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CONTENTS

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VEGETATION AND HABITAT DIVERSITY IN ORELYAK RESERVE (SOUTH-WEST BULGARIA)

VASSILEV K., PEDASHENKO H., VELEV N.
Institute of Biodiversity and Ecosystem Research – Bulgarian Academy of Sciences, Sofia, Bulgaria
Corresponding author e-mail address: kiril5914@abv.bg

ABSTRACT: The Orelyak reserve is situated in the central part of Pirin Mts. It occupies an area of 759 ha and was declared to protect the well preserved beech forests. Five habitats according to the Habitat Directive were found - 9130, 9150, 5130, 4060, 6520. The most widespread vegetation type belongs to *Carpino-Fagetea* class, represented by alliances *Fagion sylvaticae* and *Cephalanthero-Fagion*, two associations (*Asperulo odoratae-Fagetum sylvaticae*, *Galio pseudoaristati-Fagetum sylvaticae*) and *Abies alba-Fagus sylvatica* community. The rest of the forest vegetation was classified to alliance *Carpinion orientalis* of *Quercetea pubescentis* class and includes *Ostrya carpinifolia* community, which is found locally in the reserve at lower altitudes. Shrub vegetation has limited distribution and was classified to alliances *Pruno tenellae-Syringion* and *Juniperion nanae*. It is presented by *Juniperus communis* and *Juniperus sibirica-Chamaecytisus absinthoides* communities. Grasslands cover only 2 % of the reserve's territory. They were classified into three classes: *Trifolio-Geranietea sanguinei*, *Molionio-Arrhenatheratea* and *Galio-Urticetea*.
Keywords: classification, conservation, endemics, habitats, NATURA 2000, Pirin Mts, vegetation.

1 INTRODUCTION

Orelyak reserve was declared as a protected area in 1985 to preserve a sample of primary, characteristic of southern Pirin beech forests, formed on humus-carbonate soils, having specific flora and limited distribution in the country. Its initial territory (850 ha) was twice reduced (1995 and 2013) and now covers 757.1 ha. More than 90% of the reserve territory is covered by forests.

General information about the flora and vegetation of the Pirin Mountain can be found at: [4, 14, 16, 26].

There was no complete study of the reserve's vegetation until now. The only known specific source of data from its territory is a report, ordered by the Committee on Environmental Protection at Council of Ministers in 1988 [35]. Unfortunately the report is not available anymore and only its title is still known.

This study aims at revealing the syntaxonomic and habitat diversity of Orelyak reserve and at assessing their current condition.

2 MATERIAL AND METHODS

2.1 Study area

The study was conducted in Orelyak reserve, located in the central part of Pirin Mts. The altitude ranges from 990 m to 1870 m a.s.l. (Fig. 1). This determines the clear altitudinal zonation of climatic elements and the occurrence of typical mountain climate. The average annual temperature decreases from 9,0 ºC at the lowest points of the reserve to 4,3 ºC at altitude of 1800 meters. July and August are the warmest months in the year. The average July temperatures are 18,4 ºC at 1000 m a.s.l. and 13,0 ºC at 1800 m a.s.l. The coldest month is January with average temperatures between -1.2 ºC and -4.2 ºC. Absolute maximum temperature is mostly seen in August (27-35 ºC). Absolute minima are recorded in the winter months - December, January and February (-20 ºC – -25 ºC) [19]. Annual precipitation rate is between 850 and 1000 mm. The maximum rainfall occurs in November or December (100-150 mm), which coincides with the maximum frequency of Mediterranean cyclones. The minimum rainfall occurs in August, which coincides with both the minimum in the distribution of these cyclones and the negligible influence of cold fronts of the Atlantic cyclones. The snow cover lasts about 50-100 days a year in low and middle mountain belt. At 1800 m a.s.l. its duration is increased to 150 days [19]. The bedrock type is predominantly silicate. Carbonate terrains are only present at the southernmost part of the reserve as well as in the northeastern corner [6]. The prevailing part of the area, which is characterized by good afforestation and slopes up to 25-30°, is covered by cambisols. On the slopes with inclination above 30-35° (about ¼ of the territory) soils are mainly leptosols. On silicate terrains – rankers, whereas on carbonate – rendzinas. In the lowest parts of the slopes and bottoms of the valleys fluvisols are distributed [8].

The potential natural vegetation is presented by Rhodopean beech and spruce-fir-beech forests (*Fagus sylvatica*, *Abies alba*, *Picea abies*) with *Telekia speciosa*, *Peucedanum aegopodioides* (Mapping unit F153) [32].

The territory of the reserve is a Site of Community Importance (NATURA 2000 site BG0001028 Sreden Pirin-Ali Botush).

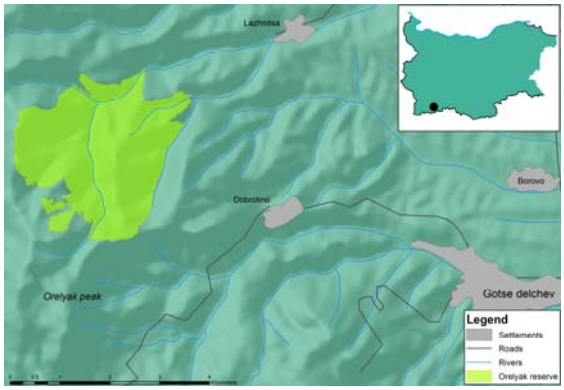

Figure 1: Map of the study area

2.2 Vegetation sampling

The field sampling was carried out in the period July – August 2014 following the Braun-Blanquet approach [18, 36]. We covered the whole range of different vegetation types on the territory of the reserve. We used 16 m^2, 24 m^2 and 100 m^2 square-shaped plots (n = 20), respectively for grassland, shrubland and woodland vegetation. All relevés were stored in TURBOVEG

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database [30] and in the Balkan Vegetation Database [21].

Species nomenclature pursued Key to the Plants of Bulgaria [5].

2.3 Data analysis of relevés

Numerical classification was performed by PC-ORD [2] incorporated in JUICE 7.0 software package [24]. Relative Sørensen was used as distance measure and species similarity was calculated using flexible beta clustering (-0.25). The species values were square-root transformed and 3 cut leves (0, 5, 25) were used.

