

Flora and Vegetation of "Elenova gora" Natural Forest Reserve, Central Balkan Range (Bulgaria)

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Abstract. The study aims to investigate the flora, medicinal plants and vegetation diversity of "Elenova Gora" natural forest reserve, situated on the southern slopes of Central Balkan Range. The reserve occupies an area of 53.88 ha. The flora without mosses comprises of 132 vascular plant species, classified into 50 families and 108 genera. The most species-rich families are *Asteraceae*, *Lamiaceae*, *Poaceae*, *Ranunculaceae*, *Apiaceae*, *Aspidiaceae*, *Rubiaceae*, *Rosaceae*. Sixty five medical plants and 8 species of conservation concern were found (2 Balkan endemics, 3 species included in the Red List of Bulgarian vascular plants and in the Biodiversity Act and 3 species included in Appendix II of CITES). Eight relevés were collected during 2014 following the Braun-Blanquet approach. The vegetation diversity is represented by 3 classes (*Carpino-Fagetea sylvaticae*, *Mulgedio-Aconitetea* and *Thlaspietea rotundifolii*), 3 alliances (*Fagion sylvaticae*, *Petasition officinalis* and *Stipion calamagrostis*), 4 associations (*Asperulo odoratae-Fagetum sylvaticae*, *Festuco drymejae-Fagetum sylvaticae*, *Petasitetum hybrido-kablikiani*, *Parietietum officinalis*) and 1 plant community (*Abies alba-Fagus sylvatica*). On the territory of the reserve was established 1 habitat type (9130 *Asperulo-Fagetum* beech forests) protected by Directive 92/43/EEC and the Bulgarian Biodiversity Act. Although its small size "Elenova Gora" natural forest reserve harbors relict beech forests and related herbaceous riverside communities with significant plant diversity and conservation value for maintenance of the beech forests of Central Balkan mountain and of the country.

Key words: Central Balkan Range, beech forests, plant diversity, medicinal plants, vegetation diversity.

Introduction

"Elenova Gora" natural forest reserve occupies a small territory of only 53,88 ha and is located close to the eastern border of "Central Balkan" National park. It was established in 1961 (Order № 2200/30.08.1961 of General Department of Forestry at the Council of Ministers) to protect a rare natural formation of beech forests (*Fagus sylvatica* L.) with age between one and two hundred years.

The reserve's territory is a part of the Bulgarian NATURA 2000 network and falls into Central Balkan – buffer site (BG0001493). Various natural as well as semi-natural and anthropogenic phytocoenoses surround the reserve.

The flora on the territory of the reserve has not been studied before. Some indirect, outdated or too general data about the diversity of vascular plants and in particular

the group of medicinal plants in the region of the reserve are represented in the studies of Urumov (1929) and Bondev (1995). Also some general information about the floristic composition of the natural beech forests can be found in Radkov (1963), Garetkov (1967), Marinov et al. (1982, 1987), Bondev (1991) and Dimitrov (2015). The vegetation diversity in the reserve has been previously referred as part of the large-scale study of beech forests in Bulgaria by Tzonev et al. (2006).

The aim of this study was to investigate the floristical, medicinal plants' and the syntaxonomical diversity of "Elenova Gora" natural forest reserve and to assess their current condition.

Material and Methods

Study area

The study was conducted in "Elenova Gora" natural forest reserve, located near the village of Skobelevo (Pavel Banya municipality) and falling within the territory of Kalofer Mountain, which comprise the southern slopes of Central Balkan Range. It covers only 53.88 ha and is distributed between 845 and 1310 m a.s.l. (Fig. 1).

The northeast boundary of the reserve is limited by the valley of Gabrovnitsa River, a left tributary of Tundzha River and therefore northeast slopes prevail. The dominating slope inclination is 30-35°, but in some places it reaches 40-55°. The reserve is influenced by the mountain variant of the Temperate-Continental climate (Velev, 2002) with its typical summer maximum and winter minimum of precipitation (Stanev et al., 1991). The territory of the reserve is composed of Mesozoic rocks, represented by alternating sandstones, siltstones and marls with layers of clay limestone. The soils are dark and transitional Eutric Cambisols with varying mechanical composition from clay-sandy to medium sandy-clay (Zlatunova, 2017). The indigenous vegetation in the area consists of pure beech forests (Bondev et al., 1991).

Floristic composition sampling

The field studies were conducted in June-August 2014. The taxonomic identification and

nomenclature of vascular plants as well as biological types and life forms follow the key reference sources for Bulgaria (Assyov & Petrova, 2012; Delipavlov & Cheshmedzhiev, 2003; Jordanov, 1963-1979; Kozhuharov, 1992, 1995; Peev, 2012; Velčev, 1982, 1989). Floristic elements follow Assyov & Petrova (2012). The conservation status was determined according to IUCN, CITES, Biological Diversity Act (2002), Red List of Bulgarian vascular plants (Petrova & Vladimirov, 2009), the list of Balkan endemic species (Petrova & Vladimirov, 2010) and Red Data Book of Republic of Bulgaria (Peev (ed.), 2015). The list of medicinal plants is in accordance with Appendix 1 of Medicinal Plants Act (2000) and their special regimes of protection and regulated harvesting with Order №RD-203/02.03.2020 and Appendix 4 of Biological Diversity Act (2002).

