

Medicinal plants of conservation significance in the Rila National Park (Bulgaria)

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Abstract. Rila National Park is one of the largest protected areas in Europe and the biggest national park in Bulgaria. In order to contribute to biodiversity protection in the park, an inventory of the medicinal plants of conservation significance was carried out. During the field studies, 38 medicinal plant species of conservation concern have been found, including 17 protected by the Biological Diversity Act; 20 entered in the *Red List of Bulgarian Vascular Plants* (two Critically Endangered, nine Endangered, eight Vulnerable, and one Data Deficient); and 12 listed in the *Red Book of R Bulgaria*. Furthermore, one Bulgarian and six Balkan endemics were also registered. Two species found in the Park are covered by the Bern Convention, two are Data Deficient according to IUCN, and four fall under CITES. Distribution and occurrence of the species in the respective plant communities and habitats are reported. State of the populations and identified threats are discussed.

Key words: Bulgaria, endemics, habitats, medicinal plants, protected species, Rila National Park, threats

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Introduction

Rila National Park, declared in 1992, is situated in the Rila Mountains, Southwest Bulgaria. It is the biggest of the three National Parks (NP) in Bulgaria. It occupies 78 056 ha and comprises four Reserves - Central Rila, Ibar, Parangalitsa, and Skakavitza Re-

serves - on 20% of its territory (Management Plan of the Rila National Park, 2001-2010). The altitude of the Park's territory varies between 1200 m and 2925 m. That territory falls within two protected areas of Natura 2000 in Bulgaria: Rila Sites of Community Importance (SCIs) BG0000495 under Directive 92/43/EEC for the protection of natural habitats and wild

fauna and flora (Directive 92/43/EEC 1992); and Rila Special Protection Areas (SPAs) BG0000495 under Directive 2009/147/EC on the conservation of wild birds (Directive 147/EC 2009). Relief of the terrains in the Park is typically alpine, very rugged, with steep slopes, high ridges and deep river valleys. There are 40 peaks in the Park at an altitude exceeding 2000 m, including the highest peak on the Balkan Peninsula – Musala, at 2925 m. a. s. l. The Park lies in one of the richest water supplying areas in the country, and the sources of the longest river, Iskar, and the biggest river, Maritsa, are also there. The territory features more than 120 lakes, most formed during the Glacial period. Half of the Park's territory is covered by natural forests. Earlier researches in the Rila NP have testified to its significant biodiversity. According to the literature review, there has been no comprehensive study of the medicinal plants of conservation importance in the Rila NP. There are studies on the distribution, populations size and threats to some species such as *Gentiana lutea*, *G. punctata* (Georgieva & Evstatieva 2000; Georgieva 2007), and *Rhodiola rosea* (Aneva & al. 2021). Most available data come from the researches into specified territories or resources of certain medicinal plants, or from the management plans of the Park - Ilieva & al. (1953), Bondev & al. (1981), Tashchev & Pavlov (1995a, b), Peev & al. (2000), Vitkova & Evstatieva (2000a, b), Management Plan of Rila National Park (2001-2010), Peev & Tzoneva (2015), Peev & al. (2018), Sidjimova (2021), or from phytocoenotic studies - Ganchev (1963), Pavlova & Pavlov (1981), Pavlov & al. (1996), and Roussakova (2015).

During the field studies for preparation of the Draft Management Plan of the Rila NP (2015-2024), 1338 fern and seed plant species have been found, more than 398 of which are medicinal plants. The presence of endemics, relicts, rare and endangered plants, makes the Park territory especially valuable for preservation of conservation significant species.

The goals of this study are: 1. Inventory of the medicinal plant species of conservation significance in the Rila NP; 2. Collection and systematization of the available chorological information about the target species; 3. Monitoring of the populations of four economically significant medicinal plants of conserva-

tion significance. 4. Identification of the negative-impact factors and real threats for the development of the species. 5. Specification of the species requiring special measures for preservation.

Material and methods

Distribution and state of the populations of medicinal plants of conservation significance in the Rila NP have been studied mainly during the period May – August 2015, in relation to the development of the Draft Management Plan of the Rila NP (2015-2024). Some periodical studies supplementing that information have been carried out by 2021. Field studies have been conducted in nine Park areas (Kostenets, Beli Iskar, Belovo, Borovets, Govedartsi, Blagoevgrad, Belitsa, Yakoruda, and Dupnitsa) and four Reserves (Parangalitsa, Central Rila, Ibar, Skakavitsa). An area of approximately 15 650 ha, in the 1200 - 2600 m height gradient, has been studied by the route method. The transects have been selected so as to cover the maximum of the Park area, and to include the greatest number of habitats of different type. During the field trips, a list of medicinal plants has been prepared according to the Medicinal Plants Act (2000). The encountered medicinal plants have been recorded in a field notebook, with notes on their altitude, area and horizontal structure of the populations, number of individuals or projective cover, and habitat type. Status of the species is given according to Jordanov (ed.) (1963–1979), Velchev (ed.) (1982, 1989), Kozuharov (ed.) (1995), and Delipavlov & Cheshmedzhiev (2011). The established taxa on the territory of the Park are presented in Table 1, with their conservation status, relative abundance and codes of the habitats according to EUNIS (2007). The conservation significance of the species was determined according to CITES (2009), Bern Convention (1979), IUCN (2018), Directive 92/43/EEC (1992), Biological Diversity Act (2002, 2007), Petrova & Vladimirov (2009), Bilz & al. (2011), and Peev (ed.) 2015. Conservation status types of the habitats followed Biserkov (ed.) 2015. Relative abundance has made it possible to assess the quantitative ratio of species in a phytocoenosis and to determine

the prevalent species. Relative abundance of the herbaceous medicinal plants of conservation significance has been determined by visual assessment and presented on Drude six-point scale according to Pavlov (1995). For trees and shrubs, a 10-point scale has been used, where one point corresponds to 10% of the total number of individuals. GPS coordinates of the newly-established localities of the target species have been recorded on the GARMIN GPSMAP 62st and presented in Table 2. Four economically important medicinal plants have been monitored by stationary approach: *Rhodiola rosea*, *Arctostaphylos uva-ursi*, *Gentiana lutea*, and *G. punctata*. These species are widely used in phytotherapy and pharmacy because their valuable biologically active substances are beneficial for human health (Nikolov, 2007). Collection of these species from their natural populations has brought about reduction of the resources and extinction of some of their localities. The survey of plots followed the methodology for higher-plants monitoring according to Gushev & Bancheva (2016). Chorological information for the period 2015-2022 taken from relevant literature and the Bulgarian herbaria (SOM - Institute of Biodiversity and Ecosystem Research, SO - Sofia University St. Kliment Ohridski, SOA - Agricultural University, Plovdiv) has been systematized and presented in Annex 1.

Results

Conservation status of the species

The inventory has identified 398 species of medicinal plants in the Rila NP. Thirty-eight species are of conservation significance (Table 1) and account for 10% of all medicinal plants found in the Park. According to the research, 20 species are included in the *Red List of the Bulgarian Vascular Plants* (Petrova & Vladimirov 2009). Two species are Critically endangered (CR), nine are Endangered (EN), eight are Vulnerable (VU), and one is Data Deficient (DD). Twelve species are listed in the *Red Data Book of the Republic of Bulgaria* (Peev 2015). Ten protected species included in Appendix 3 of the Biological Diversity Act (2007) have been found in the Park (Table 1) and are under

strict prohibition of collecting on the territory of the country. Seven of the found species are under the Conservation and Regulated Use Regime listed in Appendix 4 of the Biological Diversity Act (2007); they are prohibited for gathering. Another 20 species are under the Special Regime of Protection and Use (SRPU) in Bulgaria, according to the Decree № RD-135 (2022); they are forbidden for harvesting in the national parks in the country. *Campanula lanata* Friv. and *Rheum rhaponticum* are included in Appendix I of the Bern Convention. *Campanula lanata* and *Galanthus elwesii* are included in the IUCN Red List of Threatened Species, in DD category. Four of the identified species fall under CITES (2009): *Galanthus elwesii*, *Gymnadenia conopsea*, *Orchis morio*, and *O. ustulata*. Among the medicinal plants of conservation significance on the territory of the Rila NP, seven endemic species have been identified so far: one Bulgarian endemic – *Rheum rhaponticum* (glacial relict and Critically Endangered species), and six Balkan endemics - *Angelica pancicii*, *Campanula lanata*, *Alchemilla bulgarica*, *A. catachnoa*, *A. gracillima*, and *A. viridiflora*.

Distribution of the target species

As a result of the present study, 38 medicinal plants of conservation significance belonging to 29 genera and 23 families have been reported for the territory of the Rila NP (Table 1). They include lichens, ferns and seed plants (perennial grass plants, semi-shrubs, shrubs, and trees). All these species have different requirements for their growth and development and have been found in more than 27 habitat types. Fourteen of them appear in the *Red Data Book of the Republic of Bulgaria*, Volume III, Natural Habitats. One habitat type is Critically Endangered; two are Endangered; seven are Vulnerable, and three are Nearly Threatened. The altitudinal range of these habitats is as follows: seven are above 2400 m a.s.l., nine are between 1300 – 2400 m a.s.l., and 11 are between 1200 and 1800 m a.s.l. The number of identified target species in one habitat varies from one to eight. The largest number of species has been found in the habitats E2.31 Alpic mountain hay meadows (8), F2.2A2 Balkano-Hellenic dwarf bilberry heaths (7), H3.152 Carpatho-Balkano-Rhodopide campion siliceous

cliffs (6), and E5.572 Moesian tall herb communities (5) (Table 1).

