborus odorus	-	2	-	14	-	0	*Potentilla argentea*	-	5	-	14	-	0
Eryngium campestre	-	32	-	57	-	13	*Poa compressa*	-	6	-	0	-	0
Carex humilis	-	21	-	0	-	50	*Scleranthus perennis*	-	10	-	0	-	0

Table 2. Continued

Syntaxa	Cirsio-Brachy-podion		Festu-cion valesi-acae		Sature-jion mon-tanae		Syntaxa	Cirsio-Brachy-podion		Festu-cion valesi-acae		Sature-jion mon-tanae	
Number of relevés	107		7		8		Number of relevés	107		7		8	
Fidelity/Constansy	Phi	%	Phi	%	Phi	%	Fidelity/Constansy	Phi	%	Phi	%	Phi	%
Anthericum liliago	-	12	-	0	-	13	*Genista tinctoria*	-	12	-	0	-	13
Poa badensis	-	10	-	29	-	13	*Stachys recta*	-	5	-	14	-	13
Cerastium banaticum	-	33	-	14	-	25	*Cichorium intybus*	-	5	-	14	-	13
Globularia aphyllanthes	-	21	-	0	-	25	*Abietienella abietina*	-	7	-	14	-	0
Koeleria macrantha	-	36	-	29	-	25	*Stachys germanica*	-	5	-	14	-	0
Coronilla varia	-	26	-	14	-	0	*Cirsium ligulare*	-	21	-	14	-	0
Onobrychis arenaria	-	26	-	29	-	25	*Hypericum maculatum*	-	7	-	0	-	0
Anthylis vulneraria	-	28	-	29	-	25	*Vicia sativa*	-	6	-	0	-	13
Prunella vulgaris	-	13	-	0	-	0	*Thlaspi kovatsii*	-	7	-	0	-	0
Hypericum perforatum	-	36	-	29	-	25	*Lathyrus pratensis*	-	8	-	0	-	0
Lotus corniculatus	-	40	-	57	-	25	*Hieracium bauchinii*	-	10	-	29	-	0
Carex caryophyllea	-	45	-	43	-	25	*Salvia nemorosa*	-	11	-	0	-	0
Plantago lanceolata	-	56	-	86	-	38	*Dactylis glomerata*	-	9	-	0	-	13
Centaurea sp.	-	7	-	0	-	0	*Festuca pratensis*	-	10	-	0	-	0
Danthonia alpina	-	9	-	0	-	13	*Festuca panciciana*	-	6	-	0	-	0
Alyssum minus	-	11	-	14	-	13	*Thesium divaricatum*	-	7	-	0	-	0
Rosa sp.	-	4	-	29	-	25	*Ornithogalum kochii*	-	7	-	14	-	25
Stipa pennata	-	6	-	0	-	0	*Thalictrum minus*	-	12	-	0	-	0
Pastinaca hirsuta	-	6	-	0	-	0	*Ranunculus repens*	-	5	-	0	-	13
Verbascum lichnitis	-	9	-	0	-	0	*Achillea millefolium*	-	21	-	14	-	0
Arenaria serpyllifolia	-	6	-	14	-	0	*Elymus repens*	-	20	-	29	-	25
Poa pratensis	-	16	-	0	-	0	*Knautia arvensis*	-	24	-	14	-	25
Veronica chamaedrys	-	17	-	0	-	0	*Juniperus sibirica*	-	7	-	0	-	13
Scorzonera cana	-	13	-	0	-	0	*Hieracium* sp.	-	6	-	0	-	0
Hypnum cupressiforme	-	10	-	14	-	25	*Helianthemum nummularium*	-	7	-	0	-	13
Bromus riparius	-	50	-	0	-	63	*Alchemilla erythropoda*	-	10	-	0	-	0
Vicia villosa	-	15	-	0	-	0	*Bromus barcensis*	-	6	-	14	-	0
Sesleria latifolia	-	29	-	0	-	50	*Corothamnus procumbens*	-	13	-	0	-	25
Convolvulus arvensis	-	19	-	43	-	13	*Sedum album*	-	4	-	14	-	13
Trifolium repens	-	12	-	14	-	0	*Pedicularis grisebachii*	-	9	-	0	-	0
Schistidium apocarpum	-	8	-	0	-	0	*Hyacintella leucophaea*	-	7	-	0	-	0
Leontodon autumnalis	-	7	-	0	-	0	*Thesium linophyllon*	-	11	-	0	-	13
Chamaecytisus jankae	-	10	-	0	-	13	*Trinia glauca*	-	7	-	0	-	13
Leucanthemum vulgare	-	18	-	0	-	0	*Carex michelii*	-	7	-	0	-	0