Vegetation sampling

During the vegetation season 2014 a total of 8 relevés were collected following the Braun-Blanquet approach (Braun-Blanquet, 1965; Westhoff & van der Maarel, 1973). The sample plots were placed in the most homogenous parts of communities. The sample plots were square-shaped with size of 16 m² for grassy and 100 m² for woody vegetation (Chytrý & Otýpková, 2003). The total cover of vegetation and the abundance and cover of the species were estimated in percentages. Altitude, slope inclination and location were measured by Garmin eTrex Vista whereas the exposition was determined by a compass. Soil depth was classified as shallow (<10 cm depth), (2) moderately deep (10-20 cm) or deep (> 20 cm). All relevés were stored in TURBOVEG database (Hennekens & Schaminée, 2001) and included in the Balkan Vegetation Database (GIVD ID: EU-00-019) (Vassilev et al., 2016). The numerical classification was performed by PC-ORD (McCune & Mefford, 1999) and JUICE 7.0 (Tichý, 2002) software packages. Sørensen (Bray-Curtis) was used as distance measure and similarity was calculated by Ward's clustering method. The species values were square-root transformed.

Habitat types were determined according to Council Directive 92/43/EEC (EC, 1992), Annex

1 of the Biological Diversity Act (2002), Manual for Determination of Habitats with European Importance in Bulgaria (Kavrakova et al., 2009) and the Bulgarian Red Data Book, vol. 3 (Biserkov et al., 2015).

Results

Vascular flora

The flora of "Elenova Gora" natural forest reserve comprises of 50 families, 108 genera and 132 vascular plants, which account 31,4% of the family diversity in the country, 11,9% of the genera and 3,4% of the species. Most of the inventoried species are spermatophytes – 45 families (90%), 99 genera (91,7%) and 119 species (90,15%). On the territory of the reserve no representatives of *Lycopodiophyta* or *Equisetophyta* were found. The taxonomic structure of the flora is presented in Table 1. *Polypodiophyta* comprises 10% of the total number of families, 8,3% of the genera and 9,9% of the species in the reserve. *Pinophyta* is represented by the fewest taxa - 4% of all families, 1,9% of the genera and 1,5% of the species. *Magnoliophyta* dominates in taxonomic diversity with 86% of the families, 89,8% of the genera and 88,6% of the species, found in the reserve. The list of taxa is provided in Appendix 1.

Table 1. Taxonomic structure of the flora of "Elenova Gora" forest reserve.

Taxon	No of species	No of genera	No of families
<i>Polypodiophyta</i>	13	9	5
<i>Pinophyta</i>	2	2	2
<i>Magnoliophyta</i>	117	97	43
<i>Magnoliopsida</i>	96	80	36
<i>Liliopsida</i>	22	2	2
Total number	132	108	50

The families with the highest number of species are *Lamiaceae* and *Asteraceae*, including 11 species each (8,3%), *Poaceae* – 10 (7,6%), *Ranunculaceae* – 7 (5,3%), *Aspidiaceae* and *Rubiaceae* – 6 each (4,5%), *Rosaceae* – 5 (3,8%).

The life forms of the flora of "Elenova Gora" natural forest reserve is presented in Fig. 2. The significant participation of phanerophytes and geophytes in the life spectrum of the community shows some specific features of the studied beech forest community. The group of phanerophytes is represented mainly by deciduous species with the small exception of *Abies alba* and *Taxus baccata*, which are presented with single individuals. The group of geophytes includes rhizomatous, bulbous and tubero-bulbous herbaceous species, which take part in the community-specific early spring ephemeroïdal complex.

The phytogeographic composition of the flora of "Elenova Gora" natural forest reserve is presented in Table 3. The species with European, Euro-Asian, subBoreal and Boreal distribution constitute the typical core of the beech community in a floristic aspect. To this must be added the specific focus of sub-Mediterranean and Euro-Mediterranean species entering the north through the southern slopes of Stara Planina Mts.

Table 2. Floristic elements in the flora of "Elenova Gora" natural forest reserve.

Floristic element	No of species	Share (%)
Eur-As	23	17,4
Boreal	17	12,9
Eur	16	12,1
subMed	14	10,6
Eur-Med	14	10,6
subBoreal	13	9,8
Eur-Sib	10	7,6
Kos	5	3,8
Eur-subMed	5	3,8
Eur-OT	3	2,3
Med	3	2,3
Bal	2	1,5
Pann-Bal	2	1,5
Eur-NAm	1	0,8
Med-CAs	1	0,8
Bal-Anat	1	0,8
Pont-OT	1	0,8
subMed-CAs	1	0,8
Total number	132	100

Two Balkan endemics – *Crocus veluchensis* and *Angelica pancicii* were found (Petrova & Vladimirov, 2010). In the

Bulgarian Red List of vascular plants (Petrova & al., 2009) are included *Angelica pancicii* (VU), *Atropa bella-donna* (VU) and *Taxus baccata* (EN). In Appendix 3 of the Biological Diversity Act (2002) are enlisted *Angelica pancicii* and *Taxus baccata* as the second species is also included in the Bulgarian Red Data Book (Peev et al., 2015) and assigned as "endangered". Three orchids - *Cephalanthera damasonium*, *Dactylorhiza saccifera* and *Neottia nidus-avis* are in Append. III of CITES. There are no species included in the *Convention on the Conservation of European Wildlife and Natural Habitats* (EC, 1979) and the *Council Directive 92/43/EEC* (EC, 1992).

