



Original Contribution

LOBARIA PULMONARIA (ASCOMYCOTA, LOBARIACEAE) IN BULGARIA

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ABSTRACT

Newly discovered localities of the tree lungwort (lung lichen) are reported from Stara Planina Mts (Elenova Gora Reserve), Mt Slavyanka (Ali Botush Reserve), West Frontier Mts (Maleshevska Planina, Sokolata Reserve) and Rhodopi Mts (Mantaritsa Reserve). Brief historical background, including information on previously published data on *Lobaria pulmonaria* from Bulgaria, is presented. As one of the species, being under protection of IUCN, the knowledge on its current distribution is still scarce. An UTM-grid map of the certain locations, supported by data from collections studied and available literature sources, is applied.

Key words: distribution, lichenized fungi, tree lungwort, UTM-grid map

INTRODUCTION

Usually reviewed and detailed historical distribution data are lacking for many species, especially for the group of epiphytic foliose lichens. One of the main characteristics of this foliose lichen-forming fungus is that its local populations are spread on significantly small number of trees, as it has limited dispersal potentials (1). Therefore, it is regarded as greatly influenced by tree harvesting or extirpations of the lichen thalli. *Lobaria pulmonaria* (L.) Hoffm. is used as a key species in primeval forest preservation matters and recently it serves as an old forest indicator worldwide, also in Bulgaria (2). It widely has been applied traditionally as a model species in ecological, ecophysiological and conservation biological research, while the tree lungwort is still threatened in many European countries: (3), (4), (5), (6), etc. A thorough review on published data, emphasized on some of the important reasons and processes of general decline of the populations of *L. pulmonaria* in Hungary and in Europe was made (7). The authors stressed a discussion at several different schemes published, mainly dealing with the dispersal and population dynamics of the lung lichen. In Bulgaria *L. pulmonaria*

seems to be rare species and therefore its constant monitoring and the knowledge about its distribution are essential for future conservation strategies. According to the present times, many foreign authors pointed out several important natural factors, among which were slow growth of the lichen thalli, formation of the generative (vegetative and sexual) structures at an age about 25 years, the air pollution, the acidic rainfalls, habitat fragmentation and climate changes, proven to be major forces of the decline processes or reduction of populations at national levels (3, 7). Selected lichen substances with aims to obtain compounds with antimicrobial effects by testing numerous genera of foliose lichen-forming fungi, including the thalli of the tree lungwort collected from Rila Mts, were studied (8). In the past centuries this lichen was used for treatment of bronchial coughs, spasmodic coughs, head colds, inflamed mucous membranes. Even nowadays it serves as ingredient of homeopathic drugs and as compound of herbal remedies in many European countries (e.g. *Sticta pulmonaria* CH 9 and 15 CH, *Sticta Pulm* 30C, etc.). The present note aims to summarize the knowledge about the distribution of the lung lichen in Bulgaria.

MATERIALS AND METHODS

The available information, obtained from the existing records in specialized lichenological literature, the data of the revised specimens,

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housed at the Mycological Collection, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia (SOMF) and in the collection of lichens from the Museum of Natural History, Bulgarian Academy of Sciences, Sofia (abbreviated below as NatlHistMus), as well as from unpublished finds, is used. The inclusion of already published data from the previous sources on fungal diversity (including lichens), containing no detailed useful information for the present purposes of the data mapping, is avoided. The newly localities from Bulgaria are designated with an asterisk (*). Distribution list by floristic regions is added following the accepted form (9). The nomenclature is in agreement with (10). The information is presented on UTM-grid map with 10 km square. A thorough list of the known localities and the available sources of information is added for further usage. All cited collections of *L. pulmonaria* are on bark of beech, unless otherwise stated. Abbreviations used throughout the text: BZ - Bozhana Zhelezova, DS - D.Y. Stoykov.

RESULTS

The review of the literature reports, the revision of the herbarium specimens, together with the newly unpublished finds revealed 90 records of the species. This information, extracted from the sources cited above and checked from the fully listed data below, is presented on **Figure 1**.