Species composition is represented in phytosociological tables with the cover/abundance estimates. The proposed syntaxonomical scheme is based on dendrogram separation so that syntaxa have ecological and phytogeographical interpretation.

2.5. Habitat classification and mapping

Habitat types were determined according to the Interpretation Manual of European Union Habitats [17, 33]. Assignment of each vegetation unit at association level to a certain Habitat Directive Code (HDC) was given in the text. Mapping was done using ArcGIS 10.0 software [9]. Spatial data was collected in the field using GPS devise Juno BS by Trimble and was later overlaid over the most recent orthophoto images available. Outlining the polygons was done manually by using features collected in the field as well as the orthophoto images. Mapping was done in scale 1:5000.

3 RESULTS

3.1 Vegetation types

Classification of the relevés showed 8 different communities on the territory of Orelyak reserve. The list of established syntaxa consisted of 6 classes, 6 orders, 7 alliances, 3 associations and 6 plant communities (Fig. 2). Beech forests were the most widespread vegetation type and covered more than 89.7% of the reserve's territory.

3.1.1 Ass. *Asperulo odoratae-Fagetum sylvaticae* (HDC: 9130; 637.1 ha, Annex III)

This was the most widespread association on the territory of the reserve. Its communities occured between 1200 and 1870 m a.s.l. on moderately steep slopes (10^o-35^o) with varying aspects. Soils were moderately deep cambisols.

This association included neutrophilous and species-poor beech forests. The dominant species was *Fagus sylvatica*. The shrub layer was usually missing but the herb layer had cover between 0% and 50%, mainly by *Euphorbia amygdaloides*, *Geranium robertianum*, *Lapsana communis*.

3.2.2 *Abies alba-Fagus sylvatica* community (HDC: 9130; 2.3 ha, Annex III)

This vegetation type was found at 1400-1635 m a.s.l. on north and northeastern facing slopes with inclination of 20^o-45^o. *Abies alba* was the dominant species and subdominant was *Fagus sylvatica*. Shrub layer was presented by young trees of above mentioned species as well as *Evonymus verrucosus* and *Rubus caesius*. The herb layer was species-poor but species with higher cover and abundance were *Geranim macrrorhizum, Dryopteris filix-mas, D. dilatata*.

3.2.3 Ass. *Galio pseudoaristati-Fagetum sylvaticae* (HDC: 9150; 40.4 ha, Annex III)

Alliance *Cephalanthero-Fagion* and association were distributed only in northern part of the reserve, where calcareous bedrock was found. They were distributed between 1000-1200 m a.s.l. on north slopes with inclination of 25^o-35^o. Soils were moderately deep leptosols. *Fagus sylvatica* dominated the tree layer (75%-95%). Shrub layer was presented by young trees of *Fagus sylvatica*, *Abies alba*, *Acer campestre* and had cover up to 35%. Herb layer was poor-species with total cover up to 30-35%. Species with higher cover and abundance were *Physospermum cornubiense* and *Brachypodium sylvaticum*.

3.2.4 *Ostrya carpinifolia* community (HDC: 91W0; 4.5 ha; Annex III)

Ostrya carpinifolia forests were locally distributed from 1000-1200 m a.s.l. on the territory of the reserve. They covered areas between 750 and 800 m a.s.l. on slopes with varying aspects with inclination between 25^o-40^o. Soils were moderately deep leptosols.

Ostrya carpinifolia dominated the tree layer (50%-70%). Shrub layer had cover between 10-20% and was formed by young trees of *Ostrya carpinifolia*, *Fraxinus ornus* and *Acer campestre*. The herb layer had total cover between 50-70% and was consisted mainly by *Geranium macrorrhizum* and *Poa nemoralis*. Bryophyte layer was well developed (total cover 20-30%) and species with higher cover and abundance were *Brachytheciastrum velutinum* and *Homalothecium lutescens*.

Shrubland vegetation had limited distribution in the reserve, e.g. 7.2% of its territory. It was represented by *Chamaecytisus absinthoides*, *Juniperus sibirica* and *J. communis* communities.

3.2.5 *Juniperus sibirica-Chamaecytisus absinthoides* community (HDC: 4060; 33.4 ha, Annex II)

The communities of *Juniperus sibirica* and *Chamaecytisus absinthoides* covered areas between 1500 and 1750 m a.s.l. on slopes with varying aspects and inclination between 5^o-25^o. Soils were shallow to moderately deep cambisols. The cover of shrub layer was between 55-100%. The herb layer was well developed and dominats were *Agrostis capillaris*, *Festuca panciciana*, *F. hirtovaginata*, *Trifolium repens*, *Calamagrostis arundainacea*, *Thymus jankae*. These communities were used as pastures.

3.2.6 *Juniperus communis* community (HDC: 5130; 20.1 ha)

This vegetation was distributed at 1000-1200 m a.s.l. on slopes with varying aspects and inclination of 25^o-45^o. Soils were moderately deep and dry litosols. The dominant species was *Juniperis communis* with cover 40-70%. Subdominant species were *Festuca valesiaca*, *Thymus* spp. This community was not sampled in the field and there is no relevés in the annexes.

Grassland vegetation had limited distribution in the reserve and covered only 2 % of its territory. It was presented by subalpine pastures and ruderal vegetation.

3.2.7 Ass. *Pteridietum aquilini* (HDC: not present; 10 ha, Annex I)

This association was distributed in beech forest belt on slightly slopes with varying exposition. The vegetation was developed mainly on abandoned pastures

or around farmland buildings. The plant communities were dominanted by *Pteridium aquilinum* with cover 90-100%. The rest species were accompanying and their cover was up to 5-7%.

3.2.8 *Agrostis capillaris* community (HDC: 6520; 5.2 ha, Annex I)

This vegetation was locally distributed on higher altitudes between 1400-1600 m a.s.l. Soils were shallow to moderately deep. Tussock-grasses like *Agrostis capillaris*, *Lolium perenne*, *Dactylis glomerata*, *Festuca rubra*, *Lolium perenne* and *Trifolium repens* were subdominants in the communities. The vegetation was used as pastures.

3.2.9 *Urtica dioica* community (HDC: not present ; 0.1 ha)

This community had very limited distribution and covered an area of about 25 m^2. It was found on flat terrain, close to a stream and in the horizontal structure *Urtica dioica* was the dominant species.