Medicinal plants

Of the recorded vascular plants, 65 species are considered medicinal (marked with asterisk (*) in Appendix 1), referring to 37 families and 58 genera. Their number equals

half (49,2 %) of the total list of plants in the reserve and 8.4% of the medicinal plants in the country. The families with biggest number of medicinal plants on the investigated territory are *Ranunculaceae* (7 species), *Lamiaceae* (6 species) and *Apiaceae* (4 species).

Eight medicinal species are protected by the Medicinal Plants Act - *Phyllitis scolopendrium*, *Asplenium trichomanes*, *Angelica pancicii*, *Asarum europaeum*, *Taxus baccata*, *Atropa bella-donna*, *Galium odoratum*. They are under special regime of protection and regulated harvesting according to order issued annually by the Minister of Environment and Water (Order №RD-83/03.02.2014, Order №RD-115/13.02.2015, Order №RD-77/09.02.2016, Order №RD-89/03.02.2017, Order №RD-56/01.02.2018, Order №RD-88/30.01.2019, Order №RD-203/02.03.2020).



Fig. 1. Map of the studied area of "Elenova Gora" natural forest reserve.

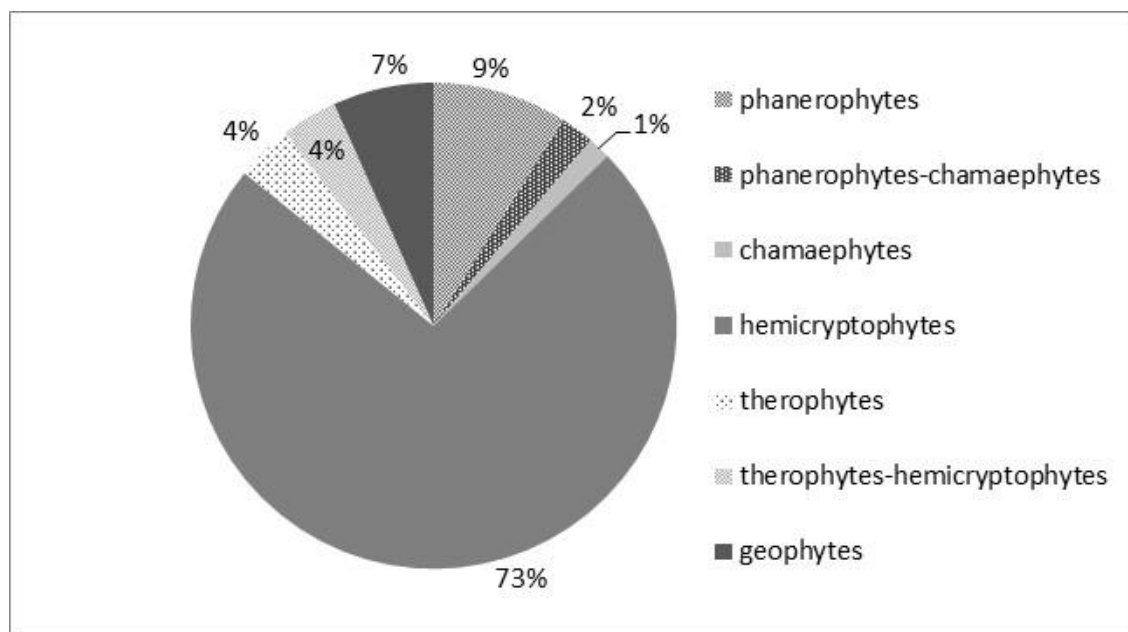


Fig. 2. Life form spectrum of the flora of the "Elenova Gora" natural forest reserve.

The first 7 are forbidden for commercial use throughout the country, while the species *Galium odoratum* is restricted for use only outside the territory of national parks. Five taxa are included in Annex 4 of the Biodiversity Act (*Dryopteris* sp. div., *Polystichum* sp. div., *Crocus* sp. div., *Polygonatum odoratum*, *Dactylorhiza* sp. div.) because of the vulnerability of their populations as a result of previously wider harvesting. The mentioned species are represented with single localities and low abundance of subpopulations on the territory of "Elenova Gora" natural forest reserve. According to the status of the protected area their collection, including for personal needs, is prohibited.

According to the degree of preference to specific habitats medicinal plants in the reserve can be divided into two main groups. The first group includes characteristic of mesophytic forest habitats widespread species with numerous populations, such as *Dryopteris filix-mas*, *Athyrium filix-femina*, *Polypodium vulgare*, *Acer platanoides*, *Sanicula europaea*, *Asarum europaeum*, *Pulmonaria officinalis*, *Cardamine bulbifera*, *Mercurialis perennis*, *Lamium maculatum*, *Oxalis acetosella*,

Anemone nemorosa, *A. ranunculoides*, *Geum urbanum*, *Galium odoratum*, *Polygonatum odoratum*, *Arum maculatum*, *Asplenium trichomanes*, *A. ruta-muraria*, *Saxifraga rotundifolia*, etc. The second group includes species with limited distribution in the reserve. Some of them are widespread in the country, but due to some features in their biology and ecology in most cases they form small populations, such as *Polystichum lonchitis*, *Phyllitis scolopendrium*, *Atropa belladonna*, etc. A special case is *Taxus baccata*, which is of limited distribution in the country and on the territory of the reserve there is only one individual in the southwestern part of the reserve. No significant natural resources of medicinal plants have been identified in "Elenova Gora" natural forest reserve. Populations of most medicinal species are represented by small groups (up to a dozen individuals) or small spots (up to several dozen individuals).

Vegetation

Based on numerical analysis, the syntaxonomical diversity of Elenova Gora reserve is represented by 3 classes, 3 orders, 3 alliances, 4 associations and 1 community.