List of records

Lobaria pulmonaria (L.) Hoffm., *Deutschl. Flora, Cryptogamie*, p. 146, 1796 [Synonyms: *L. pulmonaria* var. *hypomela* (Delise) Cromb.; *L. pulmonaria* var. *sorediata* (Schaer.) Zahlbr.; *L. pulmonaria* f. *sorediata* (Schaer.) Zahlbr.; *Sticta pulmonacea* Ach.; *S. pulmonaria* (L.) Birolì]

– Northeastern Bulgaria: Shoumen, Kyoshkovete locality, around Kiril Avramov chalet, alt. 540 m (see 11); near Shoumen, 1962, BZ (SOMF 23875), MH-98. – Forebalkan: Vratsanski Balkan, vicinities of Vratsa, GN-08 (see 12). – Eastern Stara Planina Mts: road to cap Emine, 07 June 1960, BZ (SOMF 24182), on bark of broadleaved tree, NH-63. – Central Stara Planina Mts: Beklemeto, 1565 m, 22 June 1961, BZ (NatlHistMus 1095), over mossy bark of old beech, LH-04; between Tuzha chalet and Pashovitsa locality, 1300-1400 m, LH-42 (see 13); nearby Ray chalet, 1600 m, 7 August 1962, BZ (NatlHistMus 1113), LH-22, on eruptive rock; between Ray chalet and Kalofer, LH-22 (see 11); Severen Dzhendem Reserve, above Kalofer, below Botev peak, ca 1700 m, 13 June 1929, on mossy rock, LH-32 (see 14); around Bouzludzha chalet, LH-73 (see 11); Troyanski

Balkan, Zelenikovets, 21 June 1961, BZ (NatlHistMus 1106), on the ground, over moss in beech forest, LH-14; above Troyanski monastery, Zelenikovets, on soil over mosses, LH-14 (see 15); Cherni Osam River valley, near Divcevoto, Boatin Reserve, KH-74 (see 2); above Ribaritsa village, Tsaritchina Reserve, KH-54 (see 2); 10 km south to Aprilci, Vidimsko Pruskalo waterfall, Severen Dzhendem Reserve, LH-33 (see 2); Trojan, leg. Grantsharoff, det. P. Cretzoiu (SOMF 22597), LH-15 (see 12); Schipchenska Mt, Ouzana locality, 1200 m, 25 July 2012, P. Stoyanov, not deposited in SOMF, photograph available, LH-63 (see 16); *Elenova Gora Reserve, above Hristo Danovo village, 25 August 2014, leg. K. Vasilev, det. DS (SOMF 29636), LH-52. – Western Stara Planina Mts: Murgash peak, near Orlovo Gnezdo chalet, 1400 m, 24 September 1961, BZ (NatlHistMus 1097), GN-24; along Petrohan forest, FN-77 (see 11); Etropole distr., Chavdar chalet, alt. 1400 m, 8 October 1951 (NatlHistMus 1109), GN-43; Etropole distr., Baba peak, 22 May 1952, A. Toshev (SOMF 22591), on trunk of old tree, GN-43; without detailed locality, monastery (probably near Etropole), ‘shapliva treva po borikite’, A. Toshev (SOMF 22587), GN-44; without exact locality, A. Toshev, BZ (SOMF 22592). – Vitosha region: Mt Vitosha, below Reznjovete, 27 June 1956, BZ (SOMF 23032), on soil, FN-81; from Kikisha chalet towards Bay Krustyo lift station, alt. 1430 m, 22 January 1961, BZ (NatlHistMus 1117), on syenite rock among moss, FN-81. – West Frontier Mts: Blagoevgrad distr., Vlahina Mt, Suhostrel village, Stara Reka River (substitute for the old name Vraneshtitsa), ca 900 m, leg. N. Fenenko, det. BZ (SOMF 22593), on *Corylus avellana* L., FM-72; Maleshevska Planina, above Sredorek forestry, July 1963, A. Yanev (SOMF 23036, SOMF 23037), FM-60; *Maleshevska Planina, Sokolata Reserve, the vicinities of Igralishte village, 10.08.2014, leg. K. Vasilev (SOMF 29658), FM-70. – Belasitsa Mt: in humid forests, between 800-1510 m, no exact locality (see 17); *ibid.*, no detailed locality, ca 1500 m, May 1966, BZ (NatlHistMus 1098), on trunk of old *Castanea sativa* Mill.; above Petrich, 25 May 2013 (SOMF 28748), FL-88 (see 16); *ibid.*, forests of primeval type, ca 1410-1640 m, 25 May 2013 (SOMF 28746), FL-87 (see 16); above Belasitsa village, 880-900 m, 26 May 2013 (SOMF 28733), on primeval *Castanea sativa* Mill., FL-77 (see 16); above Kolarovo village, ca 780 m, 25 April 2013 (SOMF 28743), FL-78 (see 16); above Samouilovo village, below Demirkapiya mount road, ca 1710 m, 24 May 2013, DS (SOMF 28732), FL-77 (see 16). – *Slavyanka Mt: Ali Botush Reserve, above Paril chalet, 31 July 2014, leg. K. Vasilev, det. DS (SOMF 29593), GL-28. – Pirin Mts: Retizhe valley, above Mesta village, 500 m, GM-12 (see 18); region of Melnik, below Demirhan peak, 1600 m, 1983, GM-00 (see 19); between Gotce

