

MEDICINAL PLANTS ON THE TERRITORY OF LOZENSKA MOUNTAIN

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Abstract: The current study is a floristic investigation of the medicinal plants on the territory of the Lozenska Mt. (80 km²) conducted in the period 2003-2017. As a result 326 species and 11 subspecies belonging to 235 genera and 75 families were identified or 44.1% of the taxa included in the Bulgarian Medicinal Plants Act. The families with the richest number of medicinal species were *Lamiaceae* (39), *Asteraceae* (34), *Fabaceae* (22) and *Rosaceae* (19). The genera with the highest number of species were *Veronica* (6), *Geranium* (5), *Mentha* and *Orchis* (5). Most of the medicinal plants were located in the Southwestern part of the mountain (73.6%) and the least of them are in the Northeastern part (49.2%). Five species fall under restrictive collection regime and for 12 the collection is forbidden. Seventeen of the medicinal plants were species with conservation status, 2 of which are included in the Red Data Book of the Republic of Bulgaria (1984), 4 are in the lists of IUCN and Bulgarian Red List of Vascular Plants, and 9 are in the Biological Diversity Act (BDA). A map with the distribution of the species of conservation significance on the territory of the mountain was prepared.

INTRODUCTION

A significant part of the plants growing in Bulgaria are species used for centuries as medicinal. According to the Bulgarian Medicinal Plants Act (2000) their number is 766. These plants are valuable bio resources and their ethnobotanical, social and economic importance was identified and discussed in a number of national documents (Gussev, 2005). They represent a traditional export product and are well placed on the international markets (Evstatieva et al. 2007). A large amount of medicinal plants are collected by people in the country for their own purposes or for export. Every year more than 10000 tons of botanical drugs are collected, purchased, and processed in Bulgaria. Around 60–70 % of the plant material is exported, while the rest 30–40 % remain in the country for

the production of phytopharmaceuticals, herbal teas, and spices. Nearly 20% of the wild botanical drug species collected in Bulgaria are weeds or occur in rural habitats and are not threatened by collection (Hardalova, 1997). Bulgaria has a comprehensive policy on harvesting, conservation and use of the medicinal plants but still little is known about their distribution and population status in different floristic regions of the country.

Lozenska Mt. is the westernmost extension of the Ichtiman Sredna Gora Mt. with an approximate length of 18 km and area of 80 km². The interest in flora and vegetation of the mountain dates back to the 19th century. More profound studies on the vegetation in the mountain were presented by Toshev (1902), Urumov (1908) and Penev (1939). The first complete study on vegetation was presented by Ganchev (1961) who classified plant communities and describe new associations. Later on, fragmentary studies on the vegetation in different parts of the mountain were conducted by Bondev and Nikolov (1979), Gateva (1989), Dimitrov and Glogov (2003) and Pedashenko et al. (2009).

In the context of his investigation Ganchev (1961) characterized her flora as “species rich and represented by different geographical elements” and published localities for different medicinal plants. Studies on the flora of the mountain were reformed in specific habitats like mine areas, calcareous terrains, wetlands, etc. (Bondev and Lubenova, 1984; Vassileva and Kitin, 1995; Hájek et al., 2005; Pedashenko, 2006, 2007; Petrova and Vassilev, 2007). Most of the floristical studies were mainly related to the new chorological information provided by Assyov and Vassilev, (2004), Denchev et al., 1997; Dimitrov, 2002; Dimitrov and Vutov 2004; Yankova and Cherneva, 2007; Sidjimova, 2008, etc. Some of these publications are related to the distribution of the medicinal plants and the status of their populations. The publication of Vitkova and Gyurova (2001, 2002) focused on the distribution and evaluation of the resources of medicinal plants in Lozenska Mt. The state and capacity of population recovery was determined by the area occupied by them, their spatial and age structure as well.