***Ass. Galiolovcense-Artemisietum chamaemelifoliae* Pedashenko *et al*. 2010**

This is an endemic association with local distribution in the country (Ponor Mt.), which was described for the first time from the study area. It occurs on ridges and mountain slopes on slight to moderately inclined terrains with southern or eastern exposition. Soils are moderately deep, rich in nutrients, with slightly acid to slightly alkaline soil reaction (Vassilev *et al*. 2012). Stands are characterized by rocky outcrops and grazing management type.

Communities of *Artemisia chamaemelifolia* in Bulgaria are distributed only on the territory of Ponor Mt. They have closed horizontal structure dominated by *Artemisia chamaemelifolia*, *Brachypodium pinnatum*, *Festuca paniculata*, *F. rubra*, *Sesleria latifolia* and *Stipa pennata*.

The association is presented by two sub-associations – *typicum* and *centauretosum*, which are clearly floristically and ecologically (Vassilev *et al*. 2012). Subassociation *centauretosum* develops on places where grazing was abandoned about 20 years ago, which resulted in increasing occurrence

of species like *Thalictrum minus* and *Geranium sanguineum*, diagnostic for class *Trifolio-Geranietea*. In contrast, the typical subassociation occupies recently actively used pastures.

Ass. *Hieracio pilosellae-Festucetum dalmaticae* Vassilev *et al*. 2012

This association has wider distribution in the study area as compared to *Galio lovcense-Artemisietum chamaemelifoliae* (Vassilev *et al*. 2012). It could be found on eastern and southern slopes of Ponor Mt., near villages Zanoge, Zasele and Ravna. Soils are shallow to moderately deep with high percentage of skeletal material.

Association occupies xerophylous habitats at the periphery of *Cirsio-Brachypodion pinnati* distribution range and has a pronounced transitional character between *Cirsio-Brachypodion pinnati* and xerothermic alliances *Festucion valesiacae* and *Saturejion montanae*.

The association is presented in the mountain range by the two facies, dominated either by *Corothamnus procumbens* or by *Sesleria latifolia*.

Invasion of shrubs such as *Rosa* sp., *Crataegus monogyna* and *Prunus spinosa* is considered as main threat for the association. This process is impeded by decreased grazing regime.

We expect that the association could be also found in other areas of western Balkan Range and Forebalkan, limited to calcareous bedrock.

All. *Festucion valesiacae* Klika 1931

The alliance is widespread in the oak belt in the mountains and hills west of Sofia (Vassilev *et al*. in press). Within Ponor SPA, where the influence of mountain climate is essential, *Festucion valesiacae* is mostly presented in the southern parts of the area. It covers areas with shallow to moderately deep soils and slight slopes. Bedrock type is limestone or dolomite.

Festucion valesiacae includes xerothermic grasslands with semi-open to closed horizontal structure. Euro-Asian, Euro-Mediterranean and sub-Mediterranean floristic elements prevail, whereas European, Pontic and Panonian species are purely presented. Hemicryptophytes dominate while the presence of therophytes is limited up to 30%.