Delchev chalet and Bezbog, ca 1700 m, on *Picea abies* (L.) Karst., GM-12 (see 11); Bezbog, ca 1700 m alt., BZ (SOMF 23874), on *P. abies*, GM-12; Papaz Chair chalet, 1500 m, July 1967, BZ (NatHistMus 1093), GM-20 (see 20); between Todorova Polyana and Orelyak peak, 1700 m, GM-11 (see 21), below Popski Preslop, 1350 m, GM-10 (see 21); Sredna Reka river, near Pirin chalet, 1600 m, GM-01 (see 21). – Rila Mts: Parangalista, ca 1600 m, 14 August 1931, leg. N. Fenenko, det. BZ (SOMF 22590), GM-05; above Rilski monastery, 1300 m, on twigs of *Quercus*, on bark of beech and over mossy gneisses in Rilska Reka river, 1100-1300 m, FM-96 (see 22); Rilski monastery, 7 October 1953, N. Vidhorcevski (SOMF 23019), FM-96; Rilski monastery, Partizanska Polyana, ca 1450 m, 02 July 1955, BZ (NatHistMus 1107), FM-96; *ibid.*, 1400 m (NatHistMus 1122), FM-96; Partizanska Polyana, ca 1400 m, 02 July 1955, BZ (NatHistMus 1122), FM-96; *ibid.*, 02 July 1955, BZ (SOMF 23831); below Partizanka Polyana, towards Rilski monastery, ca 1400 m, 28 June 1965, BZ (NatHistMus 1114, NatHistMus 1115, NatHistMus 1118); no data, ca 1400 m, 1956, BZ (see 8), nearby Rila monastery, Droshlyavitsa river valley, 14 July 1957, BZ (SOMF 23030, SOMF 23033), FM-97; *ibid.*, July 1957 (SOMF 23035, SOMF 23053), FM-97; on the road from Partizanska Polyana to Ribni Ezera lakes, ca 1600 m, on *Abies alba* Mill., GM-06 (see 11); on the road from Chaira to Slav peak, ca 1600 m (see 11); *Parangalitsa Reserve, buffer zone along Blagoevgradska Bistritsa river, 28 July 2004, M. Gyosheva, not collected, photographs available, GM-95; in spruce forest, ca 1500 m, October 1959, BZ (NatHistMus 1116) (see 8). – Sredna Gora Proper: no detailed