Results of the field studies and chorological references have shown 15 seldom occurring species in the Park. The following species have been identified in one locality only: *Alchemilla gracillima*, *A. viridiflora*, *Diphasiastrum alpinum*, *Lycopodium clavatum*, *Orchis morio*, and *O. ustulata*; in two localities: *Alchemilla catachnoa*, *A. fissa*, *A. straminea*, *Asarum europaeum*, *Campanula lanata*, *Drosera rotundifolia*, and *Galanthus elwesii*, and in three other localities: *Juniperus sabina* and *Taxus baccata* (Tabl.2, Annex 1). In the localities of *Alchemilla fissa*, *Juniperus sabina* and *Taxus baccata*, single individuals occurred. Other seldom occurring species in the Park have been *Arctostaphylos uva-ursi* and *Rheum rhaponticum*. The populations of the above-mentioned species covered small areas and have been strongly fragmented. *Dryopteris filix-mas* (38), *Gentiana punctata* (26), *Lilium martagon* (26), *Angelica pancicii* (24), *Polystichum lonchitis* (23), *Rhodiola rosea* (22), *Valeriana officinalis* (21), *Gentiana lutea* (20) and *Huperzia selago* (20), and *Primula veris* (19) have been found in more localities. Relative abundance of 79% of the medicinal plants with conservation significance rated by Drude scale has been *sparsus* (sp) or *solitaris* (sol) (Table 1). This means that these species do exercise a small impact on the formation of the phytocoenotic environment and belong to the assectators' group. In 21% of the species, relative abundance has been *sociales* (soc) or *copiosus* (cop³, cop², cop¹). They have a prevalent impact on the formation of the phytocoenotic environment and can be referred to the edificators' group. This evidences the presence of target species in the plant coenoses. During the present investigation, a total of 88 new localities have been identified for 18 species, and another seven localities have been confirmed (Table 2). Eleven new localities have been found for *Lilium martagon*, ten for each *Gentiana lutea* and *Valeriana officinalis*, eight for *Galium odoratum*, and seven for *Angelica pancicii*. One new locality has been identified each for *Alchemilla straminea*, *Juniperus sabina* and *Taxus baccata*. In the Beli Iskar park area and in the Govedarnika locality, in habitat G1.A4, two individuals of *Taxus baccata* have been found on stony



Fig.1. Locality of *Taxus baccata* in habitat G1.A4 Ravine and slope woodlands.



Fig.2. *Juniperus sabina* in the Dolna Alinitza locality.

and hardly accessible screes (Fig. 1). In the same Park area, in the Dolna Alinitza locality, new locations of *Juniperus sabina* (Fig. 2) and *Alchemilla straminea* have been identified. In a *Pinus sylvestris* L. forest, in the shrubby storey, single individuals of *Juniperus sabina* have been identified, 20-25 cm tall and with suppressed development (Fig.2). In the Govedarnika locality (Dolna Alinitza), in habitat G3.1E, a population of *Alchemilla straminea* has spread on an area of 20-30 m², with projection cover of 8-10%, on moist terrain along the asphalt road (Fig. 3). The endemic species *Angelica pancicii* (Panitsite Lakes, Malyovishki Circus, river Skakavitsa, Vada and Lovna chalets), *Alchemilla catachnoa* (Parangalitsa Reserve, river Haidushka), *Alchemilla viridiflora* (Malyovitsa chalet) participated in the composition of high-grass phytocenosis, occupying narrow strips of soil along the banks of rivers and streams, in the lower subalpine belt, at around or above 1600 m. *Alchemilla bul-*



Fig. 3. *Alchemilla straminea* in the Dolna Alynitsa locality.

garica and *A. gracillima* (Malyovishki Circus) have been found in the composition of mountain meadows within the 1800-2000 m altitude range. As a typical chasmophyte, *Campanula lanata* (river Levi Iskar) inhabited rocky places and cracks filled in with sufficient amount of soil, showing preference of shady habitats in the beech belt.

During the present investigation, the *Rheum rhaponiticum* species has not been confirmed on the Park's territory. Its population in the area of Skakavitsa Reserve, one of the most accessible locations, has not been found. Stoyanov (1934) maintained about that species that it was one of the rarest encountered species in the Rila Mts. Chorological references have provided data on four localities of that species in the Park (Annex 1). Herbarium samples have been deposited in SOM, collected in the Urdini Lakes Circus in 1997. Peev & Tzoneva (2015) have reported localities of this species on the territory of Rila NP. These data gave the authors

grounds to assume that the species occurs within the Park's limits, and thus it was included in Table 1.

Monitoring of four selected species of high conservation rank and intensive use

Monitoring has been carried out of the populations of four economically important medicinal plants of conservation significance, widely used in medicine and cosmetics: *Rhodiola rosea* Critically Endangered; *Gentiana lutea* and *G. punctata* Endangered; and *Arctostaphylos uva-ursi* Vulnerable, all included in the *Red List of Higher Plants in Bulgaria* (Petrova & Vladimirov 2009). The status of these populations has been studied by determining their area, projection cover, numbers, spatial structure, and reproductive capacity. Chorological data have shown that *Rhodiola rosea* has been identified across the years in 23 localities on the territory of the Rila NP. During the present

Table 1. Medicinal plants of conservation significance in the Rila National Park

Family	Taxa	Conservation value	Relative abundance	Type of habitat
Parmeliaceae	<i>Cetraria islandica</i> (L.) Ach.	SRPU	soc	E4.3941; E4.11; F2.2A2; F2.48; F2.231
	<i>Diphasiastrum alpinum</i> (L.) Holub	RL (VU), BA (App. 3)	sp	E4.11
Lycopodiaceae	<i>Huperzia selago</i> (L.) Shrank&Mart.	SRPU	sol	H3.152; F2.225; F2.24
	<i>Lycopodium clavatum</i> L.	SRPU	sol	F2.2A2
Aspleniaceae	<i>Asplenium trichomanes</i> L.	SRPU	sol	H3.2A12;H3.152
Dryopteridaceae	<i>Dryopteris filix-mas</i> (L.) Schott	BA (App. 4)	cop ¹	G3.16
	<i>Polystichum lonchitis</i> (L.) Roth	BA (App. 4)	cop ²	G1.6922;
Cupressaceae	<i>Juniperus sabina</i> L.	RL and RDB (EN), BA (App. 3)	< 1	F2.2325; G3.4C
Taxaceae	<i>Taxus baccata</i> L.	RL and RDB (EN), BA (App.3)	< 1	G1.A4; G3.4C
Apiaceae	<i>Angelica pancicii</i> Vandas.	RL (VU), SRPU	cop ²	E5.41
Aristolochiaceae	<i>Asarum europaeum</i> L.	SRPU	sp	G1.6922
Asteraceae	<i>Carlina acanthifolia</i> All.	SRPU	sp	E1.883
Campanulaceae	<i>Campanula lanata</i> Friv.	RL and RDB (VU), BA, (App. 3), IUCN (DD), BC	cop ¹	H3.152
Crassulaceae	<i>Rhodiola rosea</i> L.	RL and RDB (CR), BA (App.3)	cop ¹ -sol	H2.31 H3.152;
	<i>Sedum acre</i> L.	SRPU	sp	H3.6 ; H3.2A12
Droseraceae	<i>Drosera rotundifolia</i> L.	RL (VU), BA (App. 3)	sp	D2.2265; D2.3
Ericaceae	<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	RL (VU), SRPU	soc	F2.27; F2.2A2
Gentianaceae	<i>Gentiana lutea</i> L.	RL and RDB (EN), BA (App.3)	sp	E4.3921; F2.231; F2.2A2 F2.48; G3.16; G3.1E;
	<i>Gentiana punctata</i> L.	RL and RDB (EN), BA (App. 3)	sp	F2.231 F2.2A2; F2.48; H2.31
Lamiaceae	<i>Betonica officinalis</i> L.	SRPU	sp	E2.31
Polygonaceae	<i>Rheum rhaponticum</i> L.	RL and RDB (CR), BA (App. 3), BC	sol	H2.45; H2.31
Primulaceae	<i>Primula veris</i> L.	BA (App. 4), SRPU	sp	F2.231
Rosaceae	<i>Alchemilla bulgarica</i> Rothm.	RL (VU), SRPU	sp	E2.31; F2.2A2;
	<i>Alchemilla catachnoa</i> Rothm.	RL and RDB (EN), SRPU	sp	E5.41;
	<i>Alchemilla erythropoda</i> Juz.	RL (VU), SRPU	sp	E2.31; E 2.252; E4.318;
	<i>Alcemilla fissa</i> Günter & Schum- mel.	RL and RDB (EN), SRPU	sol-un	H3.152
	<i>Alchemilla gracillima</i> Rothm.	RL (DD), SRPU	sp	E2.31
	<i>Alchemilla pyrenaica</i> Dufour	RL and RDB (EN), SRPU	cop ¹	F2.2A2; H3.152;
	<i>Alchemilla straminea</i> Buser	RL and RDB (EN), SRPU	sp	E2.31
	<i>Alchemilla viridiflora</i> Rothm.	RL (VU), SRPU	sp	E5.41
Rubiaceae	<i>Galium odoratum</i> (L.) Scop.	SRPU	cop ²	G3.16; G1.6922
Valerianaceae	<i>Valeriana officinalis</i> L.	SRPU	sp	E5.41
Amaryllidaceae	<i>Galanthus elwesii</i> Hook. f.	RL and RDB (EN), BA,(App.3), IUCN (DD),CITES	sp	G1.6922
Liliaceae	<i>Lilium martagon</i> L.	BA (App. 4)	sol	G3.1E; G3.16
	<i>Scilla bifolia</i> L.	BA (App. 4)	sp	E1.833

Family	Taxa	Conservation value	Relative abundance	Type of habitat
Orhidaceae	<i>Gymnadenia conopsea</i> (L.) R. Br.	CITES	sp	E2.31
	<i>Orchis morio</i> L.	BA (App. 4), CITES	sp	E2.31
	<i>Orchis ustulata</i> L.	BA (App. 4), CITES	sol	E2.31

Legend:

1. Conservation value: RL – Red List of Bulgarian Vascular Plants (CR Critically Endangered, EN Endangered, VU Vulnerable, DD Data Deficient); RDB – Red Data Book of the Republic of Bulgaria; BA – Biological Diversity Act; SRPU – Special Regime of Protection and Use; BC – Bern Convention; CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora; IUCN – Red List of Threatened Species.