SYNTAXONOMICAL SYNOPSIS:

Cl. *Carpino-Fagetea* Jakucs ex Passarge 1968
Ord. *Fagetalia sylvaticae* Pawł. et al. 1928
All. *Fagion sylvaticae* Luquet 1926
Ass. *Asperulo odoratae-Fagetum sylvaticae* Sougnez et Thill 1959
Abies alba-Fagus sylvatica community
All. *Cephalanthero-Fagion sylvaticae* Tüxen 1955
Ass. *Galio pseudoaristati-Fagetum sylvaticae* Tzonev et al. 2006
Cl. *Quercetea pubescentis* (Oberd. 1948) Doing Kraft 1955
Ord. *Quercetalia pubescenti-petraeae* Klika 1933
All. *Fraxinoorni- Ostryion* Tomažić 1940
Ostrya carpinifolia community
Ord. *Fraxino orni-Cotinetalia* Jakucs 1961
All. *Pruno tenellae-Syringion* (Jovanović 1979) Čarni et al. 2009
Juniperus communis community
Cl. *Loiseleurio-Vaccinietea* Eggl. 1952 ex Schub. 1960
Ord. *Rhododendro-Vaccinietalia* Braun-Blanq. in Braun-Blanq. et Jenny 1926
All. *Juniperion nanae* Br.-Bl. et al. 1939
Juniperus sibirica-Chamaecytisus absinthoides community
Cl. *Trifolio-Geranietea sanguinei* T. Müller 1962
Ord. *Melampyro pratensis-Holcetalia mollis* Passarge 1979 in Theurillat et al. 1995
Ass. *Pteridietum aquilini* Jouanne & Chouard 1929
Cl. *Molinio-Arrhenatheretea* Tüxen 1937
Ord. *Arrhenatheretalia* Tüxen 1931
All. *Cynosurion cristati* Tüxen 1947
Agrostis capillaris community
Cl. *Galio-Urticetea* Passarge ex Kopecky 1969
Ord. *Lamio albi-Chenopodietalia boni-henrici* Kopecký 1969
All. *Geo-Alliarion* Lohm et Oberd. in Görs et Müler 1969
Urtica dioica community

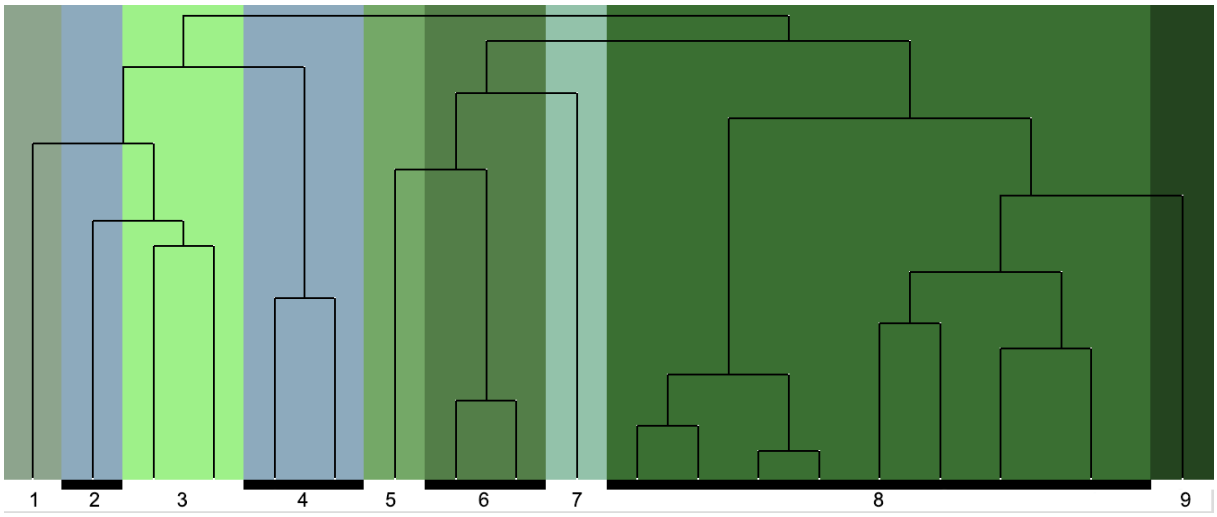

Figure 2: Dendrogram of phytosociological relevés (Relative Sørensen distance measure and flexible beta clustering (-0.25) were used). Legend: *Pteridietum aquilini* (clusters 1), *Juniperus sibirica-Chamaecytisus absinthoides* community (clusters 2 and 4), *Agrostis capillaris* community (cluster 3), *Ostrya carpinifolia* community (cluster 5), *Galio pseudoaristati-Fagetum sylvaticae* (cluster 6), *Urtica dioica* community (cluster 7), *Asperulo odoratae-Fagetum sylvaticae* (cluster 8), *Abies alba-Fagus sylvatica* community (cluster 9).