The management of conservation activities and sustainable use of medicinal plants requires detailed information on the localities and state of their populations. The current study is part of a larger investigation on the flora of Lozenska Mt. conducted in the period 2003-2017. Part of the mountain (1294.42 ha) is included in NATURA 2000 which imposes specific regimes of use including the medicinal plants policy.

The aims of this study were: 1) to inventory medicinal plants and their distribution in different parts of Lozenska Mt.; 2) to map the medicinal plants with conservation status, and 3) to recommend measures for their protection.

MATERIAL AND METHODS

Lozenska Mt. is part of the Sredna Gora floristic region. The mountain falls into the Transitional Climate Zone which is characterized by relatively mild winters, low annual temperature amplitudes, and two maxima of annual rainfall (Velev, 1997). The predominant soil types are Hromic Luvisols (in the area of xerothermic oaks) and Distric-Eutric Cambisols (in the area of beech forests) (Ninov, 1997).

The transect method was applied for the field work in order to cover the maximum area and different ecological niches. The surveyed territory and its two geographic regions - Northwest and Southeast (Danov, 1964) were divided into 4 subregions (parts) - Northwest (Part I), Northeast (Part II), Southwest (Part III), and Southeast (Part IV) and 19 transects in view of possible comparisons (Figure 1).

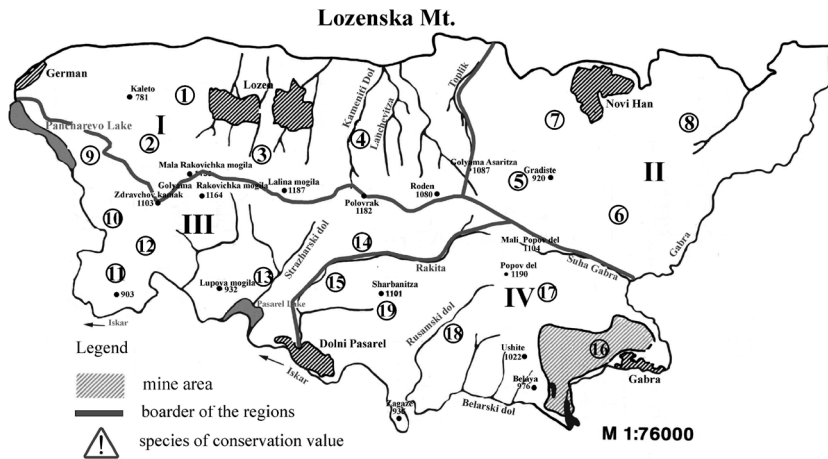


Fig. 1. Map of Lozenska Mt. with regions and transects

Nortwestern region (Part I): It covers the area of the villages of German, Gorni and Dolni Lozen, the northern slopes of the main ridge with predominantly *Fagus sylvatica* L., *Quercus dalechampii* Ten. and *Carpinus betulus* L. forests. Four transects were included in this part.

Northeastern region (Part II): It covers the territory around the village of Novi Han, between the rivers of Tarnava and Gabra, with forests of *Quercus cerris* L., *Q. dalechampii* and *Q. frainetto* Ten. and meadows along the rivers. Four transects were included in this part also.

Southwestern region (Part III): It covers the area around villages Pancharevo, Kokalyane and Dolni Pasarel. It covers the southern parts of the main ridge with meadows and oak forests and the slopes of peaks Darvodeletsa, Visokata Ela, Urvich above Iskar River covered by *Fagus sylvatica*, *Quercus dalechampii*, *Tilia tomentosa* Moench forests. This territory includes 6 transects.

Southeastern region (Part IV): It covers the area around village Gabra Chukurovo mine, Popov Del and Sharbanica peaks, dominated by forests of *Quercus dalechampii*, *Q. cerris*, *Q. frainetto* and wet meadows along the Rakitana, Rusanski and Belarski Dol Rivers. The territory includes 5 transects.