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The syntaxonomical scheme proposed:	Cl. <i>Mulgedio-Aconitetea</i> Hadač et Klika in Klika et Hadač 1944
Cl. <i>Carpino-Fagetea sylvaticae</i> Jakucs ex Passarge 1968	Ord. <i>Petasito-Chaerophylletalia</i> Morariu 1967 All. <i>Petasion officinalis</i> Sillinger 1933 Ass. <i>Petasitetum hybridokablikiani</i> Sillinger 1933
Ord. <i>Fagetalia sylvaticae</i> Pawlowski 1928	Cl. <i>Thlaspietea rotundifolii</i> Br.-Bl. 1948
All. <i>Fagion sylvaticae</i> Luquet 1926	Ord. <i>Stipetalia calamagrostis</i> Oberd. et Seibert in Oberd. 1977
Ass. <i>Asperulo odoratae-Fagetum sylvaticae</i> Sougnez et Thill 1959	All. <i>Stipion calamagrostis</i> Jenny-Lips ex Br.-Bl. 1950
Ass. <i>Festuco drymejae-Fagetum sylvaticae</i> Reşmeriță 1977	Ass. <i>Parietarium officinalis</i> Csürös 1958
<i>Abies alba-Fagus sylvatica</i> plant community	

Table 3. Phytocoenological table of vegetation diversity on the territory of "Elenova Gora" reserve.

Ordinal number	1	2	4	3	8	6	5	7
Relevé No in Balkan Vegetation Database	13097	13098	13120	13119	13124	13122	13121	13123
Altitude (m)	788	891	1030	840	1089	1082	1056	1095
Exposition (degree)	-	360	360	270	360	360	270	360
Inclination (degree)	-	40	50	40	20	60	40	50
Plot size (m ²)	100	100	100	100	100	100	16	16
Total coverage (%)	90	90	90	90	95	90	95	90
Cover of tree layer (%)	80	90	90	90	95	85	0	0
Cover of shrub layer (%)	1	1	3	5	0	3	1	5
Cover of herb layer (%)	30	30	50	25	1	15	95	90
Cover of bryophytes (%)	20	20	10	70	0	15	50	0
Cover of lichens (%)	0	0	5	5	0	1	0	0
Maximum tree height (m)	30	25	35	30	25	30	0	0
Tree diameter (at 1.5 m height)	20	25	45	40	30	40	45	50
Latitude	42.73764	42.74303	42.73917	42.67225	42.74500	42.74194	42.74028	42.74278
Longitude	25.15594	25.14617	25.15055	25.37722	25.14639	25.57778	25.15917	25.15361
Diagnostic species of association <i>Asperulo odoratae-Fagetum sylvaticae</i>								
<i>Galium odoratum</i>	herb layer	10	15	5	.	.	.	1
<i>Cardamine bulbifera</i>	herb layer	2	0.1	1	.	.	.	.
<i>Viola reichenbachiana</i>	herb layer	0.1	.	.	.	.	.	.
<i>Mycelis muralis</i>	herb layer	0.5	.	2	.	.	.	.
<i>Fagus sylvatica</i>	tree layer	80	90	80	90	10	45	.
<i>Fagus sylvatica</i>	shrub layer	.	.	.	5	.	2	1
<i>Fagus sylvatica</i> (juvenile)	herb layer	0.1	0.1	.	.	.	.	.
Diagnostic species of association <i>Festuco drymejae-Fagetum sylvaticae</i>								
<i>Festuca drymeja</i>	herb layer	.	.	.	18	.	.	.
<i>Prenanthes purpurea</i>	herb layer	.	.	.	0.5	.	0.5	.
<i>Rubus hirtus</i>	shrub layer	0.5	0.1	1	0.5	.	.	.
Diagnostic species of <i>Abies alba-Fagus sylvatica</i> community								