2. Relative abundance ratings according to Drude scale: *socialis* (soc) – great abundance in which plants approach their above-ground parts; *copiosus* (cop³) – many individuals with dissipated location; *cop*² – large number of dispersed individuals; *cop*¹ – midal abundance with less frequently located individuals; *sparsus* (sp) – few individuals, rarely located; *solitaria* (sol) – very few individuals, single-positioned; *unicus* (un) – one individual.

3. Type of habitat: D2.2265 Balkanic black-star sedge acidic fens (EN); D2.3 Transition mires and quaking bogs; E1.883 Balkanic montane mat-grass swards; E2.31 Alpic mountain hay meadows; E4.11 Boreo-alpine acidocline snow-patch grassland and herb; E4.318 Oro-Moesian mat-grass swards (VU); E4.3921 Oro-Moesian *Festuca valida* grasslands; E4.3941 Oro-Moesian crooked sedge grasslands; E 5.572 Moesian tall herb communities; E5.41 Screens or veils of perennial tall herbs lining watercourses; F2.225 Balkan [Rhododendron kotschyi] heaths (EN); F2.231 Mountain *Juniperus nana* scrub NT; F2.2325 Carpatho-Balkanic *Juniperus sabina* CR; F2.24 Alpigenic high mountain crowberry-heather heaths (CR); F2.27 Alpidic Arctostaphylos uva-ursi and Arctostaphylos alpinus (NT); F2.2A2 Balkano-Hellenic dwarf bilberry heaths (NT); F2.48 Balkano-Rhodopide *Pinus mugo* scrubs (VU); G1.6922 Southeastern Moesian neutrophile beech forests; G1.A4 Ravine and slope woodland (EN); G3.16 Moesian [*Abies alba*] forests; G3.1E South European [*Picea abies*] forests (NT); G3.4C Southeast European [*Pinus sylvestris*] forests; H2.31 Alpine siliceous screes (VU); H2.45 Rhodopide calcareous screens (VU); H3.2A12 Rhodopide calicolous chasmophyte communities (VU); H3.6 Weathered rock and outcrop habitats (VU); H3.152 Carpatho-Balkano-Rhodopide campion siliceous cliffs (VU); CR – Critically endangered; EN – Endangered, VU – Vulnerable, NT - Nearly Threatened



Fig.4. Locality of *Rhodiola rosea* near the Seven Rila Lakes.

investigation, the authors have visited most of them and have identified two more localities (Table 2). Populations of this species have been found mostly in the Seven Rila Lakes Circus (Fig.4), Malyovishki, Musalenski and Urdirn Circus, within the altitude range of 2100-2600 m. During the field studies, *Rhodiola rosea* has been found chiefly in habitats H2.31 and H3.152 (Table 1). It formed mostly small clone populations, with an area between 0.01 and 0.05 ha and projection cover of 0.5-1%, with only single clumps in some localities. The localities under peak Otovishki (0.2 ha) and Ravnichalsko Lake (0.5 ha) had greater area and higher abundance. Projection cover of the species there reached 2-4(6) %. Location under peak Otovishki comprised rock terraces and steep humid terrains with rock fragments and large boulders, the clumps of *Rhodiola rosea* growing in the soil strips between them. In the locality at the Ravnichalsko Lake, the species covered 0.2 ha on the bank of the lake, with projection cover of 5-6%. Different in size clumps have been found along the banks of a very steep stone run above the lake, on an area of 0.3-0.4 ha. Locations of that species in the Park have been in a relatively good state, but had limited resources. Anthropogenic threats proved to be the most severe. In the localities near the Seven Rila Lakes chalet and Belmeken chalet have been observed trampling by the increased tourist inflow and digging out the plant rootage for trade and personal use. Climate warming, floods caused by torrential downpours, which uprooted the young plants from the slopes, low population density, and poor competitive capacity of the species have also exercised a negative impact.

Arctostaphylos uva-ursi is another medicinal plant of conservation significance, widely used in medicine. During the present investigation, the species has been found in habitats F2.27 and F2.2A2 (Table 1). The population of Common Bearberry in the Park was strongly fragmented. Most phytocoenoses with the participation of that species cover an area of up to several hundreds of square metres. Two of the five localities reported by Ganchev (1963) have been visited. One of these localities is in the Chanangyolski Lakes Circus, under peak Haiduta, at an altitude of 2250 m and on an area of 0.2 hectares. The second

locality is above Skakavitsa chalet, at 2100 m a.s.l., with mosaic distribution of the Common Bearberry on a rocky northeastern slope above the forest line. In the above-mentioned localities, *Arctostaphylos uva-ursi* formed patches, where shrubs covered densely the soil substrate, and the projection cover of the species there reached 95%. The present investigation has shown that the species occurs seldom within the limits of the Rila NP. Its populations were in a good state, but on a small area, strongly fragmented and of no economic importance. Fires, which occur often in the nearby *Juniperus sibirica* Burgsd. communities, proved the gravest threat for the species within the Park. Limited distribution, low regeneration capacity, and poor dispersal potential are also natural threat for the species.

Populations of the species *Gentiana lutea* and *G. punctata* have been also studied. Chorological references for *Gentiana lutea* have shown 12 identified localities for this species in the Park. During the field studies, nine more localities have been found (Table 2). They are chiefly in the Central Rila Reserve (Fig. 5), Musalenski



Fig.5. Locality of *Gentiana lutea* in the Central Rila Reserve.

Circus, Seven Rila Lakes Circus, and Urdin Circus, within the 1440 m to 2300 m altitudinal range. During field studies, *Gentiana lutea* has been found in six localities (Table 1). The species occurred most often in habitats: F2.231 (Parangalitsa, Kobilino Branishte, Maritsa chalet, in the area of Chakar Voyvoda chalet, under peak Sokolov); F2.48 (Central Rila Reserve, under peak Bliznatiste); F2.2A2 (Seven Rila Lakes); E4.3921 (river Urdina, peak Arizmanitsa); G3.1E (Parangalita, Dolna Alinitsa). The localities of *Gentiana lutea* occupied mostly an area of several hundreds of square meters, with a relatively

low projection cover between 3 % and 5%. Some of these localities had greater area and abundance. The locality in the region of river Urdina (Golemo Pole) could be referred to them, at an altitude of 1850 m, on an area of 1.2 ha and with number of rosettes 0.06 / m². In the region under peak Arizmanitsa, at 2066 m a.s.l., a number of rosettes 0.5 / m² of *Gentiana lutea* have been found on an area of 0.3 ha, in a phytocenosis dominated by *Juniperus sibirica*. In the Central Rila Reserve, Deraloto locality (under peak Mareshki) another locality was studied at 1996 m a.s.l., on an area of 0.4 ha and number of 0.05 / m² rosettes. The locality above Chakar Voyvoda chalet had an area of 0.5 ha and number of rosettes 0.03 / m². In the Seven Rila Lakes Circus, the species has been found in several localities. The biggest one was situated on the eastern slope of Suhiya Rid location, close to the main hiking trail, on an area of 0.02 ha and number of rosettes 0.2/m². The populations of *Gentiana lutea* have been mostly in a good state and included both generative and vegetative individuals. The main threats to the localities are the trampling out of the terrains by the increased tourist inflow, gathering of the herb as a medicinal plant, droughts, irregular rainfalls, erosion of the substrate by running surface waters and



Fig.6. Habitat F2.2A2 Balkano-Hellenic dwarf bilberry heaths with *Gentiana punctata* in the region of peak Slavov.

avalanches, and poor competitive ability. During the present investigation, the authors have noted remains of harvesting of rhizomes and destruction of plants in the area of Skakavitsa Reserve, peak Sokolov, and near Chakar Voyvoda chalet. Only single rosettes have been observed in the population near Skakavitsa chalet. According to local residents, mass-scale unregulated gathering of rootage of the plant took place in the past. *Gentiana punctata* has been found in 16 localities, with three new identified by the authors (Table 2). The species occurs at altitudes from 1700 m to 2600 m a.s.l., chiefly in habitats F2.48 (Musalenski Circus, Malyovishki Circus, Belmeken Dam), F2.231, F2.231 (Seven Rila Lakes, peak Ushite). The localities usually covered an area of 0.02 ha up to 0.2 ha. Part of these localities have been studied by Georgieva & Evstatieva (2000). The locality on the western slope above the Seven Rila Lakes chalet had an area of 0.2 ha and a number of rosettes 0.2/m². The authors have studied also the localities in the region of Malyovitsa chalet (area 0.2 ha, number of rosettes 0.05 / m²) and above river Malka Malyovitsa (area 0.2 ha, number of rosettes 0.05/M²). In the region of peak Slavov, at 2166 m a.s.l., a new locality of *Gentiana punctata* has been found in habitat F2.2A2 (Fig. 6), one of the larg-

Table 2. New or confirmed localities of medicinal plants of conservation status in the Rila NP