The taxonomical nomenclature of the plants follows Delipavlov and Cheshmedzhiev (2003). The life forms were defined according to Pavlov (2006)

and the determination of the floristic elements is after Asyov and Petrova (2012). The conservation status of the species was established on the basis of national and European documents. The information of the species belonging to certain ecological groups of plants were based on previous publications and studies (Pavlov, 1998; Tzonev, 2002; Koev et al., 2015). The species under a prohibitive and restrictive collection regime were defined by Order of the Minister of Environment and Water № RD-89/03.02.2017. For the majority of the species the determination of the medicinal properties followed Bondev (1995), Nikolov (2006), and Zahariev et al. (2015).

The localities of the medicinal plants with conservation value found in the study area were shown on a map of Lozenska Mt. (M 1: 76000). Voucher specimens for same species are deposited in the Herbarium of Sofia University (SO).

RESULTS AND DISCUSSION

326 species and 11 subspecies belonging to 235 genera and 75 families, or 42.6% of the taxa included in the Bulgarian Medicinal Plants Act (2000) were identified as a result of the study. The taxonomical structure of the medicinal flora is presented in Table 1. The established medicinal plants are representatives of *Equisetophyta* (0.6%), *Polypodiophyta* (2.4%), *Pinophyta* (0.9%) and *Magnoliophyta* (96.1%). The *Magnoliopsida* species (92.4%) dominated over the *Liliopsida* species (7.6%).

Table 1. Taxonomical structure of the medicinal plants found on the territory of Lozenska Mt.

Regions	Rang	Equisetophyta number/%	Polypodiophyta number/%	Pinophyta number/%	Magnoliophyta		Total number
					Magnoliopsida number/%	Liliopsida number/%	
Part I	family	1(2%)	4(7.8%)	2(3.9%)	39(76.5%)	5(9.8%)	51
	genus	1(0.6%)	4(2%)	3(1.7%)	149(86.6%)	15(8.7%)	172
	species	1(0.4%)	6(2.6%)	3(1.3%)	206(88.4%)	17(7.3%)	233
Part II	family		1(2.9%)	1(2.9%)	30(85.7%)	3(8.6%)	35
	genus		1(0.8%)	1(0.8%)	120(95.2%)	4(3.2%)	126
	species		1(0.6%)	1(0.6%)	158(95.8%)	5(3%)	165
Part III	family	1(1.8%)	3(5.4%)	1(1.8%)	46(82.1%)	5(8.9%)	56
	genus	1(0.5%)	6(3.3%)	1(0.5%)	163(88.6%)	13(7.1%)	184
	species	1(0.4%)	6(3.3%)	1(0.4%)	220(90.5%)	15(6.2%)	243
Part IV	family	1(2.5%)	2(5%)	1(2.5%)	33(82.5%)	3(7.5%)	40
	genus	1(0.6%)	2(1.3%)	1(0.6%)	145(93.5%)	6(3.9%)	155
	species	2(1%)	2(1%)	1(0.5%)	194(92.8%)	10(4.8%)	209
Whole territory	family	1(1.3%)	4(1%)	2(2.7%)	60(80%)	8(10.7%)	75
	genus	1(0.4%)	6(2.6%)	3(1.3%)	205(88.4%)	17(7.3%)	232
	species	2(0.6%)	8(2.4%)	3(0.9%)	290(88.7%)	24(7.3%)	327

The families and the genera with the highest number of species were *Lamiaceae* (39), *Asteraceae* (34), *Fabaceae* (22), and *Rosaceae* (19), *Veronica* (6), *Geranium* (5), *Mentha* (5), and *Orchis* (5). Our results are comparable to the data provided by Vitkova, Gyurova (2002) for Lozenska Mt., Sidjimova (2015) for Vitosha Mt., and Gushev (2005) for the whole country (Figure 2).