<i>Abies alba</i>	tree layer	.	.	.	.	85	50	.	.
<i>Abies alba</i>	shrub layer	.	.	1	0.5	.	1	.	.
Diagnostic species of association <i>Petasitetum hybridi</i>									
<i>Petasites hybridus</i> ¹	herb layer	.	.	.	.	.	.	70	.
Diagnostic species of association <i>Parietarietum officinalis</i>									
<i>Parietaria officinalis</i> ²	herb layer	.	.	.	.	.	.	.	80
Diagnostic species of class <i>Carpino-Fagetea sylvaticae</i>									
<i>Dryopteris filix-mas</i>	herb layer	10	4	3	.	.	.	.	.
<i>Acer platanoides</i> (juvenile)	herb layer	0.1	.	.	.	.	.	.	.
<i>Acer pseudoplatanus</i>	shrub layer	.	.	.	.	.	1	.	.
<i>Sanicula europaea</i>	herb layer	1	.	.	.	.	.	.	.
<i>Arum maculatum</i>	herb layer	0.1	.	.	.	.	.	.	.
<i>Symphytum tuberosum</i>	herb layer	0.1	.	.	.	.	.	.	.
<i>Geranium robertianum</i>	herb layer	0.5	0.1	5	.	.	.	2	.
<i>Stachys sylvatica</i>	herb layer	0.1	.	.	.	.	.	.	5
<i>Neottia nidus-avis</i>	herb layer	0.1	.	.	.	.	.	.	.
<i>Oxalis acetosella</i>	herb layer	0.5	1	1	.	0.5	1	.	.
<i>Staphylea pinnata</i>	shrub layer	1	.	.	.	.	.	.	.
<i>Aremonia agrimonoides</i>	herb layer	0.1	.	.	.	.	.	.	.
<i>Mercurialis perennis</i>	herb layer	.	0.1	35	.	.	.	.	.
<i>Campanula rapunculoides</i>	herb layer	.	.	.	1	.	.	.	.
<i>Euonymus europaeus</i>	shrub layer	.	.	.	1	.	.	.	.
<i>Luzula luzuloides</i>	herb layer	.	.	.	3	.	2	.	.
<i>Brachypodium sylvaticum</i>	herb layer	.	.	.	1	.	.	.	.
<i>Poa nemoralis</i>	herb layer	.	.	.	0.5	.	.	.	.
<i>Galium rotundifolium</i>	herb layer	.	.	.	3	.	2	.	.
<i>Euphorbia amygdaloides</i>	herb layer	.	.	1	.	.	.	.	.
<i>Actaea spicata</i>	herb layer	.	.	1	.	.	.	.	.
<i>Polystichum setiferum</i>	herb layer	.	.	.	.	.	.	8	.
<i>Blechnum spicant</i>	herb layer	.	.	.	.	.	.	3	.
<i>Melica uniflora</i>	herb layer	.	.	.	.	.	0.5	.	.
<i>Stellaria nemorum</i>	herb layer	.	.	.	.	0.5	0.1	.	1
Diagnostic species of class <i>Robinietea</i>									
<i>Sambucus nigra</i>	shrub layer	.	.	1	.	.	.	.	.
Diagnostic species of class <i>Thlaspietea rotundifolii</i>									
<i>Epilobium lanceolatum</i>	herb layer	.	.	.	.	.	.	2	.
Diagnostic species of class <i>Mulgedio-Aconitetea</i>									
<i>Aegopodium podagraria</i>	herb layer	0.1	0.5	10	.
<i>Urtica dioica</i>	herb layer	10	5
<i>Senecio nemorensis</i>	herb layer	1	1	.

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<i>Chrysosplenium alternifolium</i>	herb layer	5	.
Diagnostic species of class <i>Epilobietea angustifolii</i>									
<i>Lapsana communis</i>	herb layer	2	0.1	.	.	.	.	0.5	.
<i>Glechoma hederacea</i>	herb layer	.	.	2	.	.	.	.	.
<i>Stachys alpina</i>	herb layer	.	.	2	.	.	.	.	.
<i>Tanacetum macrophyllum</i>	herb layer	.	.	.	.	.	.	2	5
<i>Atropa belladonna</i>	herb layer	.	.	.	.	.	.	1	.
<i>Galeopsis speciosa</i>	herb layer	.	.	.	.	.	.	.	3
Other species									
<i>Lamiastrum galeobdolon</i>	herb layer	0.5	.	.	.	.	.	.	.
<i>Polygonatum officinalis</i>	herb layer	0.5	.	.	.	.	.	.	.
<i>Carex remota</i>	herb layer	.	.	.	1	.	.	.	.
<i>Geranium macrorrhizum</i>	herb layer	.	.	.	1	.	0.5	.	.
<i>Orthilia secunda</i>	herb layer	.	.	.	0.5	.	.	.	.
<i>Hieracium racemosum</i> gr.	herb layer	.	.	.	1	.	0.5	.	.
<i>Brachythecium velutinum</i>	moss layer	.	.	.	10	.	.	.	.
<i>Dicranum scoparium</i>	moss layer	.	.	.	10	.	.	.	.
<i>Hylocomium splendens</i>	moss layer	.	.	.	40	.	.	.	.
<i>Neckera crispa</i>	moss layer	.	.	.	5	.	.	.	.
<i>Tortella tortuosa</i>	moss layer	.	.	.	5	.	.	.	.
<i>Lamium purpureum</i>	herb layer	.	.	2	.	.	.	.	.
<i>Fraxinus excelsior</i>	tree layer	.	.	15	.	.	.	.	.
<i>Fraxinus excelsior</i>	shrub layer	.	.	2	.	.	.	.	.
<i>Hypnum cupressiforme</i>	moss layer	.	.	5	.	.	.	.	.
<i>Pterigynandrum filiforme</i>	moss layer	.	.	2	.	.	.	.	.
<i>Brachytheciastrum velutinum</i>	moss layer	.	.	3	.	.	.	.	.
<i>Salvia glutinosa</i>	herb layer	.	.	.	.	.	.	5	.
<i>Circaea lutetiana</i>	herb layer	.	.	.	.	.	.	1	.
<i>Galium aparine</i>	herb layer	.	.	.	.	.	.	2	.
<i>Solanum dulcamara</i>	herb layer	.	.	.	.	.	.	.	.
<i>Calamagrostis arundinacea</i>	herb layer	.	.	.	.	.	10	.	.
<i>Polypodium vulgare</i>	herb layer	0.5	.	.	1	.	.	.	.

¹species also diagnostic for al. *Petasition officinalis*, ord. *Petasito-Chaerophylletalia* and cl. *Mulgedio-Aconitetea*; ²species also diagnostic for al. *Stipion calamagrostis*, ord. *Stipetalia calamagrostis* and cl. *Thlaspietea rotundifolii*.

Association *Asperulo odoratae-Fagetum sylvaticae* (Table 3, rel. 1-3).