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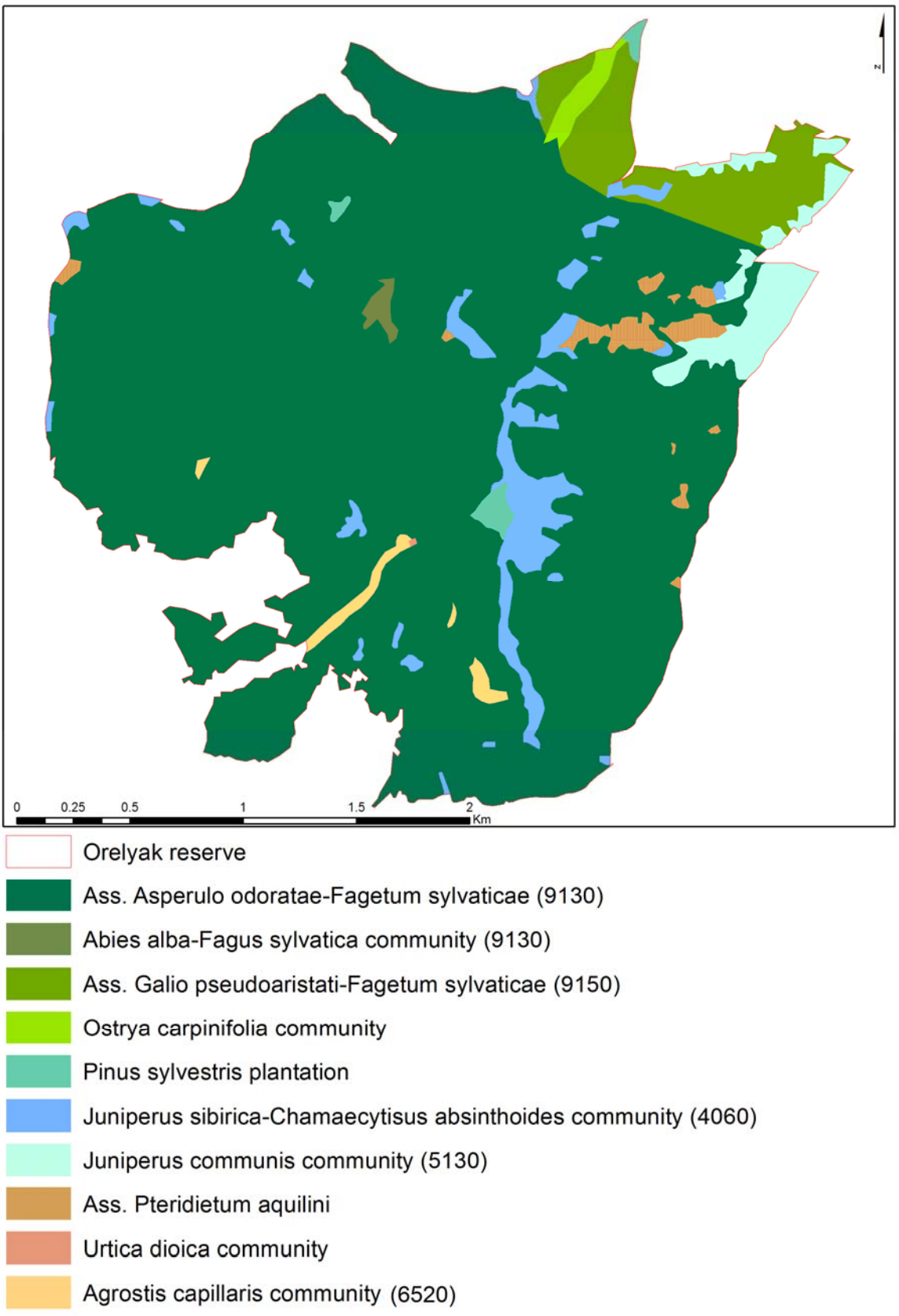

Figure 3: Map of vegetation units of Orelyak reserve. Numbers given in brackets represent the codes of habitats according to the Habitat directive: 9130 – *Asperulo-Fagetum* beech forests, 9150 – Medio-European limestone beech forests of the *Cephalanthero-Fagion*, 4060 – Alpine and Boreal heaths, 5130 – *Juniperus communis* formations on heaths or calcareous grasslands, 6520 – Mountain hay meadows.

4 DISCUSSION

4.1 Vegetation

The territory of the reserve protects well-preserved beech forests. Their separation is a result of different bedrock types – silicate and limestone, which is a reason for distribution of two alliances - *Fagion sylvaticae* and *Cephalanthero-Fagion sylvaticae*. The species composition of the established associations is similar to their characteristic described by Tzonev et al. [29]. The association *Asperulo odoratae-Fagetum sylvaticae*, which has poor-species composition is the most widly distributed syntaxon in the reserve. The *Abies alba-Fagus sylvatica* community, which is mainly found in southern part of the country is distributed in the upper part of the reserve at higher altitudes. In fact, it represents a successional stage between beech and *Abies* woodlands. Alliance *Cephalanthero-Fagion sylvaticae* is found at lower altitudes and its association *Galio pseudoaristati-Fagetum sylvaticae* has similar species composition and ecological characteristics as described by [29].

Ostrya carpinifolia woodlands are locally found at lower altitudes along the mountain streams. This vegetation is poorly studied in the country [10, 11, 12, 25]. Future analysis is needed to reveal the syntaxonomical diversity of this vegetation in Bulgaria.

Shrub and grassland vegetation in the reserve cover limited areas. Grassland vegetation includes subalpine pastures, which has been extensively distributed before declaration of the reserve. Their composition is transitional between alliances *Cynosurion cristati* and *Poion alpinae*. According to [31, 34] *Poion alpinae* is found in Rhodope Mts and mentioned localities are far from the reserve territory. Due to higher altitudes (1400-1600 m a.s.l.) of these grasslands some typical species for the latter alliance are found (*Phleum alpinum*, *Festuca nigrescens*, *Cerastium alpinum*). Finally, these communities are closer to *Cynosurion cristati* alliance because of the prevalence of its diagnostic species in the relevés. *Cynosurion cristati* alliance is studied by [13, 21, 28, 27, 31] from other parts of the country. On the territory of the reserve this vegetation is intensively grazed and trampled. This favors the distribution of gap colonizer species with rhizomes or stolons (e.g. *Trifolium repens*, *Lolium perenne*).

The rest grassland vegetation types are represented by ruderal and fringe vegetation. *Pteridium aquilinum* communities has similar structure, species composition and ecology like other bracken phytocoenoses known from Belasitsa Mt [11], Malashevska Mt, Pirin Mts, Forebalkan, Rhodope Mts, Ograzhden Mt (Balkan Vegetation Database, unpublished data). They are monodominant communities with poor-species composition, which are found on areas, which has been used as intensive pastures in the past but nowadays are abandoned.