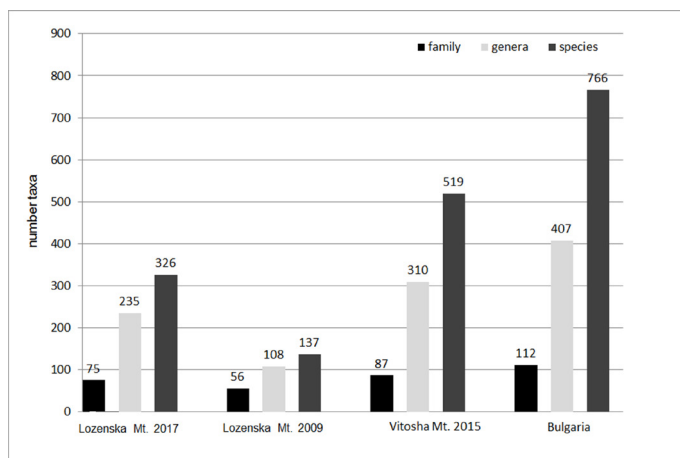


Fig. 2. A comparison of the taxonomical structure of medicinal plants found in Lozenska Mt., Vitosha Mt. and the territory of Bulgaria

The number of medicinal plants found in the four regions of the mountain was different in relation to the specific ecological conditions and the influence of the anthropogenic activities in the mountain. The influence of these factors needs to be taken into consideration when the plants are collected. The highest number was established in Part III - 240 species (73.6%) and Part I - 236 species (72.4%). The number of medicinal plants in Part IV and Part II was considerably smaller, 199 species (61.3%) and 160 species (49.2%), respectively. The medicinal plants constituted 36.8% of all species in the mountain and about 40% of them were anthropophytes such as *Sambucus ebulus* L., *Capsella bursa-pastoris* (L.) Medik., *Achillea millefolium* L., *Cirsium canuum* (L.) All., etc. Most of the medicinal plants in the study area are widespread in the country. Such species were *Eryngium campestre* L., *Xeranthemum annuum* L., *Acinos arvensis* (Lam.) Dandy, *Teucrium chamaedrys* L., *Potentilla argentea* L., *Prunus spinosa* L., etc. The species common to three of the mountain parts were 9% and in two of them - 3.4%.

In Part I the medicinal plants inhabit predominantly grasslands of carbonate terrains (*Thymus comptus* Friv., *Anacamptis pyramidalis* (L.) Rich., *Orchis purpurea* Huds., *Hieracium pilosella* L., etc.). The geophytes and sciophytes are usually associated with the autochthonous beech formations which have limited distribution only in Part I (*Vaccinium myrtillus* L., *Asarum europaeum* L., *Oxalis*

acetosella L., *Anemone nemorosa* L., etc.). The number of medicinal plants found in this part of the mountain only is 30. The lowest share of medicinal species (2.8%) was found in Part II. Most of these plants are light-loving mesophyllous species found in ruderal grasslands in the place of abandoned fields (*Lolium temulentum* L., *Alcea pallida* Waldst & Kit., *Agrostemma githago* L., etc.). The medicinal plants found in this part of the mountain only were 10 species (*Pimpinella saxifraga* L., *Atropa bella-donna* L., *Succisa pratensis* Moench, *Achillea nobilis* L., etc.).

In Part III the highest presence (12.1%) of medicinal plants was established. In contrast to Part I, more species were found in shrub communities on limestone terrains (part of the Habitat 40A0 Subcontinental Peripanonic Shrub communities) such as *Syringa vulgaris* L., *Cotinus coggygia* Scop., *Xeranthemum annuum* L., *Thymus pannonicus* All., *Thymus striatus* Vahl., *Achillea clypeolata* Sm., etc.. Some of the species that are characteristic for this part of the mountain are found along the Iskar River (*Petasites hybridus* (L.) Gaertn., B. Mey. & Schreb., *Telekia speciosa* (Schreb.) Baumg., etc. For this part of the mountain populations of *Galanthus elwesii* Hook. by Sidjimova (2008) were previously reported. This threatened plant included in Red Data Book of Bulgaria (1984; 2015) was not found during this study and future work is needed to confirm the distribution of this valuable medicinal plant on the territory of the mountain.