Taxon	Locality	Altitude (metres)	GPS coordinates (decimal degrees)	Source
<i>Alchemilla straminea</i>	Govedarnika locality (Beli Iskar village)	1437	N 42.211261/E 23.549776	Vitkova, Tashev & Delcheva 2015
<i>Angelica pancicii</i>	Alinitsa locality	1679	N 42.220825/E 23.524088	Vitkova, Tashev & Delcheva 2015
	Central Rila Reserve	1912	N 42.147307/E 23.569763	
	Skakavitza Reserve	1874	N 42.22974/E 23.305843	
	Dolen Suhar locality	1409	N 42.216896/E 23.548745	
	Parangalitsa Reserve	1851	N 42.04455/E 23.404628	
	Tyufka locality (Angelova Bichkia)	1909	N 31.191079/E 23.682180	
	Valley of river Blagoevgradska Bistritsa	1894	N 42.045732/E 23.411401	
	Rilski Lakes chalet – Skakavitza chalet	2210	N 42.21862/E 23.31594	Dimitrov & Tashev 2015
<i>Carlina acanthifolia</i>	Arizmanitsa locality	2132	N 42.064221/E 23.350535	Vitkova, Tashev & Delcheva 2015
<i>Cetraria islandica</i>	Arizmanitsa locality	2138	N 42.064294/E 23.351029	Vitkova, Tashev & Delcheva 2015
	Peak Slavov	2163	N 42.147022/E 23.821551	
	Markudzhitsite locality	2390	N 42.22063/E 23.57514	
	Parangalitsa Reserve	2025	N 42.046040/ E 23.429857	
	Govedarnika locality (Dolna Alinitsa)	1274	N 42.240403/E 23.543005	
<i>Dryopteris filix-mas</i>	Ibar Reserve	1341	N 42.226417/E 23.776343	Vitkova, Tashev & Delcheva 2015
	Skakavitza Reserve	1840	N 42.231520/E 23.304249	
	Central Rila Reserve	1912	N 42.147307/E 23.569763	
	Valley of river Blagoevgradska Bistritsa	1894	N 42.045732/E 23.411401	
	Tyufka locality	1902	N 42.191167/E 23.681692	
		1394	N 42.241989/E 23.685427	
	Close to Stara Reka (Kostenecki Divide)	1077	N 42.234538/E 23.799055	
	Rilski Lakes chalet	2108	N 42.21862/E 23.322310	Dimitrov & Tashev 2015
	Otovitsa chalet	1425	N 42.23253/E 23.22343	
	<i>Galium odoratum</i>	Sokolovets locality	1107	N 42.235401/E 23.793307
Ibar Reserve		1387	N 42.226565/E 23.770591	
Parangalitsa Reserve		1525	N 42.040785/E 23.371431	
		1487	N 42.041928/E 23.367863	
		1501	N 42.041665/E 23.369824	
Skakavitza Reserve		1923	N 42.231546/E 23.309148	
		1699	N 42.237302/E 23.306773	
Close to Stara Reka (Kostenecki Divide)		1107	N 42.235401/E 23.793307	
Otovitsa chalet		1425	N 42.23253 /E 23.22343	Dimitrov & Tashev 2015

Taxon	Locality	Altitude (metres)	GPS coordinates (decimal degrees)	Source	
<i>Gentiana lutea</i>	Alinitsa locality	1439	N 42.211013/E 23.550015	Vitkova, Tashev & Delcheva 2015	
	Parangalitsa Reserve	1502	N 42.0404/E 23.371491		
	Arizmanitsa locality	2066	N 42.061429/E 23.349872		
	Central Rila Reserve	1989	N 42.184648/E 23.629604		
	Chakar Voyvoda chalet	1997	N 42.226277/E 23.628962		
	Seven Rila Lakes (Suhia Rid), confirmed	2305	N 42.211562/E 23.319374		
	Below peak Sokolov	2057	N 42.180185/E 23.805917		
		2040	N 42.179924/E 23.80624		
		2060	N 42.180618/E 23.806029		
	Rila Lakes chalet – peak Otovitsa	2108	N 42.21862/E 23.322310		Dimitrov & Tashev 2015
2696		N 42.212838/E 23.32049			
<i>Gentiana punctata</i>	Kutlinita , Kostenetski Divide	1780	N 42.213953/E 23.755886	Vitkova, Tashev & Delcheva 2015	
	Yonchevo Lake, confirmed	2039	N 42.199556/E 23.406601		
	Seven Rila Lakes confirmed	2183	N 42.220277/E 23.317715		
		2149	N 42.220724/E 23.319374		
	Peak Slavov	2166	N 42.145392/E 23.823490		
		2163	N 42.147022/E 23.821551		
		2171	N 42.14549/E 23.823317		
	Ravnichalsko Lake	2245	N 42.188944/E 23.748222		Vitkova & Tashev 2007
	Rila Lakes chalet, confirmed	2108	N 42.21862/E 23.322310		Dimitrov & Tashev 2015
	Rial Lakes chalet – Skakavitsa chaket	2098	N 42.212838/E 23.32049		
<i>Huperzia selago</i>	Seven Rila Lakes, confirmed	2108	N 42.21862/E 23.322310	Dimitrov & Tashev 2015	
	Rila Lakes chalet – peak Otovitsa	2098	N 42.212838/E 23.32049		
<i>Juniperus sabina</i>	Govedarnika locality (Dolna Alinitsa)	1246	N 42.240714/E 23.542781	Vitkova, Tashev & Delcheva 2015	
<i>Lilium martagon</i>	Ibar Reserve	1978	N 42.198384/E 23.767038	Vitkova, Tashev & Delcheva 2015	
	Alinitsa locality	1661	N 42.221379/E 23.523321		
	Deraloto locality	1985	N 42,183834/E 23,627322		
	Sokolovets locality	1390	N 42.226418/E 23.770501		
	Skakavitsa Reserve	1874	N 42.229740/E 23.305843		
	Beli Iskar Water Reservoir	1912	N 42.147307/E 23.569760		
	Dolen Suhar locality (Beli Iskar)	1437	N 42.210882/E 23.550429		
	Close to Stara Reka (Kostenetski Divide)	1107	N 42.235401/E 23.793307		
	Ibar Reserve	1390	N 42.226418/E 23.770501		
	Otovitsa chalet	1425	N 42.23253°/E 23.22343		Dimitrov & Tashev 2015
	Rila Lakes chalet	2108	N 42.1862/E 23.322310		
	<i>Polystichum lonchitis</i>	Parangalitsa Reserve	1482		N 42.042260/E 23.366818
Beli Iskar Water Reservoir		1881	N 42.147316/E 23.568844		
Central Rila Reserve		1966	N 42.183886/E 23.630386		
		1881	N 42.14732/E 23.56884		
Ravnichalsko Lake		2245	N 42.188944/E 23.748222	Vitkova & Tashev 2007	
Rila Lakes chalet		2108	N 42.21862/E 23.322310	Dimitrov & Tashev 2015	
<i>Primula veris</i>	Parangalitsa Reserve	1500	N 42.041542/E 23.369681	Vitkova, Tashev & Delcheva 2015	
	Seven Rila Lakes	2293	N 42.215455/E 23.316834		

Taxon	Locality	Altitude (metres)	GPS coordinates (decimal degrees)	Source	
<i>Rhodiola rosea</i>	Seven Rila Lakes, confirmed	2305	N 42.220724/E 23.319374	Vitkova, Tashev & Delcheva 2015	
	Ravnichalsko Lake	2245	N 42.188944/E 23.748222	Vitkova & Tashev 2007	
	Rila Lakes chalet, confirmed	2108	N 42.21862/E 23.322310	Dimitrov & Tashev 2015	
<i>Scilla bifolia</i>	Parangalitsa Reserve	2003	N 42.046111/E 23.427551	Vitkova, Tashev & Delcheva 2015	
	Belmeken Water Reservoir	2040	N 42.179924/E 23.806240		
	Ibar, Kutlinita locality	1986	N 42.198375/E 23.766564		
<i>Sedum acre</i>	Central Rila Reserve	1972	N 42.183838/E 23.630058	Vitkova, Tashev & Delcheva 2015	
	Seven Rila Lakes	2315	N 42.213236/E 23.317155		
<i>Taxus baccata</i>	Govedarnika locality (Dolna Alinitsa)	1274	N 42.238285/E 23.543861	Vitkova, Tashev & Delcheva 2015	
<i>Valeriana officinalis</i>	Alinitsa locality	1661	N 42.221379/E 23.523321	Vitkova, Tashev & Delcheva 2015	
	Central Rila Reserve	1523	N 42.197024/E 23.553540		
	Dolen Suhar locality	1359	N 42.215924/E 23.548818		
	Dolna Alinitsa locality	1440	N 42.211356/E 23.549855		
	Below peak Slavov	1936	N 42.175513/E 23.806952		
	Skakavitsa Reserve		1828		N 42.232362/E 23.304418
			1619		N 42.240357/E 23.309624
	Parangalitsa Reserve		1436		N 42.042234/E 23.364377
			1486		N 42.0419/E 23.367181
Otovitsa chalet	1425	N 42.23253/E 23.22343	Dimitrov & Tashev 2015		

est on the territory of the Rila NP, with an area of 2.5-3 ha and number of rosettes 0.5 /m². That locality was on a hard-access terrain, out of the way of the hiking routes and was in a good condition. The species has been identified with single specimens or groups in the habitat H2.31 (Kanarski Circus, peak Musala, Urdin Circus). Some of the major threats to the species is deterioration of the conditions in its habitats as a result of climate changes (erosion of the substrate by running surface waters and avalanches, droughts and high summer temperatures). High summer temperatures and lack of rainfalls entail untimely withering of the flowers of the plants and formation of a considerably lower number of seeds. A potential threat for the plants' extinction is their uprooting by the wild pigs.