Vegetation description: Its communities have closed horizontal structure with total cover 95-100%. Dominant species is *Fagus sylvatica*. There are 4 well-developed layers – tree layer (cover 90-95%), shrub layer (cover

1-5%), herb layer (cover 25-30%) and moss layer (10-20%). Other species with higher cover and abundance, e.g. more than 10% are *Galium odoratum*, *Dryopteris filix-mas*, *Mercurialis perennis* and *Fraxinus excelsior*.

Ecology and distribution: This plant community type occurred on flat to

moderately steep terrains with inclination up to 50° and northern exposition. Soils are moderately deep and bedrock is sediment. It is widest distributed vegetation type on the territory of reserve.

Syntaxonomy: This association is widespread on the territory of Bulgaria (Tzonev et al., 2006, Pedashenko et al., 2015, Vassilev et al., 2016). Species composition and vegetation structure of its communities on the territory of the reserve are similar to other phytocoenoses in the country.

Habitat types: According to EUNIS habitat classification are classified to G1.693 Balkan Range beech forests, whereas following Directive 92/43/EEC it is classified to 9130 *Asperulo-Fagetum* beech forests.

Association *Festuco drymejae-Fagetum sylvaticae* (Table 3, rel. 4)

Vegetation description: This association has closed horizontal structure and total cover of vegetation is 90%. It is characterized by poor species composition. Dominant species is *Fagus sylvatica* and subdominant species are *Festuca drymeja* and *Hylocomnium splendens*. Shrub layer is formed by young trees of *Fagus sylvatica* as well as *Euonymus europaeus*, *Rubus hirtus* and *Abies alba*. Herb layer has cover 25-30%. Moss layer is well-developed (about 70%) and is formed by *Hylocomnium splendens*, *Dicranium scoparium*, *Brachythecium velutinum*, *Neckera crispa*, *Tortella tortuosa*.

Ecology and distribution: This plant community type has limited distribution on the territory of reserve and occurred on moderately steep terrains with inclination up to 40° and north-western exposition. Soils are moderately deep and bedrock is sediment.

Syntaxonomy: Floristically and ecologically similar stands were studied from the territory of Osogovska Mts., Stara Planina Mts., Rui Mt., Rhodopi Mts., Sredna Gora Mt., Mikrenski Hills, Mt. (Tzonev et al. 2006).

Habitat types: According to EUNIS habitat classification are classified to G1.693

Balkan Range beech forests, whereas following Directive 92/43/EEC it is classified to 9130 *Asperulo-Fagetum* beech forests.

Abies alba-Fagus sylvatica community (Table 3, rel. 5-6)

Vegetation description: Species poor community with closed horizontal structure dominated by *Abies alba* and subdominant is *Fagus sylvatica*. Total vegetation cover is 90-95%. There are 4 layers – tree layer (90-95%), shrub layer (3-5%), herb layer (2-15%) and moss layer (up to 15%).

Ecology and distribution: On the territory of the reserve it is found on moderately steep to steep terrains with inclination up to 60° and northern exposition. Soils are shallow to moderately deep. Bedrock type is sediment.

Syntaxonomy: Floristically and ecologically similar stands were studied from the territory Stara Planina Mts., Western Rhodopi Mts., Rila Mts., Vitosha Mt., Rui Mt. and Belassitsa Mt (Tzonev et al., 2006).

Habitat types: According to EUNIS habitat classification are classified to G1.693 Balkan Range beech forests, whereas following Directive 92/43/EEC it is classified to 9130 *Asperulo-Fagetum* beech forests.

Association *Petasitetum hybridokablikiani* (Table 3, rel. 7)

Vegetation description: This community includes dense stands of *Petasites hybridus*, which is a dominant species with cover 90-95%. In vertical structure of phytocoenosis there are formed 2 layers – herb layer (90-95%) and moss layer (50%). Other species with higher cover and abundance are *Aegopodium podagraria* and *Urtica dioica*. Litter is weakly accumulated.

Ecology and distribution: It has very limited distribution on the territory of reserve, along tributaries of Gabrovnitsa river. This community covers an area of about 100 m². Soils are wet and rich of gravel and sediments. The stand is found on

moderately steep terrain with inclination about 20° and western exposition. Bedrock type is sediment.

Syntaxonomy: This is a new association for the territory of the country. Generally, in Bulgaria, the *Petasites hybridus* phytocoenoses were poorly studied. Pedashenko et al. (2015) report association *Petasito hybridi-Platanetum orientalis* Kárpáti et Kárpáti 1961 from Kongura reserve, Mt. Belasitsa, where *Petasites hybridus* is a dominant species in the herb layer. The diversity and syntaxonomy of plant communities dominated by *Petasites* sp. have been investigated in regional context on the territory of Bulgaria and Romania from Nazarov et al. (2021, in press). They were classified to 3 associations - *Petasitetum albae* Dihoru ex Nazarov et al. 2021, *Petasitetum hybrido-kablikiani* Sillinger 1933 and *Telekio-Petasitetum hybridi* Morariu ex Resmeriță et Rațiu 1974.

Habitat types: According to EUNIS habitat classification are classified to E5.5722 Moesian butterbur tall herb communities.

Association *Parietarium officinalis* (Table 3, rel. 8)

Vegetation description: Very species-poor community with closed horizontal structure and dominated by *Parietaria officinalis*. Total vegetation cover is 90-95%. Other species found in the species composition are *Stachys sylvatica*, *Urtica dioica*, *Tanacetum macrophyllum*.

Ecology and distribution: It has limited distribution on the territory of reserve on steep slopes with northern exposition above Gabrovnitsa river and covering an area about 80-120 m². Soils are moderately deep to shallow, skeletal and rocky.