Only 3.4% of the medicinal species were found in Part IV of the mountain. Among them mesophilous species such as *Orchis ustulata* L., *Equisetum palustre* L., *Gratiola officinalis* L., *Iris pumilla* L., etc. inhabiting the marshy meadows prevailed. Another part of medicinal plants found in this region are ruderal species (*Xanthium spinosum* L., *Scleranthus perennis* L., *Chenopodium bonus-henricus* L., etc.) which have penetrated as a result of the increased human activity such as urbanization, mine exploration, off-road vehicles and pastures.

Almost the same species diversity was found by Vitkova and Gyurova (2002) in the xerothermic and mesophyllous vegetation zones of the mountain while in the beech-hornbeam subzone it was the lowest. The majority of the established medicinal plants, according to the authors, were anthropophytes (53%), most of them distributed in the xerothermic zone (54%) and less in the mesophyllous zone (36%). The results of the present study show almost the same presence of anthropophytes and autochthonous species (115 and 120 species respectively). In all parts of the mountain (except Part I) anthropophytes prevailed and their highest percentage was calculated for Part II (40%).

The proportions of heliophytes and mesophytes calculated were 58.1% and 52%, respectively. The distribution of the species according to their biological type is shown in Figure 3. The perennial species (per) dominated with more than 55% followed by annuals (over 10% in each of the studied territories). The highest number annuals (ann) was found in Part II (12.7%). Trees and shrubs (sch) constituted about 6% of the medicinal plants found in the mountain. The least represented is the group of semi-shrubs which constituted less than 0.5% of the medicinal plants. The same was the order of biological types mentioned by Evstatieva et al. (2007) for the medicinal plants in Bulgaria.

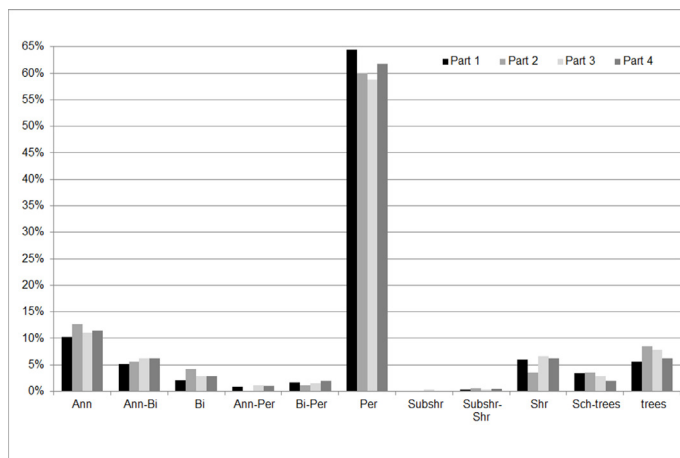


Figure 3. Biological types of the medicinal plants

The biological spectrum of the medicinal species on the territory of the mountain was nearly the same in each of the regions and close to that established for the country. The prevalence of hemicryptophytes (55.7%) is characteristic for the floras of temperate climates. The higher percentage of cryptophytes (predominantly geophytes) in Part I (10.3%) and Part III (9.1%) can be explained by the predominance of forest habitats, where most of the grass cover is formed by cryptophytes (Dimitrov et al., 2012). The presence of dry limestone terrains and the degradation of the communities caused by the anthropogenic influence are prerequisites for the high percentage participation (11.3%) of the trophies in total and in each of the parts of the mountain.

The Euro-Asiatic geoelements (27.2%) prevail followed by the European (25.1%), the Sub-Mediterranean (11.9%) and the Boreal (14.4%) ones. Three Balkan endemic (*Angelica pancicii* Vandas, *Achillea clypeolata* Sm., *Thymus comptus* Friv.), one subendemic (*Syringa vulgaris* L.) and 36 relict species were established.