Discussion

The results of the present study have shown that most medicinal plants of conservation significance inhabit the alpine and subalpine belts in the Park. These plants growing under extreme conditions, namely, thin soil cover, erosion, low temperatures, strong winds, and high solar irradiation. The threats encountered by these species can be divided into two types. The first group includes threats caused by the climate changes and meteorological conditions. Thus, for instance, climate warming entails reduction of snowfalls, which considerably reduce water resources. This, in turn, leads to significant changes in the habitats of the plants and brings about reduction in their populations or their extinctions. These changes par-

ticularly affect hygrophytes like *Drosera rotundifolia*, *Angelica pancicii*, and *Alchemilla catachnoa*, and mesophytes like *Alchemilla straminea*, *A. pyrenaica*, *A. viridiflora*, *A. gracillima*, and *Campanula lanata*. The populations of *Angelica pancicii* in the regions of Malyovitsa Tourist Complex and Vada chalet have decreased in size across the years (Vitkova & Evstatieva 2000a), and that trend still continues. Reduction of running waters and drying out of mountain springs have led to withering of *Alchemilla catachnoa* and *Angelica pancicii* plants, which inhabited their banks in the locations of Gorna Alinitsa, near Skakavitsa chalet and below Yonchovo Lake. Another negative factor are the torrential rains, which strip out the soil cover from terrains on steep mountain slopes and screes. This causes uprooting and carrying away of the juvenile plants of *Rhodiola rose*, which grow on screes above Ravni Chal Lake, and of *Gentiana punctata* in the Malyovishki Circus. Torrential rains also lead to destruction of the juvenile plants of *Gentiana lutea* populations on steep rocky slopes resulting from the consequent erosion near Skakavitsa chalet (Peev & al. 2018).

The second group of threats results from human activity, for instance, from changes in the hydrological regime caused by reallocation of rivers in some water basins, numerous water catchments, building of new water power plants, from fires, etc. During the field studies, changes caused by fires in the plant communities, including of medicinal plants, have been observed. For instance, in the area of Yonchovo Lake, where a big fire raged 20 years ago (Fig. 7). The field research has revealed changes in the plant cover and populations of *Gentiana punctata*, while *Primula veris* showed reduced abundance. Water catchments on the territory of the Park had a strong negative impact on the plant communities. Examples of that activity are obvious around the Beli Iskar Dam. The beds of some streams there have completely collapsed, which has led to changes in the composition of plant communities. Deprived of sufficient moisture, a number of plant species, such as *Angelica pancicii*, *Gentiana punctata*, *Lilium martagon*, *Orchis morio*, *Polystichum lonchitis*, *Valeriana officinalis*, and *Alchemilla* spp. had decline in their populations and disappeared.



Fig. 7. The area around Yonchovo Lake after the great fire in 1990.



Fig. 8. Anthropogenically influenced terrains in the Seven Rila Lakes region.

Another significant impact on the populations of medicinal plants is caused by the increased tourist inflow after the building of high-capacity lifts (to the Seven Rila Lakes), numerous ski tracks, and unregulated gathering of rare and protected species. The present study has shown that one of the gravest affected areas by anthropogenic activity on the territory of the Rila NP is the region of the Seven Rila Lakes (Fig. 8). In recent years, it has become a spiritual, cultural and recreation center. The lift built in the area carries out thousands of tourists daily. This causes nitrification of the soil and water, trampling of plant communities, uprooting and destruction of rare and protected plant species. The populations of the Critically Endangered species *Rhodiola rosea* and the Endangered *Alchemilla fissa*, *Gentiana lutea* and *G. punctata* are decreas-

ing there. Application of strict measures is necessary, as for instance, week days when the lift will not work. A fixed permissible number of tourists per day and advance reservations for visiting could be also introduced. Plant species of conservation significance have strong legal protection in Bulgaria, including within the Park boundaries, under the legislation acts issued by the Ministry of Environment and Waters of Bulgaria. According to these acts, gathering of protected species under BA (Appendix 3) is absolutely prohibited on the Park's territory. Despite strict security, there has been still evidence that some of these plants have been gathered, namely, *Rhodiola rosea* (Belmeken chalet, Seven Rila Lakes chalet) and *Gentiana lutea* (peak Sokolov, Chakar Voyvoda chalet, Skakavitsa chalet). Considering the extreme conditions under which a number of medicinal plants of conservation significance grow, any disturbance of their populations may lead to their extinction. The first and most important precondition for protection of the species is preservation of their natural habitats by regulation of the tourist inflow and curbing the motives for changes in the hydrological regime and causes of forest fires. As a result of the current research, one Critically Endangered and five Endangered species have been identified as requiring special protection measures. These species have a high conservation status, single and low-number populations, specificities of their development and specific habitat conditions. The group of these species includes: *Rhodiola rosea*, *Galanthus elwesii*, *Juniperus sabina*, and *Taxus baccata*. Special attention merit also *Gentiana lutea* and *G. punctata*, threatened by the intensive human inflow passing through some of their populations. For these species, it is imperative to study in detail specificities of their development, population areas, and threatening factors. It is necessary to subject to annual monitoring the populations in areas under strong anthropogenic pressure, namely, the Seven Rila Lakes Circus, Malyovishki Circus, peak Belmeken, and Skakavitsa Reserve. Such *in situ* measures will ensure effective conservation of the species. In case of decrease of the number of individuals below the threshold set by the Park experts, conventional and biotechnological methods should be applied. The *ex situ* approach relates to creation of collections of these species to be

grown under conditions close to their natural habitats. Whenever necessary, that genetic material could be used for reintroduction of the species in their natural populations. A separate study of the distribution of *Rheum raponticum* will provide answers on the existence of the species within the Park boundaries.

Conclusion

The inventory carried out in the Rila NP helped identify 38 medicinal plants of conservation significance, which account for 10% of all medicinal plants inhabiting the Park. They include two Critically endangered, nine Endangered, eight Vulnerable, and one Data Deficient species, or 52% of the medicinal plants of conservation significance in the Park. It has been proved that 40% of the target species occur seldom on the territory of the Park; they have been identified in 1-2 (3) localities. Eighty-eight localities for 18 species have been identified for the first time. The major threats for the studied species are described. The greatest impact exercise organic distribution, attachment to some specified habitats, climate changes, and intensified tourist inflow in some regions of the Park (lifts, tourist complexes and chalets), as well as gathering them as medicinal herbs. Monitoring of the economically important species *Rhodiola rosea* (CR), *Arctostaphylos uva-ursi* (EN), *Gentiana lutea* (EN), and *G. punctata* (EN) has shown that the populations of these plants are balanced, but of no resource importance. Measures have been suggested for *in situ* and *ex situ* protection of the species *Rhodiola rosea*, *Gentiana lutea*, *G. punctata*, *Galanthus elwesii*, *Juniperus sabina*, and *Taxus baccata*. These species call for annual monitoring in the regions under stronger anthropogenic pressure. It is also necessary to continue the investigation of the distributions of *Rheum raponticum*, *Lycopodium clavatum*, *Diphasiastrum alpinum*, *Galanthus elwesii*, and *Campanula lanata*.

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Annex 1

Chorological data on the medicinal plants with conservation significance in the Rila NP from literary sources and herbaria in Bulgaria

Alchemilla bulgarica: Southwards of peak Kadiyt-sa (Malyovitsa Divide), 1750 m (Jordanov & Panov 1965).

Alchemilla catachnoa: 1. Parangalitsa Reserve, above river Haidushka (SOM 132181, Vitkova 2015); 2. Peak Elenin, Ambare, Govedarnika, 2350 m (SOM 40559).

Alchemilla erythropoda: 1. Valcha Polyana locality, close to Belmeken (SOM 163840); 2. Belmeken and near river Chavcha (SO 38179); 3. Kara Bunar locality, 2410 m (SOM 40512); 4. Dinkov Dol, 1900 m and peak Golyam Mechi, 2400 m (Peev & al. 2000).

Alchemilla fissa: 1. Above Babreka Lake (SOM 170150); 2. In the region of peak Malyovitsa and the Seven Rila Lakes, 1900–2200 m (Vitkova 2015).

Alchemilla gracillima: Malyovishki Circus (Peev & al. 2000).

Alchemilla pyrenaica: In the region of Okoto, Babreka and Bliznatsite lakes, 1800–2400 m (SOM 170162, Vitkova 2015).

Alchemilla straminea: Above Hodzhovitsa chalet, 2300 m (SOM 40482).

Alchemilla viridiflora: Along the road to Malyovitsa chalet (SOM 161147).

Angelica pancicii: 1. Along the banks of river Chavcha in Kostenetski Divide (SO 55219, 55220, 5521); 2. Below the Seven Lakes, 2000 m (SOM 55777); 3. Tsarska Rila, above river Suha Maritsa, 2000 m (SOM 55779); 4. Near river Dupnishka Bistritsa (Topla Rila), 1800 m (SOM 55776); 5. Near river Kraina in Zelena Rila, 1450 m (SOM 55778); 6. In the region of Musala, 1800 m (Urumov 1917; Rönniger 1962); 7. Between Chaira and Belmeken (SO 95660); 8. Seven Rila Lakes (the circuses in the upper reaches of river Dzerman), 1800–1850 m; on the ridge towards Haiduta locality; in the area of the upper Panitsite Lakes, Malyovishki Circus near Malyovitza Resort, 2200–2250 m; riv-

er Skakavitsa, Skakavitsa chalet and Zeleni Preslap, 1500–1850 m; northwards of Vada chalet, 1450–1500 m; in the region of Lovna chalet (Vitkova & Evstatieva 2000a); 9. Along the river in the upper part of Dinkov Valley (Peev & al. 2000).