Only 7 relevés are assigned to this alliance (Table 2). The group of diagnostic species includes *Astragalus onobrychis*, *Medicago falcata* and *Centaurea stoebe*. There is no clear dominant species in these communities. Transitional communities between *Festucion valesiacae* and *Cirsio-Brachypodion* are often observed on the territory.

All. *Saturejion montanae* Horvat *et al*. 1974

The alliance includes open grasslands within *Quercion frainetto* in eastern Serbia, and Bulgaria (Horvat *et al*. 1974, Royer 1991, Sopotlieva 2008). According to Todorova, Tzonev (2010) *Saturejion montanae* communities are open petrophilous steppes where tufted grasses share dominant position with chamaephytes of *Lamiaceae* family (*Satureja* sp., *Thymus* sp., *Hyssopus* sp., *Teucrium* sp.). The alliance comprises xerothermic plant communities rich in sub-Mediterranean, Euro-Asian and Euro-Mediterranean species as well as many endemics. On one hand, species composition of *Saturejion montanae* is influenced by the Mediterranean flora characteristic for southern parts of the Balkan Peninsula, and on the other, it is influenced by neighbouring communities of *Festucetalia valesiacae* (*Festucion valesiacae)* and *Astragalo-Potentilletalia* (*Koelerio-Festucion dalmaticae* and *Saturejo-Thymion*). Species with steppic nature, such as *Stipa* sp., and *Festuca* sp. have high abundance in communities.

Stands are developed entirely on calcareous terrains with rocky outcrops which are irregularly grazed. Soils are shallow and on some places almost absent.

The alliance was first mentioned for the area by Vassilev *et al*. (2012). All 8 stands that were sampled are located in the most eastern and southern parts of the study area above the villages Zanoge, Zasele, Gintsi, Gubesh and Ravna. Influence of alliances *Cirsio-Brachypodion* and *Festucion valesiacae* on *Saturejion montanae* communities is essential due to the small areas which they cover.

Threats for grassland vegetation in Ponor SPA

Main objective for establishment of Ponor SPA is diversity of birds. Preservation of habitats they occupy is a goal of the further activities in this zone. Each habitat and corresponding vegetation type is threatened differently. Wet grasslands of *Scheuchzerio-Caricetea* fuscae are dependent on the water supply in the distribution area. Water sources in Ponor Mt. are limited. Larger areas with significant water supply are situated mostly around Petrohan pass. Intensive urbanization of the area and developing tourist facilities could change water regime and underground water table.

Mesic grasslands are also subject of changes. Certain vegetation change towards the communities of less waterlogged habitats could be observed in both mesic and fen grasslands. Traditional management in the best way to support persistence of meadows with a high conservation value. Mesic grasslands should be maintained as hay meadows in the future. Unfortunately the region is very sparsely populated that results in decreasing intensity of mowing.

Decreased stock breeding also affects grazing regime. Dry grasslands are mainly managed as pastures. Low grazing intensity appears to be the main threat for biodiversity in these grasslands. Under such conditions a gradual process of succession leading to replacement of legumes and other forbs by tussock grasses was observed. Resulting communities are usually species poorer. They become dominated by widespread grasses as *Agrostis capillaris*, *Festuca rubra* and *Lerchenfeldia flexuosa*. Another succession process favoured by reduced intensity of agricultural practices is shrub establishment in grasslands. Over the last decade large areas covered by grasslands were converted into scrublands. Most threatened are *Cirsio-Brachypodion pinnati*, *Nardetum strictae* sensu lato and *Festucion valesiacae*. Areas distributed in higher elevations become invaded by *Vaccinium myrtilus*, *Bruckenthalia spiculifolia* and *Juniperus sibirica* whereas others, closer to settlements, are mainly affected by *Rosa* sp., *Crataegus monogyna* and *Juniperus communis*. Changes in plant communities affects the distribution of natural habitats. Especially they lead to reducing territory of the habitat "6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)" (sensu Habitat Directive 92/43 EEC). Intentional burning of shrubs is a common practice in Ponor SPA but it should not be applied for areas covered by habitat type 5130 *Juniperus communis* formations on heaths or calcareous grasslands.