Urtica dioica community represents ruderal vegetation dominated by nitrophilous species. Class *Galio-Urticetea* is poorly studied in the country [20, 23]. There is a lack of diagnostic species for previously described associations *Urtico dioicae-Parietarietum officinalis* and *Urtico-Cruciatetum laevipedis* [7, 15, 22]. Further research of syntaxnomy of Bulgarian *Urtica dioica* communities are needed. Shrubland vegetation is dominated by *Chamaecytisus absinthoides* and *Juniperus sibirica*. *Chamaecytisus absinthoides* is a Balkan endemic [1] and only association *Festuco-Chamaecytisetum absinthoides* is known for Bulgaria so far [34]. It is distributed on higher altitudes and is rich of subalpine species like *Festuca valida*, *Potentilla ternata*, etc. *Chamaecytisus absinthoides* communities in *Fagus* and *Quercus* belts are still not studied. This species has wider ecological niche and is also subdominant of some grassland communities. Its communities have wide distribution in mountains of south Bulgaria (Malashevska Mt, Ograzhden Mt, Pirin Mts, Rhodope Mts, Rila Mts). In *Juniperus sibirica-Chamaecytisus absinthoides* community of the reserve some diagnostic species of *Molinio-Arrhenatheretea* (e.g. *Agrostis capillaris*, *Poa pratensis*, *Lolium perenne*, etc.) and *Festuco-Brometea* (*Centaurea rhenana*, *Teucrium chamaedrys*, *Galium verum*, etc.) are also found.

Frequently, shrubland and grassland communities form transitional (mosaic) vegetation types, which represent different successional stages of vegetation. In 1985, when the reserve was declared, the cover of pastures was 11.5 ha whereas nowadays they cover only 5.2 ha. The double reduction of open communities is mainly because of reducing of grazing, which leads to increasing of forest and shrubland territories.

4.2 Conservation importance

From conservational point of view, among all 8 communities, there are 5 habitat types (Fig. 3) protected by Annex 1 of the Bulgarian Biological Diversity Act (2007) [3] and Habitat Directive 92/43/EEC. All of them (9130, 9150, 5130, 4060, 6520) are widespread on the territory of the country.

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Annex I: Synoptic table of grassland vegetation syntaxa of Orelyak Reserve

Table number	1	2	3	4
Plot size (m^2)	16	16	16	16
Altitude (m)	1825	1915	1537	1480
Aspect (^{o})	135	270	90	90
Slope (^{o})	5	8	15	45
Total cover (%)	100	90	95	95
Cover shrub layer (%)	5	-	-	-
Cover herb layer (%)	100	90	95	95
Cover moss layer (%)	20	5	2	6
latitude	41,60004	41,58454	41,58958	41,58971
longitude	23,61088	23,63335	23,62923	23,62933
Diagnostic species of ass. *Pteridietum aquilini*				
Pteridium aquilinum	5	.	.	.
Diagnostic species of *Agrostis capillaris* community				
Agrostis capillaris	2	3	3	.
Diagnostic species of *Urtica dioica* community				
Urtica dioica	+	.	.	5
Diagnostic species of Cl. *Trifolio-Geranietea sanguinei* & Ord. *Melampyro pratensis-Holcetalia mollis*				
Clinopodium vulgare	+	.	.	.
Hypericum perforatum	+	.	+	.
Geranium sanguineum	.	.	1	.
Trifolium alpestre	.	.	+	.
Diagnostic species of Cl. *Molionio-Arrhenatheretea,* Ord. *Arrhenatheretalia* & All. *Cynosurion cristati*				
Leontodon autumnalis	.	1	2	.
Plantago media	.	+	+	.
Trifolium repens	.	3	+	.
Prunella vulgaris	.	1	+	.
Dactylis glomerata	+	.	2	.
Festuca rubra	.	.	2	.
Lolium perenne	.	2	.	.
Lathyrus pratensis	.	.	2	.
Poa pratensis	.	+	.	.
Poa annua	.	2	.	.
Diagnostic species of Cl. *Galio-Urticetea* , Ord. *Lamio albi-Chenopodietalia boni-henrici* & All. *Geo-Alliarion*				
Galium aparine	.	.	.	2
Impatiens noli-tangere	.	.	.	+
Geranium robertianum	.	.	.	1
Lapsana communis	.	.	.	+
Festuca gigantea	.	.	.	+
Other species				
Cardamine resedifolia	.	+	.	.
Arenaria serpyllifolia	.	+	.	.
Scleranthus perennis	.	+	.	.
Trifolium pratense	.	.	+	.
Bryum caespiticium	.	1	.	.
Thymus sibthorpii	.	.	+	.
Geum molle	.	.	+	.
Verbascum longifolium	.	2	.	.
Lamiastrum galeobdolon	+	.	.	.
Cruciata glabra	.	.	+	.
Brachypodium pinnatum	.	.	+	.
Sherardia arvensis	.	+	.	.
Cruciata laevipes	.	.	+	.

continued

ISSN 1857-9507 on-line: www.sf.ukim.edu.mk/sumarski_pregled.htm

continuation of Annex I

Eurhynchium angustirete	.	.	.	+
Arabis glabra	.	.	+	.
Rubus caesius	+	.	.	.
Viola gracilis	+	.	.	.
Geranium pyrenaicum	.	+	.	.
Dryopteris filix-mas	.	.	.	2
Ranunculus polyanthemos	.	.	+	.
Hordelymus europaeus	.	.	.	+
Polygonum aviculare	.	+	.	.
Bilderdykia convolvulus	.	2	.	.
Lysimachia nummularia	.	+	.	.
Cynosurus echinatus	.	.	2	.
Galeopsis tetrachit	.	.	.	1
Rumex acetosa	.	+	.	.
Colchicum autumnale	.	.	+	.
Scabiosa ochroleuca	.	.	+	.
Tortella tortuosa	.	.	.	+
Leontodon crispus	.	.	+	.
Dianthus gracilis	.	.	+	.
Poa trivialis	.	2	.	.
Pottia sp.	.	+	.	.
Capsella bursa-pastoris	.	+	.	.
Rumex acetosella	.	1	+	.
Veronica chamaedrys	.	+	+	.
Carex muricata	.	+	+	.
Alchemilla sp.	.	+	2	.
Veronica acinifolia	.	+	+	.
Stellaria holostea	.	.	.	+
Plagiomnium rostratum	.	.	.	+
Primula veris	.	.	+	.
Poa nemoralis	1	.	.	.
Galium verum	.	.	+	.
Stellaria graminea	.	.	1	.
Taraxacum sp.	.	+	.	.
Phleum alpinum	.	1	+	.
Veronica officinalis	.	2	+	.
Potentilla inclinata	.	+	+	.
Cerastium decalvans	.	+	.	.
Mentha spicata	+	.	+	.
Myosotis arvensis	+	.	.	+
Brachytheciastrum velutinun	.	.	.	+
Tanacetum corymbosum	.	.	+	.
Stachys germanica	.	.	+	.
Rumex sanguineus	+	.	.	+
Sagina apetala	.	+	.	.
Brachythecium rutabulum	.	.	.	+
Chamaecytisus absinthioides	2	.	.	.
Homalothecium lutescens	.	.	.	+
Stachys sylvatica	.	.	.	+
Poa angustifolia	.	.	+	.
Cerastium alpinum	.	+	.	.
Arabis sagittata	.	+	.	+
Hypericum maculatum	.	.	2	.