Arctostaphylos uva-ursi (L). Spreng.: 1. In the localities of Venetsa, 2200 m; Konski Kldenets, 2120 m; in the circus of the Haramiyski Lakes and the ridge dividing them from the Seven Rila Lakes; above Skakavitsa chalet, 2100 m; on the northern slope of peak Kalin, 2400 m (Ganchev 1963); 2. Under the Gornoto Chansko Lake, river Pravi Iskar, 2250 m (Vitkova & Evstatieva 2000a).

Asarum europaeum: 1. In the locality of Demir Kapiya, above Beli Iskar village, towards Orlovi Skali locality (Velenovsky 1891); 2. Along the valley of river Bistrishka (Ilieva & al. 1953).

Asplenium trichomanes: 1. Peak Sokolets above Chamkoriya 1700 m (Ahtarov 1932); 2. Shamakliev Dol; Topli Dol; Rakitsko Dere; Hodzhovitsa locality; Kozarski Dol, in the upper reaches of river Maritsa (Roussakova 1973).

Betonica officinalis: In the meadows from lower to the alpine part of Rila (Velenovsky, 1891).

Campanula lanata: 1. Kostenetski Divide, along the trail to Belmeken chalet (Davidov 1903; SO 86340); 2. On the eastern slope of river Levi Iskar; 1200–1400 m (SOM 157472); 3. River Urdina (SOA 16990); 4. On rocks above river Kriva (SOA 16986).

Carlina acanthifolia: 1. River Urdina, 1450 m (SOM 82326); 2. Pomochena Polyana in Kostentski Divide (Georgiev 1891).

Diphasiastrum alpinum: Seven Rila Lakes; 2320 m (SO 46425); Janev & Panov 1964

Drosera rotundifolia: 1. Vadata locality above river Cherni Iskar, 1600 m (SOM 34647); 2. Above Ovchartsi village (Ilieva & al. 1953).

Dryopteris filix-mas: 1. Airan Dere (Urumov 1913); 2. River Dupnishka Bistritsa, 1600 m (SOM 192); 3. Along Dupnishka Bistritsa and Urdina rivers, above 1700 m; river Malyovishka (1000–1400 m); Lopushnitsa (above Govedartsitsi village) and Levi Iskar riv-

ers (Ilieva & al. 1953); 4. In the upper reaches of river Blagoevgradska Bisritsa, between 1200 and 2100 m (Penev 1960); 5. In the upper reaches of river Haidushka, 1900 m (Penev 1960a); 6. Studenoto Dere; Plyachkovo Dere; Suhayat Dol; Rakitsko Dere; Topli Dol; Shamakliev Dol; Haramliysko Dere, Kotarsko Dere; Lisichi Dol; Kozarski Dol; Dalbok Dol; in the upper reaches of river Maritsa, in the localities Hristakiev Prostor, Korabishte, Svlachishte, and Mecha Glava (Roussakova 1969, 1973); 7. In the valley of river Skakavitsa under the Seven Rila Lakes (Panov 1985; SOM 142502); 8. Near river Beli Iskar, 1400 m (SOM 213); 9. Near river Hodzhovitsa, 1800 m (SOM 215).

Galanthus elwesii: 1. Chakalitsa locality; 1700 m, N 41.98442°/E 23.31718° (SOM: 177471); 2. Argacha locality (above Bistritsa village), 1365 m; N 42.07869°/E 23.22630° (SOM 177470), Sidjimova 2021.

Gentiana lutea: 1. Knayzhevata Baraka, under Musala and in Studenoto Dere (SO 35145); 2. Valley of river Maritsa (SO 35143, 35144); 3. Musala (Velenovsky 1898, Toshev 1903); 4. Sara Gyol; 2100 m (SOA 16901, SOM 58078); 5. Otovitsa chalet, close to the Seven Rila Lakes (SOA 16900); 6. The circuses of the Seven Rila Lakes (Suhia Rid), 1750-1800 m (Vitkova & Evstatieva 2000a; Georgieva & Evstatieva 2000); 7. Parangalitsa Reserve, 1502 m (SOM 132599); 8. Kasakadata locality, 1600 m (SO 95661); 9. Marichini Lakes Reserve (Tashev & Pavlov 1995b); 10. Below Skakavitsa chalet; 2000 m (Georgieva 2007; SOM 106627); 11. Mechit chalet – peak Mechit (SOM 173268); 12. River Urdina (Golemoto Pole), 1807 m (Peev & al. 2018). 13. Above Maritsa chalet, along the trail from peak Musala to the chalet 1900 m (Georgieva 2007);

Gentiana punctata: 1. Kutlinita, Kostenetski Divide (SO: 35160, 35161, 35162, 35167, 35168, 35169, 35170; Georgiev 1891); 2. In the region of Musala (Georgieva 2007, SOA 6160, SOM 137110, SO 35165, 35173; Velenovsky 1898); 3. On the rocks near Ribnoto Lake, 2600 m (SOA 33980, SOM 132715); 4. Cherna Planina (Urumov 1906); 5. Sakan Dupka, 2200 m (SOM 58140, 58141); 6. The Seven Lakes Circus (SOM 58146, Vitkova & Evstatieva 2000a, Georgieva 2007); 7. Malyovishki Circus (SOM 58144, SOM 137923, Vitkova & Evstatieva 2000a); 8. Under the peaks Kalin, Damga,

Malyovitsa, Kупenite and across to Malyovitsa chalet (Ilieva & al. 1953; Georgieva 2007); 9. Belmeken Lake (SO 35179); 10. Near Yonchevoto Lake (SOM 137099; SO 35178); 11. Along the road to Strashnoto Lake (SO 69501); 12. Down the flow of river Haidushka (SO 35172); 13. Peak Deno, 2460 m (Georgieva 2007; SOM 109144); 14. Marichini Lakes Reserve (SOM 148933, Tashev & Pavlov 1995b); 15. On the western slopes of Suhia Rid (the valley of river Skakavitsa), 1850-1900 m (Vitkova & Evstatieva 2000a; Georgieva 2007); 16. Malka Malyovitsa Lake, 2250 m; under peak Ushite and Ostrishki Rid, 2400 m (Georgieva 2007).

Gymnadenia conopsea: 1. Under peak Musala (SOA 19063); 2. In the valley of river Bistritsa (Urumov 1906); 3. Plevnishte locality, above Okaden Kamak, 2000 m (SOM 15102); 4. In the valley of river Bistritsa and Byalata Voda around Dupntsa (Stojanov & Stefanov 1948).

Huperzia selago: 1. Peak Ravni Chal; 2250 m (SO 01487, 01488, 83369); 2. Seven Rila Lakes, 2500 m (SO 93325, SOA 393955); 2450 m (SOM 1367, 1368, 1370; SOA 39395; Peev & al. 2000) 3. Urdinski Circus (SO 01485); 4. Suha Vapa, above Granchar Lake (SO 01490, 01491); 5. Above Malyovitsa chalet (SO 96193); 6. Kutlinita in Kostenetski Divide (SO 01476); 7. Kutlinita above the springs of river Kraina in Kostenetski Divide, in the valleys of rivers Zavrachitsa and Maritsa in the Raduil Divide (Georgiev 1891); 8. Green Rila, 2350 m (SOM 1366); 9. Draganitsa, 2650 m (SOM 1346, 1373); 10. Musala (SOM 1372, SOA 989); 11. Sivri Chal, 2550 m (SOM 109109); 12. Peak Irechek, 2460 m (SOM 109136); 13. Peak Elenin (SOM 1369); 14. Peak Haiduta (SO 01482); 15. River Otovitsa (SOA 996); 16. Belmeken (SOA 25812, 25814, 25815).

Juniperus sabina: 1. In the valley of river Beli Iskar, 1600 m (Roussakova 2015); 2. Edi Somun locality (Urumov 1904).

Lilium martagon: 1. Chamkoriya – Toskova Bichkiya (Toshev 1903); 2. Govedarnika and river Bistritsa (Urumov 1906); 4. Along river Beli Iskar, 1400 m (SOM 12488); 5. Between Chamkoriya and Marichini Lakes (SOM 12472); 6. Okaden Kamak, 1600 m (SOM 12503); 7. River Urdina, 1550 m (SOM 12501, 12504); 8. Musala, 1700 m (Rechinger 1933); 9. Along river

Dupnishka Bistritsa, 1750 m and in Samokovishteto locality (Ilieva & al. 1953); 10. Haramliysko Dere and Shamakliev Dol, in the upper reaches of river Maritsa, the valley of Malak Ibar, Rakitsko Dere, Hodzhovitsa locality, Kozarski Dol (Roussakova 1973); 11. Above Maritsa chalet (SOM 147503).

Lycopodium clavatum: Musala (SO 01427, SOA 950, Georgiev & Kitanov 1939).