Acknowledgements: This study was initiated and funded by the project ''Conservation of globally important biodiversity in high nature value seminatural grasslands through support for the traditional local economy'' (GEFSEC Project №43595), co-ordinated by the Bulgarian Society for the Protection of Birds/BirdLife Bulgaria. The authors are also grateful to reviewers for constructive suggestions on the first version of the manuscript.

Referances

Apostolova I., D. Sopotlieva, H. Pedashenko, N. Velev and K. Vasilev. 2012. Bulgarian vegetation database – current status and essential features. – *Biodiversity Ecology*, **4**: 141-148.

Berg Ch., J. Dengler, A. Andank and M. Isermann. 2004. Die Pflanzengesellschaften Mecklenburg-Vorpommerns und ihre Gefährdung. – Textband. -Herausgegeben vom Landesamt für Umwelt, Naturschultz und Geologie Mecklenburg-Vorpommern. Jena, (Weissdorn-Verlag), 606 p.

Borhidi A. 2003. Magyarország növénytársulásai (Hungarian plant communities). Budapest, (Akadémiai Kiadó), 610 p.

Borhidi A., B. Kevey, G. Lendvai. 2012. Plant communities of Hungary. Budapest, (Akadémiai Kiadó), 525 p.

Braun-Blanquet J. 1965. Plant Sociology. The Study of Plant Communities. New York and London, (Hafner Publishing Company), 439 p.

Cachovanová, L., M. Hájek, Z. Fajmonová, R. Marrs. 2012. Species richness, community specialization and soil-vegetation relationships of managed grasslands in a geologically heterogeneous landscape. – *Folia Geobotanica*, **47** (4): 349-371.

Chytrý M., D. Blažková. 2007. *Molinio-Arrhenatheratea* Tüxen 1937. – In: Chytrý M. (ed.): Vegetace České republiky. 1. Travinná a keřičková vegetace [Vegetation of the Czech Republik 1. Grassland and heathland vegetation]. Praha, (Akademia), 66-168p.

Chytrý M., Z. Otýpková. 2003. Plot sizes used for phytosociological sampling of European vegetation. – *Journal of Vegetation Science*, **14**: 563-570.

Chytrý M., L. Tichý, J. Holt and Z. Botta-Dukát. 2002. Determination of diagnostic species with statistical fidelity measures. – *Journal of Vegetation Science*, **13**: 79-90.

Dimitrov M. 2001. Syntaxonomic analysis of herbaceous vegetation in the Yundola Forestry Experimental Station. – In: Temniskova D. (ed.): Proceedings of Sixth National Conference of Botany, Sofia, June 18-20, 2001, Sofia, (University "St. Kl. Ohridski" Press), 263-276 p. (In Bulgarian).

Fischer A., O. Rugel and R. Rattay. 1985. 'Ruderale Wiesen' – Ein Beitrag zur Kenntnis des *Arrhenatherion*-Verbandes. – *Tuexenia*, **5**: 237-248.

Háberová, I., M. Hájek. 2001. *Sceuchzerio-Caricetea fuscae*. – In: Valachovič M. (ed.): Rastlinné spoločenstvá Slovenska. 3. Vegetácia mokradi. Bratislava, (Veda,) pp. 185-174.

Hájek M., P. Hájková and I. Apostolova. 2008. New plant associations from Bulgarian mires. – *Phytologia Balcanica*, **14** (3): 377-399.

Horsák, M., M. Hájek, P. Hájková, R. Cameron, N. Cernohorsky, I. Apostolova. 2011. Molluc communties in Bulgarian fens: predictive power of the environment, vegetation, and spatial structure in an isolated habitat. – *Naturwissenschaften*, **98**: 671-681.