data, ca 1650 m (see 11); no data, N. Nikoloff (see 12); Koprivshitsa municipality, Bogdan peak, 27 April 1962, leg. Cv. Hinkova, det. BZ (SOMF 23876), KH-92. – Western Rhodopi Mts: Gotse Delchev distr., Gurmen municipality, Kanina River, Zherev Chark, ca 1400 m, 26 August 1931, leg. N. Fenenko, det. BZ (SOMF 22589), in spruce forest, GM-30, Dubrashki Rid, vicinities of Kovachevitsa village, on *Picea abies* (L.) Karst. (SOMF 23994), GM-31, Jundola resort (SOMF 24058), GM-36; Jundola resort, Kuzmanovi Baraki, ca 1250 m, 7 June 1956, BZ, (NatHistMus 1108), on *Picea abies*, GM-36; Chaira resort, the valley of Koprivska Reka river, ca 1500 m, November 1955, BZ (SOMF 24317), on *Pinus* sp., GM-47; Koprivska River valley, ca 1500 m, GM-47 (see 23); below Sestrimo, along Kriva Reka river, Chaira resort, 30 October 1953, BZ (SOMF 23995), on rocky boulders, GM-37; *ibid.*, on rocky formations, along with *Popypodium vulgare* L., GM-37 (see 23); *Mantaritsa Reserve, Pashino Bardo, ca 1650 m, 30 July 2014, DS, not deposited in SOMF, photographs available, KG-64; *Mantaritsa Reserve, above Cigov Chark resort, alt. ca 1350 m, 01 July 2014, DS (SOMF 29657), KG-54; **ibid.*, alt. ca 1445 m, 04 July 2014, DS (SOMF 29582), on piece of fallen tiny twig, KG-54. – Strandzha Mts: Bogorodichen Dol, near Rezovska river, 13 May 1965, BZ (NatHistMus 1112), NG-65; Bogorodichen Dol, June 1965, BZ (SOMF 24401), on trunk of *Quercus* sp., NG-65; near Kosti village, Silkosiya Reserve, NG-65 (see 2); near Gramatikovo, Kamuka protected area, NG-55 (see 2), north to Malko Turnovo, Sredoka Reserve, NG-45 (see 2), on bark of beech and oaks.

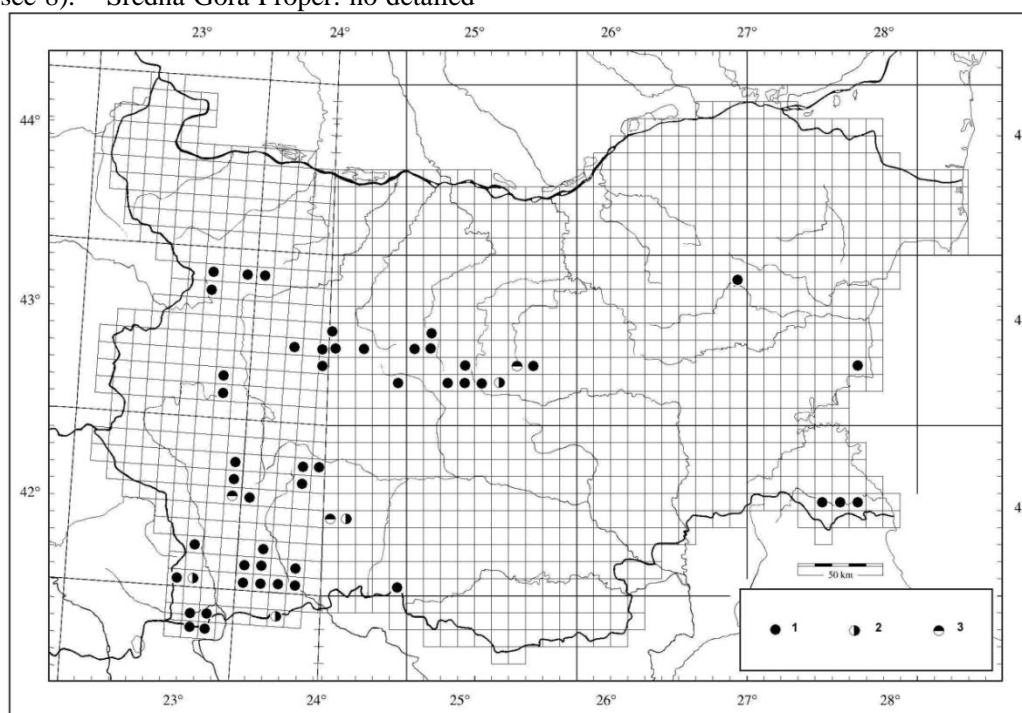


Figure 1. Distribution of *Lobaria pulmonaria* in Bulgaria: 1 – literature and/or herbarium records; 2 – new records, confirmed by herbarium specimens; 3 – records (including newly finds) with photographs taken.