Orchis morio: Above river Bistritsa, Blagoevgrad district, 1400 m (SOM 14588)

Orchis ustulata: Above Vada chalet (SO 14178)

Polystichum lonchitis: 1. In the valley of river Chavcha and river Kraina in the Kostenetski Divide (Georgiev 1891); 2. Above river Kriva (SOM 413, Ahtarov 1932); 3. Peak Elenin (SOM 408); 4. Musala (SOM 435, 405; Ahtarov 1932); 5. Seven Rila Lakes, 2250 m (SOM 436, Ahtarov 1932); 6. Kutlinita, 2000 m (SOM 438, Ahtarov 1932); 7. River Levi Iskar (SOA 63467); 8. Sungurli Chal (Urumov 1917); 9. River Urdina (SOM 414, 425; Ahtarov 1932); 10. Otovitsa chalet (SOA 13691); 11. Musta Chal, 2400 m (SOM 109103); 12. Belmeken (SOA 43329); 13. In the valley of Golyam Ibar, 1900-2200 m (Roussakova 1972); 14. Shamakliev Dol, Haramliysko Dere, Rakitsko Dere, in the upper reaches of river Maritsa (Roussakova 1973); 15. Parangalitsa Reserve (SOM 132238); 16. Kostenetski Divide (SOA 63466); 17. Granchar chalet, 2185 m, 42°08' N; 23°35' E (Ivanova 1997)

Primula veris: 1. In the valley of river Ibar in Radoil Divide (Georgiev 1891); 2. Kupena and Tankiya Valog in Rila (SO 56852); 3. Seimenski Kamak in the Otovishki Divide; 2200 m (SOM 56801); 4. In the region of rivers Dupnishka Bistritsa, Bistritsa, Otovitsa, Separevska Bistritsa, Urdina, Malyovishka, Lopushna, Levi Iskar, Tiha Bistritsa, and river Bistrishka Mala (Ilieva & al. 1953); 5. On a slope above river Ibar and Pechishte locality, in the upper reaches of river Maritsa (Roussakova 1973); 6. Skakavishki Circus, 1900-2150 m (Peev & al. 2000); 7. Along the road from Malyovitsa Tourist Complex to Malyovitsa chalet (Vitkova & Evstatieva 2000b)

Rheum rhaponticum: 1. Teknedzhik locality, above river Dupnishka Bistritsa, 2100 m (SOM 17906, 17909,

17910, 17911, 17912, 17913, 17914, 17915, 17917, 17942; SO 17627; Stojanoff 1937); 2. Skakavitsa, 1800 m (SOA 3086, 3087, 13347; Stojanov & Stefanov 1948); 3. On the northwestern slope of peak Kalin, 2200 m (Ilieva & al. 1953); 4. River Urdina (SOM 134798, 134797); 5. Urdini Lakes Circus, 2100 m (SOM 138034, 134797, 134789; 29122).

Rhodiola rosea: 1. Kutlinita (SO 33491, Georgiev 1891); 2. In the valley of river Chavcha in the Kostenetski Divide (SO 33488); 3. Toshkova Bichkiya (SO 83914); 4. Along river Bistritsa, between Sitnyakovo and Musala (Urumov, 1908); 5. Malyovitsa, 2600 m (SO 83913, SOM: 137829, 150728); 6. Along river Hodzhovitsa, 2310 (SOM 35116); 7. Above river Dupnishka Bistritsa, 2100 m (SOM 35112); 8. Airan Dere, in the upper reaches of river Bistritsa (Urumov 1913); 9. River Urdina (SOM 35108); 10. Peak Elenin, 2600 m (SOM 35104); 11. Peak Prekarek (SOA 4873); 12. Near Musala chalet, 2393 m (SO 33493, (Peev & al. 2000); 13. Granchar (SOA-48098); 14. Seven Rila Lakes Circus, (SOM 35105, 164124; SO 93345); 15. Along Strashnoto Lake (SO 103765, SO 69518, (Peev & al. 2000); 16. Zavrachitsa chalet (SOA-38739); 17. On the slopes of Belmeken (SO 3349); 18. Ravnichalsko Lake (Vitkova & Evstatieva 2000a); 19. In the region of peak Otovitsa, N 42.19764°/E23.30174° (SOM 171899); 20. Sakan Dupka locality; 2500 m (SOM 35 117, 35 115); 21. Sungurli Chal (SOM 35113); Seven Rila Lakes, Skakavishki Waterfall, Kalin Water Reservoir, Rusaliite, Belmeken, Musala chalet (Aneva & al. 2021).

Scilla bifolia: 1. Peak Kalbura below Malyovitsa chalet, 2300 m (SO 18307); 2. Studenoto Dere locality and on a slope in the valley of river Maritsa, 2500 m (Roussakova 1972); 3. Topli Dol, Rakitsko Dere, Shamakliev Dol, and Hodzhovitsa locality (Roussakova 1973); 4. On the slopes of peak Merdzhika (SOM 132243); 5. Belmeken Water Reservoir, 1895 m (SOM 163518).

Sedum acre: 1. Malyovitsa chalet (Vitkova & Evstatieva 2000a); 2. Peak Elenin (Toshev 1903); 3. Musala, 1600 m (Rechinger 1933); 4. On the western slope across Malyovitsa chalet (Ilieva & al. 1953).

Taxus baccata: 1. In the valley of river Beli Iskar, 1400 m (SOM 1464; Evstatieva 2015); 2. River Urdi-

na (SOM 1460, 1461, SOA 1048, SO 01626; Evstatieva 2015); 3. River Bistritsa (Evstatieva 2015).

Valeriana officinalis: 1. Kostenetski Divide (Davidov 1903); 2. In the regions of rivers Bistritsa, Tiha Bistritsa, Dupnishka Bistritsa (Ilieva & al. 1953); 3. Along the rivers Separevska Bistritsa, Otovitsa, Urdina, Malyovishka, Lopushna, Levi Iskar, Preki Reki; at the Seven Rila Lakes, 1400-2300 m; in the upper reaches of river Haidushka, 1900 m (Penev 1960a).

References

- Ahtarov, B.** 1932. Fern plants (*Pteridophyta*) in the Bulgarian herbarium at the Royal Natural History Museum in Sofia; new deposits, new species, variations and forms. – *Izv. Tsarsk. Prir. Inst. Sofiya.*, (5): 162-176 (in Bulgarian).
- Aneva, I., Zhelev, P., Sidjimova, B., Nikolova, M. & Savev, S.** 2021. Population status and natural localities of *Rhodiola rosea* in Rila Mts., Bulgaria. – *Ecologia Balkanica, Special Edition* (4):145-151.
- Bern Convention** 1979. Bern Convention on the Conservation of European Wildlife and Natural Habitats. App. I. 1979.
- Bilz, M., Kell, SP., Maxted, N. & Lansdown, R.V.** 2011. European Red List of Vascular Plants. Luxembourg. Publications Office of the European Union.
- Biological Diversity Act.** 2002. Decree No. 283 accepted by the 39th National Assembly on 2 August 2002. – *State Gazette*, No. 77/09.08.2002. pp. 9-42 (in Bulgarian).
- Biological Diversity Act.** 2007. Amendments and Supplementation of Decree No. 354 passed by the 40th National Assembly on 1 November 2007. – *State Gazette*, No. 94/16.11.2007, pp. 2-44 (in Bulgarian).
- Biservkov, V. (ed.)** 2015. Red Data Book of the Republic of Bulgaria, Natural habitats. Vol. 3. Sofia. BAS and MOEW, available at: e-ecodb.bas.bg.
- Bondev, I., Meshinev, T., Andreev, A. & Slavova, L.** 1981. The flora and vegetation of Parangalitsa Reserve. Regional Symposium under Project 8-MAS „Preservation of Natural Areas and the Genetic Fund „, 20-24 October 1980. Blagoevgrad, pp. 100-111 (in Bulgarian).
- CITES**, 2009. Convention on International Trade in Endangered Species of Wild Fauna and Flora. Appendices. <http://www.cites.org/eng/app/appendices.shtml> (access: 11.11.2009).
- Davidov, B.** 1903. Contribution to the study of the flora of Bulgaria – *Period. Spis. Bulg. Knizh. Druzh.*, (64): 195-217 (in Bulgarian).
- Decree № RD-135.** 2022. Decree № RD-135/04.02.2022. – *State Gazette*, No. 13/15.02.2022, pp. 55-56 (in Bulgarian).
- Delipavlov, D. & Cheshmedzhiev, I. (eds.)** 2011. Key to the Plants of Bulgaria. Plovdiv. Academic Press, Agricultural University, Plovdiv (in Bulgarian).
- Directive 92/43/EEC**, 1992. Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora. – *OJ L* 206, 22.07.1992. Pp. 7-50.
- Directive 147/EC**, 2009. Directive 2009/147/EC on the Conservation of Wild Birds.
- Evstatieva, L.** 2015. *Taxus baccata*. – In: **Peev, D.** (ed), Red Data Book of the Republic of Bulgaria, Plants and fungi, Vol.1, pp. 303. Sofia. BAS and MoEW
- EUNIS**, 2007. European Nature Information System. EUNIS database. Vol. 2.
- Ganchev, S.** 1963. Plant cover of the orophytic belt in the western part of northwestern Rila. – *Izv. Bot. Inst. (Sofia)*, (12): 5-99 (in Bulgarian).
- Georgiev, S.** 1891. Rhodope Mountains and Rila Mountain and their Vegetation. *Msb. Book V*, Pp. 329 (in Bulgarian).
- Georgiev, T. & Kitanov, B.** 1939. New materials and critical notes on the flora of Bulgaria. – *Izv. Bulg. Bot. Druzh.*, (8): 67-77 (in Bulgarian).
- Georgieva, E.** 2007. Ecological, biological and phytochemical features of *Gentiana lutea* L. and *Gentiana punctata* L. in Bulgaria. *PhD Thesis*. Inst. Bot., Bulg. Acad. Sci., Sofia (in Bulgarian, unpubl.).
- Georgieva, E. & Evstatieva, L.** 2000. Distribution and conservation of *Gentiana lutea* L. and *G. punctata* L. in Bulgaria. – In: Proc. First Conference on Medicinal and Aromatic Plants of Southeast European Countries and VI Meeting of Days of Medicinal Plants. 29.05 - 3.06.2000. Arandjelovac (FR Yugoslavia), pp. 183-188.
- Gussev, C. & Bancheva, S.** 2016. Methods for monitoring of higher plants. – In: National System for Monitoring of Biological Diversity, Ministry of Environment and Waters. Retrieved from eea.government.bg, accessed: 10.05.2021 (in Bulgarian).
- Ilieva, St., Kolev, I., Boeva, A. & Valev, St.** 1953. Contribution to the study of wild medicinal plants in the northwestern part of Rila Mountain. – *Journal of the Research Institute at the Ministry of Agriculture*. XX, (3): 61-94 (in Bulgarian).
- IUCN** 2018. IUCN Red List of Threatened Species. Version 2018-1, available at: iucnredlist.org.
- Ivanova, D.** 1997. Reports (831–839). – In: **Kamari, G., Felber, F. & Garbari, F.** (eds), Mediterranean chromosome number reports 7. *Fl. Medit.*, (7): 225-235.
- Janev, A. & Panov, P.** 1964. Materials and critical notes on the flora of Bulgaria. – *Ann. Sofia Univ., BGG Faculty*. 57(1): 75-101 (in Bulgarian).
- Jordanov, D. & Panov, P.** 1965. New materials and notes on the flora of Bulgaria. – *Izv. Bot. Inst. (Sofia)*, XV: 259-263 (in Bulgarian).
- Jordanov, D. (ed.)** 1963–1979. *Fl. Reipubl. Popularis Bulgaricae*. Vols. I-V. In *Aedibus Acad. Sci. Bulgaricae, Serdicae* (in Bulgarian).
- Kozuharov, S. (ed.)** 1995. *Fl. Reipubl. Bulgaricae*. Vol. 10. Editio Acad. “Prof. Marin Drinov”, Serdicae (in Bulgarian).
- Medicinal Plants Act**, 2000. Medicinal Plants Act. – *State Gazette*, No. 29/07.04.2000, pp. 9-29 (in Bulgarian).
- Nikolov, S. (ed.)** 2007. Specialized Encyclopedia of Medicinal Plants. Trud Publishing House, Sofia, pp.566.
- Panov, P.** 1985. New data and critical notes on the Bulgarian flora. – *Fitology*, (28): 33-40 (in Bulgarian).
- Pavlova, E. & Pavlov, D.** 1981. Eco-phytocenological study of the Marichini Lakes Reserve. – In: Regional Symposium under Project 8-MAS „Conservation of Natural Areas and their