Annex II: Synoptic table of shrubland vegetation syntaxa of Orelyak Reserve

Table number	1	2	3
Plot size (m^2)	64	64	64
Altitude (m)	1513	1758	1589
Aspect (^{o})	45	90	90
Slope (^{o})	5	25	25
Total cover (%)	90	85	95
Cover shrub layer (%)	70	60	75
Cover herb layer (%)	75	55	55
Cover moss layer (%)	2	20	
latitude	41,59791	41,6029	41,59001
longitude	23,63659	23,61496	23,62561
Diagnostic species of *Juniperus sibirica-Chamaecytisus absinthoides* community			
Juniperus sibirica*	2	4	4
Chamaecytisus absinthioides	4	1	2
Diagnostic species of cl. *Loiseleurio-Vaccinietea* , Ord. *Rhododendro-Vaccinietalia* & All. *Juniperion nanae*			
Arctostaphylos uva-ursi	.	.	+
Diagnostic species of cl. *Molionio-Arrhenatheratea*			
Poa pratensis	2	.	+
Achillea millefolium	+	.	.
Trifolium repens	2	.	.
Agrostis capillaris	2	.	.
Dactylis glomerata	.	+	.
Achillea millefolium agg.	.	.	+
Coronilla varia	.	+	1
Diagnostic species of cl. *Festuco-Brometea*			
Centaurea rhenana	.	+	+
Teucrium chamaedrys	.	2	1
Galium verum	2	.	.
Melica ciliata	.	.	+
Sanguisorba minor	.	+	.
Armeria rumelica	+	.	.
Viola tricolor	+	.	.
Other species			
Stellaria graminea	+	.	.
Taraxacum sp.	+	.	.
Clinopodium vulgare	+	.	+
Thymus glabrescens	2	2	.
Geum urbanum	+	.	.
Veronica acinifolia	+	.	.
Carex muricata	.	.	+
Rumex acetosella	+	.	.
Veronica chamaedrys	1	.	.
Erysimum diffusum	.	+	+
Daphne oleoides	.	2	+
Ajuga laxmannii	.	+	+
Fragaria viridis	.	+	+
Potentilla pilosa	.	+	1
Hieracium pannosum	.	+	+
Trifolium alpestre	+	1	+
Brachypodium sylvaticum	.	.	2
Campanula rapunculoides	+	+	.
Primula veris	.	+	.
Festuca hirtovaginata	.	.	2

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ISSN 1857-9507 on-line: www.sf.ukim.edu.mk/sumarski_pregled.htm

continuation of Annex II

Hieracium pilosella	+	.	.
Arabis sagittata	+	+	.
Origanum vulgare	.	.	1
Dianthus cruentus	.	+	.
Bromus barcensis	.	.	2
Thymus jankae	.	.	2
Mentha spicata	+	.	+
Digitalis viridiflora	+	.	.
Acinos alpinus	.	+	.
Monotropa hypopitys	.	.	+
Euphorbia amygdaloides	.	.	+
Hypericum perforatum	.	.	+
Lamium maculatum	.	.	+
Helianthemum nummularium	.	1	.
Crataegus monogyna	.	.	1
Astragalus depressus	.	+	.
Calamagrostis arundinacea	.	.	2
Cruciata laevipes	+	.	.
Geranium pyrenaicum	+	.	.
Leontodon hispidus	+	.	.
Trifolium pratense	+	.	.
Bryum caespiticium	.	2	.
Scleranthus perennis	1	.	.
Cirsium vulgare	+	.	.
Arenaria serpyllifolia	+	+	.
Geum molle	+	.	.
Verbascum longifolium	2	+	.
Carex kitaibeliana	.	1	.
Festuca panciciana	.	3	.
Draba athoa	+	+	.
Centaurea sp.	+	.	.
Galium album	.	+	.
Prunus spinosa	+	.	.
Tortella tortuosa	.	2	.
Poa badensis	.	+	.
Acer pseudoplatanus	.	.	1
Plantago lanceolata	1	.	.
Rosa myriacantha	.	.	2
Euphrasia minima	.	+	.
Hypericum linarioides	.	.	+
Berteroa incana	+	.	.
Linaria genistifolia	.	.	+
Cynoglossum hungaricum	+	.	.
Chondrilla juncea	+	.	.
Knautia dinarica	+	.	.
Trifolium campestre	+	.	.
Cerastium brachypetalum	+	.	.
Syntrichia ruralis	+	.	.
Scabiosa triniifolia	.	+	.
Draba muralis	.	.	+
Silene italica	.	+	.
Potentilla argentea	2	.	.
Hieracium murrorum	.	+	.
Achillea clypeolata	.	+	.

* Diagnostic species of *Juniperus sibirica -Chamaecytisus absinthoides* community, cl. *Loiseleurio-Vaccinietea* , Ord. *Rhododendro-Vaccinietalia* & All. *Juniperion nanae.*