Horvat I., V. Glavač and H. Ellenberg. 1974. Vegetation Sudosteuropas. Jena/Stuttgart, (Gustav Fischer Verlag), 767 p.

ISO 10390. 1994: Soil quality – Determination of pH.

ISO 11464. 1994. Soil quality – Pretreatment of samples for physico-chemical analyses.

Janišová M., E. Uhliarová, T. Hlásny and I. Turisová. 2010. Vegetation-environment relationships in grassland communities of central Slovakia. – *Tuexenia*, **30**: 423-443.

Kononova M. M. 1966. Soil Organic Matter. Its Nature, its role in soil formation. 2nd ed., New York, (Pergamon), 544 p.

Krahulec F., M. Chytrý and H. Härtel. 2007. Smilkové trávníky a vřesoviště (*Calluno-Ulicetea*) – In: Chytrý, M. (ed.): 2007. Vegetace České republiky. 1. Travinná a keřičková vegetace [Vegetation of the Czech Republik 1. Grassland and heathland vegetation]. Praha, (Akademia), 281-317 p.

Mateeva Z. 2002: Precipitation and snow cover. In: Kopralev, I. (ed.): Geography of Bulgaria. Sofia, (ForCom), 152-154 p.

Melovski L., V. Matevski. 2008. Development of criteria for the selection of wetland habitats for strict protection – case study of Bunec site in the National Park "Mavrovo". – Proceedings, III Congress of Ecologists of the Republic of Macedonia, with International Participation. Struga, 06-09.10.2007. Skopje, (Macedonian Ecological Society), 157-166 p.

Meshinev T., I. Apostolova, V. Georgiev, V. Dimitrov, A. Petrova and P. Veen. 2005. Grasslands of Bulgaria. Final report on the National Grasslands Inventory Project – Bulgaria, 2001-2004. Sofia, (Dragon Ltd), 104 p.

Micevski K. 1994. Visokoplaninska vegetacija na planinata Bistra. [Vegetation of Mt. Bistra]. Skopje, (MANU), 91 p. (In Macedonian).

Mucina L., J. Kolbek. 1993. *Festuco-Brometea*. – In: Mucina L., G. Grabherr, and T. Ellmauer (eds): Die Pflanzengesellschaften Osterreichs. Teil I. Jena, (Gustav Fischer Verlag), 420-482 p.

Nikolov S.C. 2010. Effects of land abandonment and changing habitat structure on avian assemblages in upland pastures of Bulgaria. – *Bird Conservation International*, **20**: 200-213.

Pedashenko H., K. Vassilev. 2014. Flora of Ponor Special Protection Area (Natura 2000), western Bulgaria. – *Acta zoologica bulgarica*, **Suppl. 5**: 33-60.

Pedashenko H., K. Vassilev and I. Apostolova. 2010. Local occurrence of *Artemisia chamaemelifolia* Vill. in Bulgaria. - *Annali di Botanica*, **1**: 51-56.

Rodwell J. S., J. H. J. Schamineé, L. Mucina, SPignatti, J. Dring and D. Moss. 2002. The Diversity of European Vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats. Wageningen, (EC-LNV), 165 p.

Roleček J., L. Tichý, D. Zelený and M. Chytrý 2009. Modified TWINSPAN classification in which the hierarchy respescts cluster hererogeneity. – *Journal of Vegetation Science*, **20**: 596-602.

Royer J. M. 1991. Synthese eurosibérienne, phytosociologique et phytogéographigue de la classe des *Festuco-Brometea*. - *Dissertationes Botanicae*, **178**: 1-296.

Sanda V., K. Öllerer and P. Burescu. 2008. Fitocenozele din România sintaxonomie, structură, dinamică şi evolutie. Universitatea din Bucuresti, (Ars Docendi), 570 p.