- Genetic Fund“, 20-24 October, 1980, Blagoevgrad, pp. 100–111 (in Bulgarian).
- Pavlov, D.** 1995. Phytocenology. Sofia, Martylen, pp. 57-58 (in Bulgarian).
- Pavlov, D., Tashev, A. & Hadzhiyski, M.** 1996. Phytogeographic elements in the Marichini Lakes Biosphere Reserve. Scientific Works of the Forestry University. Vol. XXXVII, Ecology and Landscape Architecture, University of Forestry, pp. 49-55 (in Bulgarian).
- Peev, D. (ed.)**, 2015. Red Data Book of the Republic of Bulgaria, Plants and fungi, Vol.1, Sofia. BAS and MoEW.
- Peev, D., Pramatarova, M., Tsoneva, S., Valyovska, N. & Vasileva, I.** 2000. Biodiversity of vascular plants in the Rilla National Park. – In: **Sakalian, M.** (ed.), Biological Diversity of the Rila National Park. Pensoft. pp. 7 - 78.
- Peev, D. & Tzoneva, S.** 2015. *Rheum rhaponticum* L. - In: **Peev D.** (ed), Red Data Book of the Republic of Bulgaria, Plants and fungi, Vol.1, pp. 303. Sofia. BAS and MoEW
- Peev, D., Vitklova, A., Evstatieva, L. & Valyovska, N.** 2018. New data on *Gentiana lutea* ssp. *symphyandra* (Gencianaceae) in Bulgaria. – God. Sofiisk. Univ. “Kliment Okhridski” Biol. Fak. 2, Bot., 102:74-89.
- Penev, I.** 1960. The forest and shrub vegetation along the upper river Blagoevgradska Bistritsa (Rila Mountain). – Izv. Bot. Inst. (Sofia), (7): 107-164 (in Bulgarian).
- Penev, I.** 1960a. Grass communities along the villages of the Mechkovo and Parangalytsa divides of Rila Mountain. – God. Sofiisk. Univ., “Kliment Okhridski” Biol.-Geol.-Geogr. Fac, 52(1): 57-103 (in Bulgarian).
- Petrova, A., & Vladimirov, V.** (eds.). 2009. Red List of Bulgarian Vascular Plants. – Phytol. Balcan., 15 (1): 63-94.
- Rechinger, K.H.** 1933. Ergebnisse einer botanischen Reise nach Bulgarien. – Mag. Bot. Lap., 32 (1-6), 5-58.
- Management Plan of Rila National Park**, 2001-2010. Adopted by Decision No 522 of the Council of Ministers of 04.07.2001 (in Bulgarian).
- Rönniger, K.** 1962. Studienreise nach Bulgarien. —Bul. Soc. Bot. de Bugarie, Vol. 5, pp. 90-93.
- Roussakova, V.** 1969. Results of the study and detailed large-scale mapping of the plant cover in the upper reaches of the Maritsa River. – Izv. Bot. Inst. (Sofia), (19): 89-107 (in Bulgarian).
- Roussakova, V.** 1972. Map of the plant cover in the area of the upper reaches of Maritsa River in Rila Mountain. I. Explanatory text. – Notific. Bot. Inst., (22):45-68 (in Bulgarian).
- Roussakova, V.** 1973. Map of the plant cover in the area of the upper reaches of the Maritsa River in Rila Mountain. II (Explanatory Text). – Izv. Bot. Inst. (Sofia), (23): 121-154 (in Bulgarian).
- Roussakova, V.** 2015. *Savin juniper (Juniperus sabina); Rhodopide calcareous screes.* –In: **Biserkov, V.** (ed), Red Data Book of the Republic of Bulgaria, Natural habitats, Vol. 3, pp. 218-220; 376-378. Sofia, BAS and MoEW.
- Sidjimova, B.** 2021. Genus *Galanthus* (*Amaryllidaceae*) in Bulgaria: Notes on taxonomy, chorology and ecology. – Ecologia Balkanica, 13 (2): 75-93.
- Stojanoff, N.** 1937. Über die autochtonität Rila-Rhabarbes. Mitt. Kön. Nat. Inst. In Sofia. Bd. X, S. pp. 248-258.
- Stojanov, N. & Stefanov, B.** 1948. Flora of Bulgaria. Ed. 3. Univ. Press, Sofia (in Bulgarian)
- Stoyanov, N.** 1934. Extinct plants. – Proc. Union for the Protection of Nature. Book 1, 34-49 (in Bulgarian).
- Tashev, A. & Pavlov, D.** 1995a. Floristic studies in Marichina Divide of the Central Rila Reserve. - In: Proc. 70 Years of Forestry Education in Bulgaria, 7-9 June. 1995. Sofia, Ecology and Landscape Architecture. University of Forestry, 3: 265-271 (in Bulgarian).
- Tashev, A. & Pavlov, D.** 1995b. Endemic, rare, threatened with extinction and protected plants in the Biosphere Reserve Marichini Ezera. – In: **Tsankov, G.** (ed), Proc. Jubilee. Scient. Confer. Centenary of the birth of Acad. B. Stephanov (1894-1979). 2-3 June 1994. Sofia. PSSA. Vol. 2, pp.179-180 (in Bulgarian).
- Toshev, A.** 1903. Southwest Bulgaria in floristic terms. – Period. Magaz., Book 63. (in Bulgarian).
- Urumov, I.** 1904. Third contribution to the Bulgarian flora. – Proc. folk minds, science and paper., (20): 1-103 (in Bulgarian).
- Urumov, I.** 1906. Sixth contribution to the Bulgarian floral. Msb. Book XXII (in Bulgarian).
- Urumov, I.** 1908. Eighth contribution to the Bulgarian flora. – Periodic. magaz, Book 69, pp. 41-79 (in Bulgarian).
- Urumov, I.** 1913. Twelfth contribution to the Bulgarian flora. – Sborn. Bălg. Akad. Nauk., 2: 1-243 (in Bulgarian).
- Urumov, I.** 1917. Thirteenth contribution to the Bulgarian flora. – Sborn. Bălg. Akad. Nauk.. 7: 1-225 (in Bulgarian).
- Velchev, V.** (ed.). 1982. Fl. Reipubl. Popularis Bulgaricae. Vol. 8. In Aedibus Acad. Sci. Bulgaricae, Serdicae (in Bulgarian).
- Velchev, V.** (ed.). 1989. Fl. Reipubl. Popularis Bulgaricae. Vol. 9. In Aedibus Acad. Sci. Bulgaricae, Serdicae (in Bulgarian).
- Velenovsky, J.** 1891. Flora bulgarica. Descriptio et enumeratio systematica plantarum vascularium in principatu Bulgariae sponte nascentium. Prague.
- Velenovsky, J.** 1898. Flora bulgarica. Supplementum I. Prague,
- Vitkova, A.** 2015. *Alchemilla catachnoa* Rothm, *Alchemilla fissa* Gunter & Schummel, *Alchemilla pyrenaica* Dufour, *Alchemilla straminea* Buser. – In: **Peev, D.** (ed.). Red Data Book of the Republic of Bulgaria, Plants and Fungi. Vol. 1. Sofia. BAS and MoEW. <http://e-ecodb.bas.bg/rdb/bg/>
- Vitkova, A. & Evstatieva, L.** 2000a. Biodiversity of medicinal plants in the Rila National Park. – In: **Sakalian, M.** (ed). Biological Diversity of the Rila National Park. Sofia, Pensoft. pp. 79-116.
- Vitkova, A. & Evstatieva, L.** 2000b. Spread and resources of medicinal plants in Rila National Park. – In: The Book of Herbs-eco-Horizon 2000. Marin Drinov Acad. Publishing house, pp. 79-87 (in Bulgarian).