According to the order of the Ministry of Environment and Waters, the medicinal plants found were divided into three categories: 1) forbidden for collection for personal and commercial needs; 2) forbidden for commercial use but allowed for collection for personal needs with quantities specified in the law; 3) authorized for collection for personal and commercial purposes.

The following 6 species are under the restrictive collection regime: *Primula veris* L., *Galium odoratum* (L.) Scop., *Atropa bella-donna* L., *Betonica officinalis* L., *Sedum acre* L., *Berberis vulgaris* L., and *Galium odoratum* (L.) Scop. Prohibited for collection are 13 of the species: *Phyllitis scolopendrium* (L.) Newman, *Adonis vernalis* L., *Valeriana officinalis* L., *Asplenium trichomanes* L., *Asarum europaeum* L., *Convallaria majalis* L., *Angelica pancicii* Vandas, *Origanum vulgare* L., *Orchis coriophora* L., *O. laxiflora* Lam., *O. morio* L., *O. ustulata* L., *O. purpurea* Huds., and *Juniperus oxycedrus* L.. Seventeen of the

medicinal plants are species with conservation status, 2 of which are included in the Red Data Book of the Republic of Bulgaria (Velchev, 1984), 4 are on the IUCN lists and the Bulgarian Red List of Vascular Plants (Petrova and Vladimirov, 2009), and 9 species are included in Biological Diversity Act (BDA) and 8 are included in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) (Table 2).

Table 2. List of medicinal plants with conservation value

Taxa	IUCN and Red Lists (2009)	Red Book (1984)	BDA (2007)	CITES
APIACEAE				
1. <i>Angelica pancicii</i>		rare		
2. <i>Bupleurum rotundifolium</i>			Annex 4	
ASTERACEAE				
3. <i>Echinops sphaerocephalus</i>			Annex 4	
PRIMULACEAE				
4. <i>Primula veris</i>			Annex 4	
SALICACEAE				
5. <i>Salix caprea</i>			Annex 4	
SOLANACEAE				
6. <i>Atropa bella-donna</i>	VU; A2abcdB2ab(ii,v); C2b	rare		
LILIACEAE				
7. <i>Lilium martagon</i>			Annex 3	
8. <i>Polygonatum odoratum</i>			Annex 4	
9. <i>Scilla bifolia</i> L.			Annex 4	
ORCHIDACEAE				
10. <i>Anacamptis pyramidalis</i>	VU; A2c; B2ab(ii,iii,iv)		Annex 4	Annex 2
11. <i>Gymnadenia conopsea</i>				Annex 2
12. <i>Orchis coriophora</i>				Annex 2
13. <i>Orchis laxiflora</i> subsp. <i>elegans</i>	VU; B1ab(iii,iv)+2ab(iv)		Annex 2a	Annex 2
14. <i>Orchis mascula</i> subsp. <i>signifera</i>				Annex 2
15. <i>Orchis morio</i> subsp. <i>picta</i>				Annex 2
16. <i>Orchis purpurea</i>				Annex 2
17. <i>Orchis ustulata</i>	VU; B2ab(ii,iii,iv)			Annex 2

The distribution of the species with conservation value (Figure 4) shows their predominance in Part III - 10 species (*Angelica pancicii* Vandas, *Bupleurum rotundifolium* L., *Primula veris* L., *Lilium martagon* L., *Polygonatum odoratum* (Mill.) Druce, *Scilla bifolia* L., *Orchis coriophora* L., *Orchis laxiflora* Lam. subsp. *elegans* (Heuffel) Soó, *Orchis morio* L. subsp. *picta* (Loisel.) Arcangeli, and *Orchis mascula* (L.) L.) and Part I - 9 (*Angelica pancicii* Vandas, *Vicia pisiformis* L., *Lilium martagon* L., *Polygonatum odoratum* (Mill.) Druce, *Scilla bifolia* L., *Anacamptis pyramidalis* (L.) Rich., *Gymnadenia conopsea* (L.) R. Br., *Orchis morio* L. subsp. *picta* (Loisel.) Arcangeli, and *Orchis purpurea* Huds.)