Lobaria pulmonaria f. *papillaris* (Delise) Hue, Nouv. Arch. Mus. Hist. Nat., sér. 4, 3: 31, 1901 (Syn. *Sticta pulmonacea* Ach. var. *papillaris* Delise)

– Forebalkan: near Vratza, FN-98 (see 24). – Stara Planina Mts: Berkovski Balkan, FN-78 (see 24). – Vitoshka region: Vitoshka Mt, the middle forest area, northern slopes, ca 1200-1500 m, on rocks and mosses, FN-81 (see 26); above Boyana village, FN-82 (see 24). – Rila Mts: Partizanska Polyana, around Rilski monastery, FM-96 (see 11); above Blagoevgrad town, in Parangalitsa forest, alt. ca 1400 m, GM-05 (see 14). – Central Rhodopi Mts: Chepelarska Planina, Karkak Dag peak, near Smolyan, ca 1800 m, 3 June 1929, KG-90 (see 25).

Records of *Lobaria pulmonaria* are known from the following floristic regions: Northeastern Bulgaria, Forebalkan, Stara Planina Mts, Vitoshka region (Vitoshka Mt), West Frontier Mts (Vlahina Mt, Maleshevska Mt), Belasitsa Mt, Slavyanka Mt, Rila Mts, Pirin Mts, Sredna Gora Mts, Rhodopi Mts and Strandzha Mts.

DISCUSSION

The occurrence of *Lobaria pulmonaria* in Bulgaria has been reported at first in the beginning of 20th century (24). There is a gap of nearly 30 years before its reappearance, when (22) and (14) added the next records of the lung lichen in the country, and repeatedly (25) recorded *L. pulmonaria* from Rhodopi Mts. Paul Cretzoiu (12) was the Romanian biologist, specialized in bryophytes, pteridophytes, fungi (including lichenized fungi) and published materials on lichens, housed by that time in the Herbarium of the Natural History Museum of the Institute of Botany, Faculty of Agronomy (Sofia). Amongst them he noted 3 specimens of *L. pulmonaria* from Mts Stara Planina (Troyanski Balkan), the Forebalkan (surroundings of Vratsa) and from Mts Sredna Gora. Far from those times and almost 20 years after, (23) recorded the tree lungwort from the Western Rhodopes, followed by (13) who reported it from Stara Planina Mts. Several subsequent herbarium collections from Bulgaria originate from the trips of the Slovak lichenologist Dr. Ivan Pišút in Pirin Mts and were dated from the late 70^{-ties} (see 18, 21) and the mid 80^{-ties} (19) subsequently. The chronology of records (several were not dated) shows that the majority of them are relatively recent (20 records during 50^{-ties} and 33 after 1960). The lung lichen was known in the 50^{-ties} also under the Bulgarian name of ‘shapliva treva’ (A. Toshev, SOMF 22587 – label’s note).

Studies on genetically diverse European populations of *L. pulmonaria* from defined glacial refugia, mainly in primeval forests, were made (27). The authors compared several, precisely chosen ones in Austria, Bosnia and Herzegovina, Montenegro, Bulgaria and Greece by eight fungus-specific genetic markers. As a result the studied individuals from Bulgaria (Strandzha and Central Stara Planina Mts) by those specific markers used were referred to the genepool of type A. Furthermore, the members of the cited genepool showed broader geographic distribution patterns, amongst the individuals from the whole area tested (27). Our newly cited localities from the southwestern part of the country: in West Frontier Mts, in Mt Belasitsa – see here and (16), in Mt Slavyanka and in Mts Rhodopi might be of future interest as being situated in closer directions from the locations of the individuals of the lung lichen, genetically tested from Greece and Montenegro (27), which could represent a reservoir of the other genotype.

In spite of the recent finds, unknown up to date localities are likely to occur during further studies in the forests of primeval type, especially from the preserved deciduous old forests in the mountain areas of the country. During our field trips held in 2014 in the Rhodopes, the number of detected individuals varied from 50 thalli of juvenile lung lichen in bark of one old beech tree at an altitude of 1660 m in Mantaritsa Reserve (Figure 2), till 5 juvenile individuals in the region of Cigov Chark, noticed on bark of single beech tree and from 1-20 mature individuals seen at altitudes between 1350 and 1440 m, respectively. It is in agreement with conclusions recently published (28), stating that the presence of the lichen thalli, i.e. the occupation of the trees by the lung lichen, not only depends on the age of trees and air humidity, but also is primarily reflected by canopy cover and the altitude ranges above sea level.