Syntaxonomy: This is a new association for the territory of the country. *Parietaria officinalis* is well-known as a dominant or subdominant species in stands of *Platanus orientalis* and *Alnus glutinosa* woodlands and rarer in wetter *Fagus* forests in the country. It is also reported from Romania (Sanda et al., 2008).

Habitat types: According to EUNIS habitat classification are classified to H2.6G

Eastern Carpathian calcareous thermophilous screes.

Discussion

The floristic composition and phytocoenotic structure of the beech forests, protected in "Elenova Gora" natural forest reserve are typical for the area of Central Balkan Range. The natural reserve of "Byala Krava", situated alongside the eastern border of Central Balkan Range mountain has similar characteristics. Sediment rocks and brown forest soils between 699 and 1071 m a.s.l., steep northern expositions and a boundary river are some of the similar features. "Byala Krava" reserve (93.4 ha) is almost two times bigger than "Elenova Gora" reserve and it is floristically richer, e.g. number of species (250), genera (171) and families are higher respectively with 89%, 58% and 16% (*Management plan of "Byala Krava" natural forest reserve*, 2014). Three beech forest associations are also found in "Byala Krava" reserve: *Asperulo-Fagetum sylvoaticae* Sougnez et Thill 1959, *Festuco drymejae-Fagetum sylvoaticae* and *Umbilico erecti-Fagetum sylvoaticae* Tzonev et al. 2006. The last one is also presented by two subassociations - *typicum* Tzonev et al. 2006 and *laurocerasetosum officinalis* Tzonev et al. 2006. The subassociation with the Euxine species *Laurocerasus officinalis* has refugial origin. The presence of the subAtlantic-subMediterranean species of *Taxus baccata* in "Elenova Gora" reserve, in a combination with high humidity and other ecological characteristics of the particular beech community bring it closer to the relict forests in "Byala Krava" reserve. Other common for both reserves Tertiary relict species are *Carpinus betulus*, *Acer campestre*, *A. pseudoplatanus*, *Hedera helix*, *Fraxinus excelsior*, *Asarum europaeum*, *Corylus avellana*, *Lamiastrum galeobdolon*, *Clematis vitalba*, *Isopyrum thalictroides*, *Sanicula europaea*, *Staphylea pinnata*, *Acer heldreichii*, *Daphne mezereum* and *Ruscus hypoglossum*. The presence of medicinal plants and their

characteristics is almost the same within the two reserves with a prevalence in their numbers in "Byala Krava" reserve.

The associations of *Petasitetum hybridokablikiani* and *Parietarium officinalis* are represented in "Elenova Gora" natural forest reserve. The investigation of the phytocoenoses of *Parietarium officinalis* association adds a new data about syntaxonomy and ecology of *Thlaspietea rotundifolii* class in Bulgaria. Up to now the class *Thlaspietea rotundifolii* is represented by 3 orders, 3 alliances, 5 associations and 1 community in the vegetation of the country (Tzonev et al., 2009) and its syntaxonomical diversity is studied only on the territory of Rila Mts. and Pirin Mts. There is a scientific strive for a continuous research of the syntaxonomical diversity of this class on the territory of Bulgaria in order to reveal the present syntaxa diversity. The association in the reserve has a similar composition and structure with the phytocoenoses of the association in Romania, studied by Sanda et al. (2008).

Conclusions

The beech forests in "Elenova Gora" reserve is a part of a refugium hot spot during the last Ice Age and nowadays it protects a specific floristic relict complex from the Tertiary Period. The floristic diversity is represented by 132 vascular plant species, referred to 50 families and 108 genera. Woody vegetation is represented by two associations: *Asperulo odoratae-Fagetum sylvaticae*, *Festuco drymejae-Fagetum sylvaticae* and 1 vegetation community (*Abies alba-Fagus sylvatica*). There is a limited area covered by the riverine hygrophilous vegetation of *Petasitetum hybridokablikiani* association. One order (*Stipetalia calamagrostis*), one alliance (*Stipion calamagrostis*) and one association (*Parietarium officinalis*) were found for the first time for the vegetation diversity in Bulgaria.

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Appendix 1. List of recorded taxa in „Elenova Gora” natural forest reserve. Medicinal plants (Appendix 1 of Medicinal Plants Act 2000) are marked by asterisk (*).

Polypodiophyta

Polypodiopsida

Aspidiaceae: *Dryopteris carthusiana* (Vill.) H. P. Fuchs, **Dryopteris filix-mas* (L.) Schott, *Gymnocarpium dryopteris* (L.) Newman, **Polystichum aculeatum* (L.) Roth, *P. lonchitis* (L.) Roth, *P. setiferum* (Forsk.) Moore; ***Aspleniaceae***: **Asplenium ruta-muraria* L., **A. trichomanes* L., **Phyllitis scolopendrium* (L.) Newman; ***Athyriaceae***: **Athyrium filix-femina* (L.) Roth, *Cystopteris fragilis* (L.) Bernh.; ***Blechnaceae***: *Blechnum spicant* (L.) Roth; ***Polypodiaceae***: **Polypodium vulgare* L.

Pinophyta

Pinopsida

Pinaceae: **Abies alba* Miller; ***Taxaceae***: **Taxus baccata* L.