Schubert R., W. Hilbig and S. Klotz. 2001. Bestimmungsbuch der Pflanzengesellschaften Duetschlands. Berlin, (Spektrum Akademischer Verlag GmbH Heidelberg).

Škodová I. 2007. Trieda MA *Molinio-Arrhenatheratea*. – In: Janišová, M. (ed.): Travinnobylinná vegetácia Slovenska – elektronický expertný system na identifikáciu syntaxónov, Bratislava, (Botanický ústav SAV), pp. 89-91.

Söderström B., B. Svensson, K. Vessby, A. Glimskär. 2001. Plants, insects and birds in semi-natural pastures in relation to local and landscape factors. – *Biodiversity and Conservation*, **10**: 1839-1863.

Sopotlieva D. 2008. Syntaxonomical characteristic of grasslands in Straldzha-Aytos phytogeographic region. PhD Thesis. Sofia, (Institute of Botany, Bulgarian Academy of Science), 147 p. (In Bulgarian).

Stoyanoff Z. 1946/1947. A contribution to the investigation of the meadows and pastures in the Mountains of West Bulgaria. – *Annuare de L'Université de Sofia, Faculté d'Agronomie et sylviculture*, **24(2)**: 113-138.

Tichý L. 2002. JUICE, software for vegetation classification. – *Journal of Vegetation Science*, **13**: 451-453.

Tichý L., J. Holt 2006. JUICE program for management, analysis and classification of ecological data. Brno, (Vegetation science group, Masaryk University), 97 p.

Todorova S., R. Tzonev 2010. *Bromo moesiacae-Stipetum epilosae* – a new association from the relict mountain steppe vegetation in south-western Bulgaria. – *Hacquetia*, **9** (2): 185-206.

Vassilev K., H. Pedashenko, S. C. Nikolov, I. Apostolova and J. Dengler. 2011. Effect of land abandonment on the vegetation of upland semi-natural grasslands in the Western Balkan Mts., Bulgaria. – *Plant Biosystems*, **145** (3): 654-665.

Vassilev K., I. Apostolova and H. Pedashenko. 2012. Alliance *Cirsio-Brachypodion pinnati* in Western Bulgaria. – *Hacquetia*, **11** (1): 233-254.

Veen P., R. Jefferson, J. de Smidt and J. van der Straaten (eds). 2009. Grasslands in Europe of high naature value. The Netherlands, (Knnv Publishing), 320 p.

Velchev V., P. Vasilev and T. Meshinev. 1989. Ecological investigations in the Institute of Botany with Botanical garden in BAS – contributions and tasks. – *Phytology*, **37**: 30-45.

Velev N., I. Apostolova 2009. A review of *Potentillo ternatae-Nardion strictae* alliance. – *Hacquetia*, **8** (1): 49-66.

Velev N., I. Apostolova and Z. Fajmonová 2011a. *Cynosurus cristatus* grasslands in West Bulgaria. – *Phytologia Balcanica*, **17** (2): 221-236.

Velev N., I. Apostolova and Z. Rozbrojová. 2011b. Alliance *Arrhenatherion elatioris* in West Bulgaria. – *Phytologia Balcanica*, **17** (1): 67-78.

Velev N., I. Apostolova, Z. Rozbrojová and P. Hájková. 2010. The alliances *Arrhenatherion*, *Cynosurion* and *Trifolion medii* in west Bulgaria – environmental gradients and ecological limitations. – *Hacquetia*, **9** (2): 207-220.

Westhoff V., E. van der Maarel. 1973. The Braun-Blanquet approach. In: Whittaker, R. H. (ed.): Ordination and classification of plant communities, The Hague, NL, (W. Junk), pp. 617-737.

Yordanov D. 1924. On phytogeography of the Western Stara Planina Mts. – Godishnik Sofiiski Universitet. Fiziko.-Matematicski. Fakultet, **20** (1): 1-102. (In Bulgarian).