In Bulgaria up to date there are 75 known localities of *Lobaria pulmonaria*, corresponding to totally 54 UTM-Grid squares (Figure 1). The recent findings, including the known reports from the literature and especially those made during the period of the last decade (2004-2014), revealed a total number of 16 records in assumption. Our observations showed that the herbarium specimens – 52 (although six duplicates noticed) in general prevail over reports, considered from the available literature – 43 records. Most of the finds were kept in the Bulgarian Collections and nearly half of the

records available in the literature are attached to the corresponding specimens in SOMF and in NatlHistMus. This information indicates that

Lobaria pulmonaria could be regarded still as under-recorded.



Figure 2. *Lobaria pulmonaria*: juvenile thalli on bark of living *Fagus sylvatica* (Mantaritsa Reserve, Pashino Bardo locality).

Observations from Bulgaria revealed that the lung lichen is attached exclusively to the old beech bark substrates, as it grows on trunks or bark of broadleaved trees, including *Castanea sativa*, *Corylus avellana* and *Quercus* spp also. During our field trips a part of mature individual has been noticed on the ground, attached to a tiny fallen apical twig of beech. Only single collections are detected up to now on conifers, such as *Abies alba*, *Picea abies* and *Pinus* sp. The presence of the tree lungwort as inhabitant of rocks, along with mosses and ferns on rocky boulders, was detected occasionally (see 14, 23), while over mossy gneises it was known in the river courses (22). From the high mountain regions the lung lichen was noted twice on rocky ground or andesites (15), and among mosses in Mt Stara Planina and Mt Vitosha (11, 26), while once it was recorded on mossy schists (see 18).

The newly recent finds indicate that in spite of the detailed information available, the tree lungwort remains under-recorded in Bulgaria. Therefore this species of conservation concern needs to be further monitored and the knowledge about its distribution has to be expanded regularly, based on planned visits, aiming to ensure an accurate field control over its population ranges. It also will help to improve the understanding of the complex ecology of *L. pulmonaria* in our region.

ACKNOWLEDGEMENTS

The author greatly appreciates the help of Prof. Dr Dimitar Dimitrov (Natural History Museum, Bulgarian Academy of Sciences, Sofia) in allowing the access to the materials, housed at the Museum's Collection. This work is held within the frame of the project 'Taxonomy, conservation and sustainable use of fungi'.

REFERENCES

1. Scheidegger, C., Stofer, S., Dietrich, M., Groner, U., Keller, C. & Roth, I., Estimating regional extinction probabilities and reduction in populations of rare epiphytic lichen-forming fungi. *Forest Snow Landscape Res*, 75(3):415-433, 2000.
2. Spier, L., van Doort, K. & Fritz, Ö., A contribution to the lichen mycota of old beech forests in Bulgaria. *Mycologia Balcanica*, 5(3):141-146, 2008.
3. Scheidegger, C. & Werth, S., Conservation strategies for lichens: insights from population biology. *Fungal Biology Reviews*, 23:55-66, 2009.
4. Woods, R.G., A Lichen Red Data List for Wales. Plantlife, Salisbury, 2010.
5. Woods, R.G. & Coppins, B.J., A conservation evaluation of British lichens and lichenicolous fungi. Species Status 13. Joint Nature Conservation Committee. Peterborough, 2012.
6. Zalewska, A. & Bohdan, A., New records of *Lobaria amplissima* (Lobariaceae,