Annex III: Synoptic table of woodland vegetation syntaxa of Orelyak Reserve

Table number	1	2	3	4	5	6	7	8	9	10	11	12	13
RelevA area (m2)	100	100	100	100	100	100	100	100	100	100	100	100	100
Altitude (m)	1044	1241	1308	1610	1535	1762	1665	1332	1416	1617	1599	1625	1645
Aspect (degrees)	180	315	315	90	45	45	360	360	90	90	315	45	315
Slope (degrees)	45	15	10	20	10	20	10	60	45	20	45	20	25
Cover total (%)	100	90	85	90	90	85	85	95	100	85	95	90	80
Cover tree layer (%)	70	80	80	90	90	80	80	85	90	70	90	75	80
Cover shrub layer (%)	20	30	35	10	1	-	-	25	10	50	3	5	-
Cover herb layer (%)	60	35	20	2	-	10	3	15	45	20	80	50	1
Cover moss layer (%)	30	2	2	1	-	5	4	5	-	3	1	1	-
latitude	41,60841	41,60667	41,60489	41,58777	41,59706	41,58559	41,58545	41,60435	41,5981	41,59676	41,59487	41,58963	41,59231
longitude	23,63848	23,63994	23,63941	23,62558	23,63577	23,61797	23,62123	23,62963	23,62813	23,61582	23,61757	23,62476	23,6204
Diagnostic species of *Ostrya carpinifolia* community													
Ostrya carpinifolia (tr)	4	2	.	.	.	.	.	.	.	.	.	.	.
Diagnostic species of ass. *Galio pseudoaristati-Fagetum sylvaticae*													
Euphorbia amygdaloides	+	+	.	.	.	.	.	.	.	.	+	1	.
Fagus sylvatica (tr)[1]	.	4	5	5	5	5	5	5	4	4	5	5	2
Fagus sylvatica (sh)[1]	.	2	2	2	+	.	.	2	+	3	1	2	.
Fagus sylvatica (juv)[1]	.	.	+	+	.	.	.	.	.	.	+	.	.
Diagnostic species of ass. *Asperulo odoratae-Fagetum sylvaticae*													
Cardamine bulbifera[3]	.	.	.	.	.	2	+	.	+	+	1	1	.
Galium odoratum	.	.	.	.	.	.	.	.	1	2	2	3	.
Diagnostic species of *Abies alba-Fagus sylvatica* community													
Abies alba (tr)[2]	.	.	.	.	.	.	.	.	3	.	.	.	4
Diagnostic species of *cl. Quercetea pubescentis, ord. Quercetalia pubescenti-petreae & all. Carpinion orientalis*													
Fraxinus ornus (sh)	2	2	.	.	.	.	.	+	.	.	.	.	.
Fraxinus ornus (tr)	1	.	.	.	.	.	.	.	.	.	.	.	.
Veronica chamaedrys	+	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria columnae	+	.	.	.	.	.	.	.	.	.	.	.	.
Physospermum cornubiense	+	2	+	.	.	.	.	.	.	.	.	.	.
Cruciata laevipes	+	.	.	.	.	.	.	.	.	.	.	.	.
Melittis melissophylum	+	.	.	.	.	.	.	.	.	+	.	.	.

continued

ISSN 1857-9507 on-line: www.sf.ukim.edu.mk/sumarski_pregled.htm

continuation of Annex III

Diagnostic species of all. *Cephalanthero-Fagion sylvaticae*													
Cephalanthera damasonium	.	+	+	+	.	.	.	.	.	.	.	.	.
Cephalanthera rubra	.	.	+	.	.	.	.	.	.	.	.	.	.
Diagnostic species of *cl. Carpino-Fagetea , ord. Fagetalia sylvaticae & all. Fagion sylvaticae*													
Dryopteris filix-mas	.	.	.	.	.	+	+	1	2	.	+	.	.
Abies alba (sh)	.	.	2	.	.	.	.	3	.	.	.	.	.
Hordelymus europaeus	.	.	.	.	.	.	.	.	.	+	.	.	.
Mercurialis perennis	+	.	.	.	.	.	.	+	.	.	.	.	.
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	.	+	.
Oxalis acetosella	.	.	.	.	.	.	.	+	1	1	.	.	+
Sanicula europaea	.	.	.	.	.	.	.	.	+	+	.	.	.
Viola reichenbachiana	+	+	+	.	.	.	.	+	.	.	.	.	.
Neottia nidus-avis	.	.	.	.	.	.	.	.	.	+	.	.	.
Other species													
Achillea millefolium	.	+	.	.	.	.	.	.	.	.	.	.	.
Geum urbanum	+	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium alpestre	.	+	.	.	.	.	.	.	.	.	.	.	.
Melica uniflora	+	.	.	.	.	.	.	.	.	.	.	.	.
Polygonatum multiflorum	+	.	.	.	.	.	.	.	.	.	.	.	.
Ceterach officinarum	+	.	.	.	.	.	.	.	.	.	.	.	.
Evernia prunastri	+	.	.	.	.	.	.	.	.	.	.	.	.
Euonymus europaeus	+	.	.	.	.	.	.	.	.	.	.	.	.
Anomodon viticulosus	+	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium trichomanes	+	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia foliacea	+	.	.	.	.	.	.	.	.	.	.	.	.
Acer campestre (tr)	2	.	.	.	.	.	.	.	.	.	.	.	.
Polypodium vulgare	+	.	.	.	.	.	.	.	.	.	.	.	.
Moehringia pendula	+	.	.	.	.	.	.	.	.	.	.	.	.
Tilia cordata (sh)	+	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus aureus	.	+	+	.	.	.	.	+	.	.	.	.	.
Luzula sylvatica	.	1	2	.	.	.	.	+	.	.	.	.	.
Aremonia agrimonoides	.	1	+	+	.	.	.	.	.	+	.	.	.
Brachypodium sylvaticum	.	+	1	.	.	.	.	.	.	.	.	.	.
Campanula rapunculoides	.	+	+	.	.	.	.	.	.	.	.	.	.
Primula veris	.	+	+	.	.	.	.	.	.	.	.	.	.
Rosa sp.	1	2	+	.	.	.	.	.	.	.	.	.	.
Acer campestre (sh)	+	2	2	.	.	.	.	+	.	.	.	+	.
Poa nemoralis	2	1	+	.	.	.	.	.	.	.	.	.	.