Magnoliophyta

Magnoliopsida

Aceraceae: *Acer campestre* L., **A. platanoides* L., *A. pseudoplatanus* L.; ***Apiaceae***: *Aegopodium podagraria* L., **Angelica panicii* Vandas, **A. sylvestris* L., **Heracleum sibiricum* L., *Physospermum cornubiense* (L.) DC., **Sanicula europaea* L.; ***Araceae***: **Arum maculatum* L.; ***Araliaceae***: **Hedera helix* L.; ***Aristolochiaceae***: **Asarum europaeum* L.; ***Asteraceae***: *Achillea crithmifolia* Waldst. & Kit., *Hieracium gentile* Boreau, *H. racemosum* gr., *H. sabaudum* L., *Lapsana communis* L., *Mycelis muralis* (L.) Dumort., **Petasites hybridus* (L.) Gaertn., *Prenanthes purpurea* L., *Senecio nemorensis* L., *Tanacetum macrophyllum* (Waldst. et Kit.) Schultz-Bip., *T. parthenium* (L.) Schultz-Bip.; ***Balsaminaceae***: *Impatiens noli-tangere* L.; ***Betulaceae***: **Betula pendula* Roth, **Carpinus betulus* L., **Corylus avellana* L., ***Boraginaceae***: *Mycosotis sylvatica* Hoffm., **Pulmonaria officinalis* L., *Symphytum ottomanum* Friv., *S. tuberosum* L. ssp. *noctuum* (Schur) Soo; ***Brassicaceae***: **Alliaria petiolata* (M. Bieb.) Cavara & Grande, **Cardamine bulbifera* (L.) Crantz, *C. impatiens* L., *Arabis procurrens* Waldst. & Kit.; ***Campanulaceae***: *Campanula rapunculoides* L.; ***Caprifoliaceae***: **Sambucus nigra* L.; ***Caryophyllaceae***: *Moehringia trinervia* (L.) Clairv., *Stellaria alsine* Grimm, *S. nemorum* L.; ***Celastraceae***: **Euonymus europaeus* L.; ***Cornaceae***: **Cornus mas* L.; ***Euphorbiaceae***: **Euphorbia amygdaloides* L., **Mercurialis perennis* L.; ***Fagaceae***: **Fagus sylvatica* L.; ***Geraniaceae***: **Geranium macrorrhizum* L., **G. robertianum* L.; ***Lamiaceae***: *Ajuga reptans* L., *Calamintha grandiflora* (L.) Moench, **Galeopsis speciosa* Mill., **Glechoma hederacea* L., **Gl. hirsuta* Waldst. & Kit., *Lamiastrum galeobdolon* (L.) Ehrend. et Polatschek, *Lamium garganicum* L., **L. maculatum* (L.) L., **L. purpureum* L., *Salvia glutinosa* L., **Stachys sylvatica* L.; ***Oleaceae***: **Fraxinus excelsior* L.; ***Onagraceae***: *Circaea lutetiana* L., *Epilobium lanceolatum* Sebast. et Mauri, *E. montanum* L.; ***Oxalidaceae***: **Oxalis acetosella* L.; ***Papaveraceae***: **Chelidonium majus* L.; ***Parnassiaceae***: **Parnassia palustris* L.; ***Primulaceae***: **Lysimachia nummularia* L.; ***Pyrolaceae***: *Orthilia secunda* (L.) House; ***Ranunculaceae***: **Actaea spicata* L., **Anemone nemorosa* L., **A. ranunculoides* L., **Clematis vitalba* L., **Helleborus odorus* Waldst. & Kit., **Isopyrum thalictroides* L., **Ranunculus ficaria* L.; ***Rosaceae***: *Arenaria agrimonoides* (L.) DC., **Geum urbanum* L., **Fragaria vesca* L., *Rubus hirtus* Waldst. et Kit., **Sorbus aucuparia* L.; ***Rubiaceae***: *Cruciata glabra* (L.) Ehrend., **Galium aparine* L., **G. odoratum* (L.) Scop., *G. pseudoaristatum* Schur, *G. rotundifolium* L., *G. schultesii* Vest.; ***Saxifragaceae***: **Chrysosplenium alternifolium* L., **Saxifraga rotundifolia* L.; ***Scrophulariaceae***: **Veronica officinalis* L.; ***Solanaceae***: **Atropa bella-donna* L., **Solanum dulcamara* L.; ***Staphyleaceae***: *Staphylea pinnata* L.; ***Ulmaceae***: **Ulmus glabra* Huds.; ***Urticaceae***: **Parietaria officinalis* L., **Urtica dioica* L.; ***Violaceae***: *Viola reichenbachiana* Boreau, *V. riviniana* Rchb.

Liliopsida

Cyperaceae: *Carex echinata* Murr., *C. remota* L., *C. sylvatica* Huds.; ***Iridaceae***: *Crocus veluchensis* Herbert; ***Juncaceae***: *Luzula luzuloides* (Lam.) Dandy, *L. sylvatica* (Hudson) Gaudin; ***Liliaceae***: *Polygonatum latifolium* (Jacq.) Desf., **P. odoratum* (Mill.) Druce; ***Orchidaceae***: *Cephalanthera damasonium* (Mill.) Druce, *Dactylorhiza saccifera* (Brongn.) Sóo, *Neottia nidus-avis* (L.) Rich.; ***Poaceae***: **Anthoxanthum odoratum* L., *Brachypodium sylvaticum* (Huds.) P. Beauv., *Calamagrostis arundinacea* (L.) Roth, *Dactylis glomerata* L., *Festuca drymeja* Mert & Koch, *F. gigantea* (L.) Vill., *Hordelymus europaeus* (L.) Harz, *Melica uniflora* Retz., *Milium effusum* L., *Poa nemoralis* L.