- Ascomycota) in Poland. *Acta Mycologica*, 47(1):109-119, 2012.
7. Farkas, E. & Lőkös, L., *Lobaria pulmonaria* (lichen-forming fungi) in Hungary. *Mikológiai Közlemények, Clusiana*, 48(1):11-18, 2009.
 8. Lambrev, Z., Jankov, N., Bachvarova, T., Adzharova, E. & Zhelezova, B., [Antibakterielle Wirkung mancher bulgarischer Flechtenarten]. *Izvestiya na Botanicheskiya Institut (Sofia)*, 10:121-129, 1962. (In Bulgarian, Russian and German summary)
 9. Jordanov, D., (ed.). [Flora of People's Republic of Bulgaria]. Vol. 3. Bulgarian Academy of Sciences Publishing House, Sofia, 1966. (In Bulgarian)
 10. Mayrhofer, H., Denchev, C.M., Stoykov, D.Y. & Nikolova, S.O., Catalogue of the lichenized and lichenicolous fungi in Bulgaria. *Mycologia Balcanica*, 2(1):3-61, 2005.
 11. Zhelezova, B., [Materialen zur Flechtenflora Bulgariens]. *Izvestiya na Botanicheskiya Institut (Sofia)*, 12: 245-265, 1963. (In Bulgarian, Russian and German summary)
 12. Cretzoiu, P., Zur Flechtenflora von Bulgarien. *Revue Bryologie et Lichenologie*, 9:176-193, 1937.
 13. Kloss, K., Beitrag zur Flechtenflora Bulgariens. *Repertorium Specierum Novarum Regni Vegetabilis*, 65(3):141-149, 1962.
 14. Szatala, Ö., Beiträge zur Flechtenflora von Bulgarien. I. *Magyar Botanikai Lapok*, 28:82-99, 1929.
 15. Zhelezova, B., [Beitrag zur Flechtenflora Bulgariens]. *Izvestiya na Botanicheskiya Institut (Sofia)*, 10:195-198, 1962. (In Bulgarian, Russian and German summary)
 16. Stoykov, D.Y., Interesting lichenized fungi (*Ascomycota*) from Struma River valley and Mt Belasitsa. *Ecologia Balkanica (Special Edition, April 2014)*, 5. In press, 2014.
 17. Popnikolov, A., [Characterization of the lichen flora of Mt Ali-Botousch, Mt Belasitsa, and Prepetscheno locality]. *Godishnik na Sofiiskiya Universitet, Fiziko-Matematicheski Fakultet*, 33(3):345-368, 1937. (In Bulgarian)
 18. Pišút, I., Beitrag zur Kenntnis der Flechten Bulgariens. I. *Acta Rerum Naturalium Musei Nationalis Slovaci*, 13(2):3-10, 1967.
 19. Pišút, I., Lichenologische Bemerkungen 4. *Annotationes Zoologicae et Botanicae (Bratislava)*, 172:1-6, 1986.
 20. Ivanov, D., Checklist of the lichens and lichenicolous fungi from the Pirin Mountains in Bulgaria. *Berichte des Naturwissenschaftlich-Medizinischen Vereins in Innsbruck*, 96:35-57, 2010.
 21. Pišút, I., Beitrag zur Kenntnis der Flechten Bulgariens. II. *Acta Rerum Naturalium Musei Nationalis Slovenici*, 15(1):27-37, 1969.
 22. Suza, J., Lichenes Bulgariae, I. *Acta Botanica Bohemica*, 8:7-25, 1929.
 23. Zhelezova, B., [Beitrag zur Flechtenflora Bulgariens]. *Izvestiya na Botanicheskiya Institut (Sofia)*, 5:387-404, 1956. (In Bulgarian, Russian and German summary)
 24. Kazandzhiev, S., [The Lichen Flora of Bulgaria]. *Periodichesko Spisanie na Bulgarskoto Knizhovno Drouzhestvo v Sofia*, 61:470-532, 1900. (In Bulgarian)
 25. Szatala, Ö., Beiträge zur Flechtenflora von Bulgarien II. *Magyar Botanikai Lapok*, 29:58-104, 1930.
 26. Popnikolov, A., [Die Flechtenflora von Witoshagebirge]. *Godishnik na Sofiiskiya Universitet, Fiziko-Matematicheski Fakultet*, 27(3):29-74, 1931. (In Bulgarian)
 27. Scheidegger, C., Bilovitz, P.O., Werth, S., Widmer, I. & Mayrhofer, H., Hitchhiking with forests: population genetics of the epiphytic lichen *Lobaria pulmonaria* in primeval and managed forests in southeastern Europe. *Ecology and Evolution*, 2(9):2223-2240, 2012.
 28. Nadyeina, O., Dymytrova, L., Naumovych, A., Postoyalkin, S. & Scheidegger, C., Distribution and dispersal ecology of *Lobaria pulmonaria* in the largest primeval beech forest of Europe. *Biodivers Conserv*, 23:3241-3262, 2014.