continued

continuation of Annex III

Geranium macrorrhizum	3	.	.	.	.	+	.	+	2	2	4	2	.
Festuca heterophylla	.	+	.	.	.	.	.	.	.	.	.	.	.
Plagiochila porelloides	.	.	.	.	.	.	.	+	.	.	.	.	.
Dactylis glomerata	.	+	.	.	.	.	.	.	.	.	.	.	.
Homalothecium lutescens	2	.	+	+	.	.	.	+	.	.	.	.	.
Glechoma hederacea	.	.	.	.	.	.	.	+	.	+	.	.	.
Saxifraga rotundifolia	.	.	.	.	.	.	.	+	.	.	.	.	.
Potentilla rupestris	.	2	.	.	.	.	.	.	.	.	.	.	.
Galium sp.	.	+	.	.	.	.	.	+	.	.	.	.	.
Cardamine impatiens	.	.	.	.	.	.	.	.	+	.	.	.	.
Pseudevernia furfuracea	.	.	.	.	.	+	+	.	.	.	+	.	.
Evonymus verrucosus	+	2	.	.	.	.	.	+	2	.	.	.	.
Arabis sagittata	+	.	.	.	.	.	.	+	.	.	.	.	.
Lamium purpureum	.	.	.	.	.	.	.	1	1	.	.	.	.
Isothecium alopecuroides	.	.	.	.	.	.	.	.	.	+	.	+	.
Brassica rapa	.	.	.	.	.	.	.	.	+	.	.	.	.
Corylus avellana	+	1	.	.	.	.	.	.	.	.	.	.	.
Vaccinium myrtillus (sh)	.	.	+	.	.	.	.	.	.	.	.	.	.
Stachys sylvatica	.	.	.	.	.	.	+	+	.	+	+	.	.
Mnium stellare	.	.	.	.	.	.	.	+	.	.	.	.	.
Orthotrichum anomalum	.	.	.	.	.	.	+	.	.	.	.	+	.
Brachytheciastrum velutinum	2	.	+	+	.	+	.	.	.	+	.	.	.
Circaea luteciana	.	.	.	.	.	.	.	.	+	.	.	.	.
Rubus idaeus	.	+	.	.	.	.	.	.	.	.	.	.	.
Mentha spicata	+	.	.	.	.	.	.	.	.	.	.	.	.
Lapsana communis	+	.	+	.	.	.	.	+	.	.	+	.	.
Paris quadrifolia	.	.	.	.	.	.	.	+	+	.	.	.	.
Cystopteris fragilis	.	.	.	.	.	.	.	.	+	.	.	.	.
Urtica dioica	+	.	.	.	.	.	.	.	.	.	+	.	.
Rumex sanguineus	.	.	.	.	.	.	.	.	+	.	.	.	.
Monotropa hypopitys	.	.	+	.	.	.	.	+	.	.	.	.	.
Cotoneaster nebrodensis (sh)	.	+	.	.	.	.	.	.	.	.	.	.	.
Asarum europaeum	.	.	.	.	.	.	.	+	+	.	.	.	.
Polystichum setiferum	+	.	.	.	.	.	.	.	+	.	.	.	.
Lamium maculatum	.	.	.	.	.	.	.	.	1	.	.	.	.
Daphne laureola (sh)	.	.	.	.	.	.	.	.	.	+	.	.	.
Veronica montana	.	.	.	.	.	.	.	.	.	.	+	.	.
Crataegus monogyna	+	.	.	.	.	.	.	.	.	.	.	.	.

continued

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continuation of Annex III

Polystichum aculeatum	.	.	.	.	.	.	.	1	.	.	.	.	.
Galium aparine	+	.	.	.	.	.	.	.	.	.	.	.	.
Epipactis helleborine	.	.	.	.	.	.	.	+	.	.	.	.	.
Lepraria incana	.	.	.	.	.	.	+	.	.	.	.	.	.
Eurhynchium angustirete	.	.	.	.	.	.	.	+	.	.	.	.	.
Impatiens noli-tangere	.	.	.	.	.	.	.	.	.	.	+	.	.
Rubus caesius (sh)	.	.	+	.	.	.	.	.	.	+	+	.	.
Ballota nigra	.	.	.	.	.	.	.	.	.	.	.	+	.
Luzula luzuloides	.	.	.	.	.	.	.	+	.	.	.	.	.
Ostrya carpinifolia (juv)	.	+	.	.	.	.	.	.	.	.	.	.	.
Pterigynandrum filiforme	.	.	.	.	.	.	.	.	.	.	+	.	.
Cruciata glabra	.	+	.	.	.	.	.	.	.	.	.	.	.
Lamiastrum galeobdolon	+	.	.	.	.	.	.	.	.	.	.	.	.
Geranium robertianum	+	.	.	.	.	.	+	+	.	+	2	2	.
Dicranum scoparium	.	+	.	.	.	.	.	.	.	.	.	.	.
Pseudoleskea incurvata	.	.	.	+	.	+	.	.	.	.	.	.	.
Epipactis sp.	.	.	.	.	.	+	+	.	.	.	.	.	.
Dryopteris dilatata	.	.	.	.	.	.	.	.	2	+	+	.	.
Tortella tortuosa	.	+	.	+	.	+	.	.	.	.	.	.	.
Fragaria vesca	+	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera xylosteum	.	+	.	.	.	.	.	.	.	.	.	.	.
Hepatica nobilis	.	.	.	.	.	.	.	+	.	.	.	.	.
Cardamine pectinata	.	.	.	.	.	.	.	+	.	.	.	.	.
Acer pseudoplatanus	.	.	.	.	.	.	.	.	.	2	.	.	.
Lilium martagon	.	+	.	.	.	.	.	.	.	.	.	.	.
Symphytum tuberosum	.	.	.	.	.	.	.	.	.	.	+	+	.
Allium ursinum	.	.	.	.	.	.	.	.	.	2	.	.	.
Bryum moravicum	.	.	+	.	.	.	.	.	.	.	.	.	.
Syntrichia ruralis	+	.	.	.	.	.	.	.	.	.	.	.	.
Schistidium apocarpum	2	.	.	.	.	.	.	.	.	.	.	+	.
Galeopsis tetrahit	.	.	.	.	.	.	.	.	+	.	.	.	.
Pseudoleskeella nervosa	+	.	.	.	.	.	+	.	.	+	.	.	.
Stellaria nemorum	.	.	.	.	.	.	.	.	.	.	.	+	.

[1] Diagnostic species of cl. *Querco-Fagetea* , ord. *Fagetalia sylvaticae* , all. *Fagion sylvaticae* & *Cephalanthero-Fagion* ; [2] Diagnostic species of *Abies alba-Fagus sylvatica* community & all. *Fagion sylvaticae* ; [3] Diagnostic species of ass. *Asperulo odoratae-Fagetum sylvaticae* & all. *Fagion sylvaticae.* About woody species were used following abbreviations: tr - for tree layer, sh - for shrub layer and juv - for juvenile species.

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