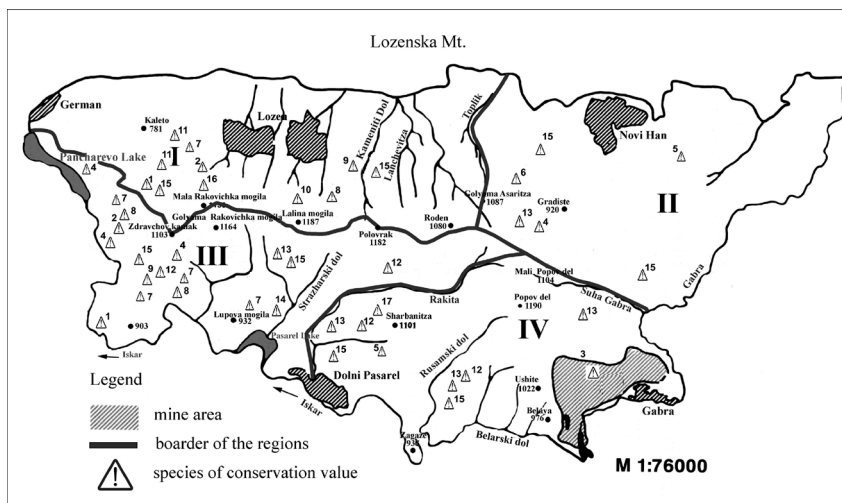


Fig. 4. The distribution of the species with conservation value

The analysis of the distribution of anthropophytes and apophytes on the territory of the Lozenska Mt. served as evidence that its Eastern parts are more strongly influenced by the anthropogenic impact. Three medicinal species are new for the Sredna gora floristic region (*Iris pseudacorus* L., *Thymus comptus* Friv., *Sanguisorba officinalis* L.) and one species is new for the territory of the Lozenska Mt. (*Juniperus oxycedrus* L.).

The established herbs are source of wide spectra of compounds with biological activity and part of them are collected from natural localities. Annual harvest of medicinal plants in Bulgaria is about 15 000–17 000 tons (Evstatieva et al., 2007). The medicinal plants found in Lozenska Mt. such as *Rosa canina* L., *Prunus spinosa* L., *Rubus idaeus* L., *Crataegus monogyna* L., *Sambucus ebulus* L., *Valletiana officinalis* L., *Urtica dioica* L., *Hypericum perforatum* L., *Melilotus officinalis* (L.) Pall., etc. are among the 25 most exported herbs in Bulgaria. The most used parts of the medicinal plants are Herba (50.3% of the species), Folium (26.1%), Flos (19.3%) and Radix (16%). The highest number (209) are medicinal plants with one usable part. The most common are two combinations of usable parts: "stems, leaves and roots" and "stems, leaves and flowers".

Special attention to the capacity of medicinal plant populations and status of the phytocoenoses where they occur have to be paid in order to preserve biodiversity of Lozenska Mt.

CONCLUSIONS

The analysis of medicinal plants distributed in Lozenska Mt. as a bio resource gave us reason to conclude that the flora is rich in medicinal plants. The list of medicinal plants was enriched with 186 species, compared to what is known so

far. The distribution of medicinal plants is different in the four regions to which the territory of the mountain is divided. The highest species richness is found in the western part due to the variety of ecological niches. The largest number of species of conservation value is concentrated in Parts I and Part III. New chorological information for medicinal plants *Juniperus oxycedrus*, *Iris pseudacorus*, *Thymus comptus*, *Sanguisorba officinalis* was also provided.

The following recommendation can be proposed in view of preserving the medicinal plants as a natural resource: a thorough assessment of the species and herbal stocks; annual phenological observations of the species with conservation value, and strict compliance with the Ministry of Environment and Water recommendations for sustainable use of resources such as collection control is needed.

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